United States
Environmental Protection
Agency

Office of Water
Washington, DC 20460

December 1991

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EPA

International Pollution Prevention Case Study Compendium

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INTERNATIONAL POLLUTION PREVENTION CASE STUDY COMPENDIUM

December 3, 1991

Submitted to:

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Washington, D.C. 20460

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EPA Contract No. 68-C8-0066, WA No. C-3-63
SAIC Project No. 1-0834-03-2189-000

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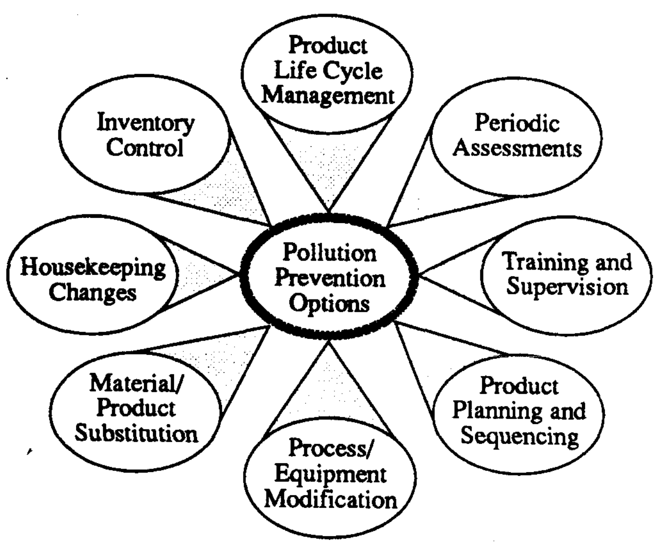
INTRODUCTION

Historically, the Environmental Protection Agency (EPA) has relied primarily on pollution abatement programs and policies that impose controls after the point of waste generation or, in the case of Superfund, after environmental hazards have already been experienced as a result of releases to the environment. This approach, commonly known as "end-of-the-pipe" management, was largely based on command-and-control regulations. This conventional regulatory approach has been tremendously successful in improving environmental quality. Indeed, this approach has resulted in many facilities implementing pollution prevention techniques to reduce pollution abatement costs while, at the same time, achieving performance objectives.

Recently, however, EPA has adopted a more pro-active attitude toward preventing the generation of pollutants at the source. EPA established a preferred hierarchy of environmental management techniques that places source reduction as the management option of first choice, followed in descending order of preference by environmentally protective recycling, treatment, and disposal. The advantage of this approach is that in preventing pollution at its origin, generators can avoid many of the costs and liabilities associated with treatment, storage, transport, and disposal.

Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste through source reduction. Source reduction may be defined as any practice that reduces the amount of any hazardous substance, pollutant, or contaminant entering the waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.[1]



[1]Pollution Prevention Act, Public Law No. 101-508, Title 6, 104 Stat. 1388 (November 5, 1990)

EPA is promoting technical information transfer and outreach to encourage industrial and governmental facilities to adopt pollution prevention and recycling techniques. EPA's strategy for encouraging the adoption of these techniques involves the consistent emphasis of the benefits of these techniques:

- A cleaner environment due to reduced pollutant generation.
- Economic savings from reduced raw materials and energy use, and avoided transportation, storage, or disposal costs for treating or landfilling wastes.
- Decreasing liability associated with handling and disposing of dangerous materials.
- Improved worker safety due to chemical exposure reduction.
- Improve process efficiency.
- Improved public image due to waste reduction efforts.

To further the transfer of pollution prevention and recycling information, EPA established the Pollution Prevention Information Clearinghouse (PPIC) in 1988. The PPIC is a free clearinghouse service containing technical, policy, programmatic, and legislative information relating to pollution prevention and recycling. The Clearinghouse is available to the public and attracts a varied group of users, including pollution prevention professionals from industry, State, Federal, and local government; trade associations; research institutions; academia; public interest groups; and international organizations. EPA encourages and welcomes industry to use the PPIC to obtain and exchange pollution prevention information.

Through a cooperative agreement with the United Nations Environment Programme (UNEP), EPA has helped establish the International Cleaner Production Information Clearinghouse (ICPIC) in Paris, France. Similar in scope and content to the PPIC, the ICPIC works in close cooperation with its United States counterpart. The two clearinghouses are electronically linked and regularly share information. Together these two programs form a truly international pollution prevention network. The PPIC and ICPIC are described in greater detail in Appendix A.

In addition to establishing the PPIC and supporting the ICPIC, EPA has joined with industry, State and local regulatory agencies, and pollution prevention experts to initiate the Industrial Pollution Prevention Project (IPPP). The IPPP's objectives are twofold: (1) to incorporate pollution prevention into the industrial effluent guidelines development process; and (2) to reach out to industry and the consuming public to spread and establish the pollution prevention ethic. Similar efforts are in progress in Europe, Japan, and other industrialized areas to collect and transfer pollution prevention techniques and technologies. The IPPP effort that resulted in this compendium was implemented to allow access by EPA and U.S. industry to international sources of pollution prevention research and experiences of industries in other countries, and to highlight ideas that may be novel for, but applicable to, U.S. industries. This compendium is a hardcopy version of selected international case studies available on the PPIC.

This compendium, with the PPIC, will allow the U.S. public to access the international information in a format that is easy to use and suitable for dissemination to industries, regulatory agencies, and other organizations and individuals.

The case studies contained in this compendium and accessible on the PPIC and ICPIC systems have been compiled from a variety of sources, including:

- United Nations Environmental Programme (UNEP)
- Organization for Economic Cooperation and Development (OECD)
- Proceedings from various international conferences on pollution prevention
- In-country sources
- Trade journals.

Information not previously available in the PPIC or ICPIC were gathered as part of this effort. The collected information was screened such that case studies added to the PPIC and ICPIC and included in this hardcopy compendium would be of interest to U.S. industries, written in English,[2] and give sufficient detail to be useful for the targeted users. Examples of failed experiences (and the reasons for failure) were not excluded from the case study collection effort.

The case studies in this compendium are abstracts of (mostly) published papers or reports. The abstracted information consists of a brief summary of the pollution prevention technologies employed, cost information, the impact or benefits derived, and who to contact for further information.[3] The cost information, consisting of investment and operational and maintenance costs, are expressed in the currency of the originating country; these costs reflect prices in the year the study was conducted. The payback time may also be provided. Additionally, the case studies identify any obstacles or constraints encountered in implementing the technology.

EPA encourages any organization or person with access to case studies that do not appear in this compendium to submit this information to allow expansion of the compendium. Details of information required and how to abstract pollution prevention case studies are given in Appendix B. Contacts at EPA are given in Appendix A.

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[2]Case study abstracts that had already been translated and that were otherwise suitable were included in the PPIC, ICPIC, and hardcopy compendium. A number of French case studies from Quebec, Canada, were translated during the course of this project and included in the PPIC, ICPIC, and hardcopy compendium.

[3]The extent of information in these abstracted case studies will vary depending upon the information provided in the original report.

The compendium divides the case studies by industry, in alphabetical order. Twenty-one industries are represented in this compendium. Within each industry, various countries and processes may be represented. The case studies are followed by an index of key words.

CASE STUDIES

BATTERY

***** DOCNO: 400-070-A-307*****

HEADLINE:	Automation of battery plate manufacturing process reduces lead oxide dust by 85% and wastewater by 98%.
INDUSTRY/SIC CODE:	Metallurgical Industry/ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	This audit of a manufacturer of battery plates suggests that the automation of the mold filling stage, reduces waste generation. Battery plates are placed manually in a fixed mold which is located in a sound-proof cabinet. When the cabinet is closed, the mold is automatically filled with lead powder. This process is quite different from the standard technology where the battery plates are placed in mobile molds which are manually handled and filled with lead oxide powder. These operations are conducted under water spraying in order to reduce dust. Polluted air is extracted.
FEEDSTOCKS:	Lead oxide powder, water
WASTES:	Lead oxide dust; water containing lead dust
MEDIUM:	Aqueous, air
COST:	Calculated based on 230,000 battery plates produced per year
CAPITAL COST:	FF 1,500,000 (1979 figures)
OPERATION/MAINTENANCE:	FF 7,730,000 (1979 figures)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 565,000 (1979 figures)
FEEDSTOCK REDUCTION:	Material consumption is 2.4 tons of lead oxide and 2 m^3 of water per 1,000 battery plates (versus 2.6 tons of lead oxide and 80 m^3 of water per 1,000 battery plates with the standard technology).
WASTE PRODUCTION:	Manufacture of 1,000 battery plates generates 110 g of lead oxide dust (including 16 g of lead) and 2 m^3 of water containing lead dust (versus 830 g of lead dust, 380 g of lead and 80 m^3 of water in the standard technology).
IMPACT:	The quantity of water used is substantially reduced, improving reliability and efficiency. Substantial improvement of working conditions: elimination of one night shift; reduction of operator fatigue, and the noise level goes down from 95 dB (standard technology) to 85 dB (low-waste technology).
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Production of Lead Battery Plates by Automatic Filling of Fixed Molds", Monograph ENV/WP.2/5/Add.70.
KEYWORDS:	Metallurgical Industry, Battery Plates, Mold Filling, ISIC 3800, Lead Oxide, Dust Recovery, Wastewater

CHEMICAL MANUFACTURING

Adhesive and Sealants Manufacturing
Inorganic Chemical Manufacturing
Organic Chemical Manufacturing
Miscellaneous Chemical

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Thermal Oxidation Of Off-gases Generated In The Manufacture of Foam Sealants and Adhesives Reduces Volatile Solvent Emissions and Process Energy Requirements.

2.0 SIC/ISIC Code: SIC 2891, Adhesives and Sealants

3.0 Name & Location of Company: DRG Kwikseal Products (Dichinson Robinson Group), Humphrey's Road, the Woodside Estate, Dunstable, Bedfordshire, UK LU5 4TP.

4.0 Clean Technology Category: This technology involves the thermal oxidation of volatile organic emissions resulting from manufacture of certain adhesives and sealants. Resultant heat derived from the oxidation process is used to heat production ovens.

5.0 Case Study Summary:

5.1 Process and Waste Information: Production of certain adhesives and sealants releases organic solvent vapors. Previously, those materials were removed from the facility as air emissions. Supplemental energy was required to heat production ovens.

The new system involves the installation of a thermal oxidation unit which treats the emitted solvent vapors thereby minimizing solvent emissions and reducing associated odors. Thermal energy derived from the oxidation process is recovered and used to power production ovens, thereby reducing overall energy requirements.

5.2 Scale of Operation: 250 employees

5.3 Stage of Development: The clean technology is fully operational.

5.4 Level of Commercialization: The clean technology is fully commercialized.

5.5 Material Balances:

Material Category	Quantity Before	Quantity After
Waste Generation:		
Organic Air Emissions (estimated)	2,000 kg/day	100 kg/day
Energy Use:	N/A	£6,000/year (initial) £29,000/year (future)

6.0 ECONOMICS:

6.1 Investment Costs: Net cost for the thermal oxidizer unit was £90,000.

6.2 Operational & Maintenance Costs: Not reported

6.3 Payback Time: Information not provided; however, resultant energy cost savings alone (initially at £6,000/year) would pay back the capital costs of the oxidizer system in 15 years.

Payback time would be considerably shorter than that calculated above, given expected increase in future energy savings resulting from use of thermal oxidation unit.

7.0 Cleaner Production Benefits: Implementation of the oxidation unit reduces volatile air emissions of solvents, reducing associated odors, and facilitating plant compliance with developing air pollution standards.

Recovery of heat energy from the oxidation unit allows the heating of production ovens without supplemental emergy requirements. Overall production costs are thereby reduced.

8.0 Obstacles, Problems & Constraints: System is efficient for high concentrations of organic vapors; efficiency may be diminished for lower concentrations. In addition, primary drawback for such a system is its initial cost, which may be significant.

9.0 Date Study Performed: Not reported; planning began in 1986.

10.0 Contacts & Citation:

10.1 Type of Source Material: Pamphlet

10.2 Citation: Pamphlet produced by Environmental Resources, Ltd.

10.3 Level of Detail: Not reported

10.4 Industry/Program Contact: David Finch/Jack Squirrel

10.5 Abstractor Name: UNEP Working Group On (Halogenated) Solvents. Reformatted by Douglas Martin, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords:

11.1 Waste Type: Organic vapor, solvent

11.2 Process Type: SIC Code 2891, adhesives and sealants

11.3 Waste Reduction Technique: Thermal oxidation

11.4 Other Keywords: Energy recovery

Keywords: Organic Vapor, Solvent, SIC 2891, Adhesives and Sealants, Thermal Oxidation, Energy Recovery.

***** DOCNO: 400-074-A-248 *****

INDUSTRY/SIC CODE: Industrial Chemical Manufacturing/ISIC 3511

TECHNOLOGY DESCRIPTION: Phosphorous contained in the by-product sludge from phosphorous production is converted to sodium phosphinate via alkaline digestion in an agitator reactor. The digestion suspension product contains contaminants from the sludge and is, therefore, filtered prior to further processing. Subsequent processing includes neutralization, evaporation, crystallization, centrifugation, and drying. This yields the sodium phosphinate final product, along with some CaHPO. The liquid resulting from the centrifugation is recycled to the process. Phosphine and hydrogen off-gases from the reaction are utilized in the production of phosphoric acid (combustion to H_3PO_4, mist absorption in circulating phosphoric acid).

FEEDSTOCKS: Phosphorous sludge, acetylene-lime hydrate, sodium hydroxide, hydrochloric acid, nitrogen, steam, electric power, water.

WASTES: With the low pollution technique there is a discharge of 340 kg PH_3 (intermediate product), 77 kg NaCl, 2 kg sodium-phosphinate dust and 5 kg filter cake.

MEDIUM: Water, air, solid

COST:
CAPITAL COST: Low, relative to conventional technology, due to the use of common steel over stainless steel.
OPERATION/MAINTENANCE: 50% reduction in energy consumption over conventional technology. Elimination of heavy corrosion costs.
MONTHS TO RECOVER: Installation can be amortized over less than three years.

SAVINGS:
DISPOSAL & FEEDSTOCK: Not reported
FEEDSTOCK REDUCTION: Phosphine gas emitted from reactor is utilized in phosphorous acid plant.
WASTE PRODUCTION: Not reported

IMPACT: Currently, 30% of the applied phosphorous is emitted into waste water in an elementary form. 10% is emitted into waste water in the form of P_2O_5. Low-waste technology recovers nearly all the applied phosphorous, yielding sodium phosphinate for use in electrolytic nickeling, and a non-toxic filter cake.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Sodium Phosphate Made From Phosphorous Sludge", Monograph ENV/WP.2/5/Add74.

KEYWORDS: Phosphorous, Sludge, ISIC 3511

***** DOCNO: 400-040-A-229 *****

INDUSTRY/SIC CODE:	Chemical Industry and Manufacturing of Chemical Products, Petroleum and Coal Derivatives and Rubber and Plastic Products/ISIC 3512
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company produces ammonium nitrate with direct verification of the reaction and debubbling of the water vapor extracted. In the low pollution technique, the verification of the reaction of the two basic elements (concentrated nitric acid and ammonia) is carried out through the pH analysis of the residual water collected at the end of the process. This water was originally contained in the nitric acid and was obtained by evaporation of the ammonium nitrate solution followed by condensation. In the low pollution technique, the ammonium nitrate laden water vapor passes through a debubbler before condensation which limits the nitrate bubbles carried by the vapor.
FEEDSTOCKS:	Ammonium nitrate, nitric acid
WASTES:	Wastewater containing ammonium, nitrogen, and nitric acid
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	F 300,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	84
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	
WASTE PRODUCTION:	Ammonium nitrate waste reduced by 93%.
IMPACT:	Material consumption is reduced in the low pollution technique by just under 2 per cent. Energy consumption, generally low, is more or less the same in both techniques. This technique allows closer verification of the chemical reactions that take place during production and thus gives a better material yield and less pollution. This principle should be extended to other procedures in the chemical sector.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Production of Ammonium Nitrate with Continuous Control of the Reaction and Degassing of the Resulting Water Vapors", Monograph ENV/WP.2/5/Add.40.
KEYWORDS:	Ammonium Nitrate, Reaction Verification, Debubbling, ISIC 3512

***** DOCNO: 400-112-A-271*****

INDUSTRY/SIC CODE:	Manufacture of Basic Industrial Chemicals Except Fertilizer/SIC 28
TECHNOLOGY DESCRIPTION:	The low waste technology is for the production of aluminum fluoride with utilization of waste silica. There are no significant changes in the production of the aluminum fluoride. The use of waste silica permits the manufacture of a marketable product to be used as a filler in rubber compounds. The steps of the process include: - Dissolution of the waste inactive silica by treating it with an ammonium fluoride solution. - Separation of ammonium cryolite by filtration, to be used in ammonium fluoride production. - Precipitation of active silica by treating the ammonium fluosilicate solution with ammonia (gas) or ammonia water. - Separation and washing of active silica on the press filter. - Evaporation of ammonium fluoride solution. - Drying and packaging of active silica.
FEEDSTOCKS:	Silicon (inactive) from aluminum fluoride production (23% SiO_2) - 4,384 kg/metric ton output; H_2SiF_6 (100 %) - 269 kg; NH_3 - 327 kg; process water - 2,330 kg; industrial water - 150 m^3.
WASTES:	Residual gases (50 m^3/ton) from the calcination of active silica, containing less than 10 mg/m^3 F, are washed and passed into the atmosphere. Process waters and waste water from equipment washing are recycled to the process for washing active silica cake.
MEDIUM:	Gaseous, liquid
COST:	(Rubles per metric ton)
CAPITAL COST:	9,500 thousand rubles
OPERATION/MAINTENANCE:	330 rubles/metric ton
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	120 rubles/metric ton gross profit on active silica filler.
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Five percent savings from depreciation charges on pollution control measures attributed to the elimination of the waste silica disposal, in addition to disposal costs.
IMPACT:	Elimination of silica disposal in a landfill site or storage pond, by creating a profitable use for this waste by-product.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Production of Aluminum Fluoride with the Utilization of Waste Silica" Monograph ENV/WP.2/5/Add112.
KEYWORDS:	Silica, Precipitation, Solid Waste Recovery, Fillers, Aluminum Fluoride, SIC 28

***** DOCNO: 400-092-A-318*****

INDUSTRY/SIC CODE:	Manufacture of Basic Industrial Chemicals Except Fertilizer/ISIC 3511
POLLUTION PREVENTION OPTIONS SUMMARY:	Liquors containing soda chlorate and sodium chloride are injected into electrolyzers which transform chloride into chlorate with titanium anodes. The resulting liquors are then sent to a crystallizing pond where part of the chlorate is recovered. The remaining part is returned to the electrolyzers after addition of sodium chloride.
FEEDSTOCKS:	Sodium chloride, electrical energy, titanium anodes
WASTES:	None
MEDIUM:	Not applicable
COST:	
CAPITAL COST:	9,000,000 francs (1978)
OPERATION/MAINTENANCE:	601 francs/ton of product (1980)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	191 francs/ton in electrical energy, which is offset by increased cost of 100 francs/ton for titanium anodes.
FEEDSTOCK REDUCTION:	Reduced energy requirements.
WASTE PRODUCTION:	Conventional technology uses graphite anodes which requires recovery and rejection of graphite powder sludge
IMPACT:	The standard technique involves filtration of the liquors prior to crystallization because the graphite anodes are gradually consumed (at a rate of 6 kg/ton). Consequently, waste disposal of graphite sludge is required. Additionally, energy consumption is reduced with the low waste technology. Titanium anodes may be used wherever alkaline chlorates are produced via electrolysis.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Manufacturing of Soda Chlorate by Electrolysis of Sodium Chloride with Graphite Anodes", Monograph ENV/WP.2/5/Add.92.
KEYWORDS:	Electrolytic Recovery, Chlorate, ISIC 3511

***** DOCNO: 400-123-A-330*****

HEADLINE:	Low waste technology process used in producing hydrogen fluoride acid, reduces volume of synthetic anhydrite produced by 85%.
INDUSTRY/SIC CODE:	Manufacture of Basic Industrial Chemicals Except Fertilizers/ISIC 3511
POLLUTION PREVENTION OPTIONS SUMMARY:	Synthetic anhydrite (calcium sulphate), produced from the production of hydrogen fluoride acid, is prepared to form a standardized anhydrite binder for use in floor construction in buildings. Part of the anhydrite produced is applied in the cement industry as a setting regulator. Conventional method is to dispose of the anhydrite. The low waste technology process involves an additional step of milling to reduce the grain size, requiring additional classifiers, mills, and bagging apparatus.
FEEDSTOCKS:	CaOH - 50 kg/ton anhydrite, ventilated paper sacks - 6.25 kg, activator- 15 kg, electricity - 97.2 MJ, compressed air (0.3 MPa) - 220 m^3
WASTES:	Anhydrite waste
MEDIUM:	Solid
COSTS:	
CAPITAL COST:	4,000,000 Marks
OPERATING/MAINTENANCE:	80% of capital investment
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Investment costs are increased by 1,700,000 Marks, operating costs are reduced by 20%. Savings are realized through reduced disposal costs and sales of anhydrite.
FEEDSTOCK REDUCTION:	None
WASTE PRODUCTION:	To-date, 60% of the anhydrite has been produced as anhydrite binder, 25% as setting regulator, and 15% was disposed of as a waste (6 kt/a per 10 kt/a HF).
IMPACT:	The volume of solid waste requiring disposal from production of HF is reduced by 85%. Operating costs are reduced by 20% due to transportation and disposal costs, and a profitable product is produced that offers advantages in the construction of floors over other binding agents used for the same purpose.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, Monograph "Use of Anhydrite Formed in the Hydrogen Fluoride Production Process" ENV/WP.2/5/Add.123.
KEYWORDS:	Solid Waste Recovery, Hydrofluoric Acid, Anhydrite, ISIC 3511

***** DOCNO: 450-011-A-001*****

1.0 Headline: New Sodium Chlorate Factory Triples Production and Employs Source Reduction Techniques to Avoid Treatment Costs

2.0 SIC: 2812

3.0 Name and Location of Company

La Societe Quenord, Magog, Quebec, Canada

4.0 Clean Technology Category

5.0 Case Study Summary

5.1 Process and Waste Information: Quenord is the largest manufacturer of sodium chlorate in the world. Their product is principally used in the fabrication of chlorine for use in the pulp and paper industry. In 1985, Quenord built a new factory that tripled its production and because of reduction techniques, its effluent was reduced to almost nothing. The company decided the most effective modifications could be made regarding the refrigeration waters which cool the liquor before their return to electrolytic cells. They used a closed circuit and an open circuit to recover calorific energy (about 22 megawatts), to reduce the amount of water used as much as possible, and to avoid contaminating the waters to eliminate the need for treatment.

The company also used other preventative measures to reduce the amount of pollutants they generate. To reduce the volume of sludge to be disposed, they used table salt and a filter press. To eliminate the separation of their existing anodes, they used metallic anodes. To eliminate the contamination of condensation waters, the company used a surface condenser rather than a barometric condenser. The company used a demisting device that allowed condensate to be recycled. To limit losses of primary material and finished products, a series of pits and pumps returned the material to production and any dust generated was sprayed to wet it. To capture runoff or accidental releases of primary materials, the company used angled barriers and drainage channels around the reservoir and also used good insulation around the buildings and equipment. To eliminate hot purge waters, the company employed an electric heating system. To reduce the risk of chromium release to the environment, the company produced chlorate crystals that were already washed and dried.

By using source reduction, the company saved the $600,000 cost of installing a treatment system. They were able to completely recycle refrigeration waters through closed circuit instead of treating them, they were able to recover energy that normally would have been lost by using an open circuit. This measure saved the company $500,000/year in production costs. Using metallic anodes, eliminating graphite sludge and increasing the output of electricity at a more efficient rate allows the company to save $2,000,000/year.

5.2 Scale of Operation: The company produces approximately 95,000 tons of sodium chlorate/year.

5.3 Stage of Development: This technology was fully implemented at the time of the case study.

5.4 Level of Commercialization: This technology was commercially available at the time of this case study.

5.5 Material/Energy Balances and Substitutions

Effluent		Standards
Total Flow [m^3/d]	715	----------
Free Chlorine [g/m^3]	0.05	----------
NaClO(3) [g/m^3]	5.5	----------
[kg/d]	4.0	----------
Total Chrome [g/m^3]	0.01	1.0
*S.S. [g/m^3]	6.0	30
S.D. [g/m^3]	200-351	3000
DCO [g/m^3]	26	30
pH - 7-8.5		5.5-9.5

* Suspended Solids

6.0 Economics*

6.1 Investment Costs: The company spent $900,000 total. Use of the techniques saved $600,000 in the cost of a treatment system.

6.2 Operational and Maintenance Costs: Operational and maintenance costs of the program were not provided. However, $500,000/year were saved in production costs and $2,000,000/year were saved in energy costs.

6.3 Payback Time: The payback time of this operation was approximately 4 months.

It is assumed that costs were reported in Canadian dollars.

7.0 Cleaner Production Benefits: As a result of using source reduction techniques, the company virtually eliminated all effluents except for the release of disinfection waters from the refrigeration process. They periodically sell condensate from their crystallization system and they save $600,000/year in treatment costs, $500,000/year in production costs, and $2,000,000/year in energy costs.

8.0 Obstacles, Problems and/or Known Constraints: Not Available

9.0 Date Case Study Was Performed: The pollution prevention measure were initiated in 1985.

10.0 Contacts and Citations

10.1 Type of Source Material: Report

10.2 Citation: <u>Secteur Chimie Inorganique, Technologies Propres, Production du Chlorate de Sodium</u>, Gouvernement du Quebec, Ministere de l'Environnement, Gestion et Assainissement des Eaux, Revised June 1988. Source document is in French.

10.3 Level of Detail of the Source Material: Additional detail is available regarding the actual refrigeration process and the open and closed circuits. Greater explanation is also given regarding other preventative measures.

10.4 Industry/Program Contact and Address: Regional offices, addresses and phone numbers are given on the back of the report.

10.5 Abstractor Name and Address: Blair M. Raber, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA, 22043.

11.0 Keywords

11.1 Waste Type: Wastewater, refrigeration waters.

11.2 Process Type/Waste Source: Basic Wastewaters, Chlorine, Industrial Inorganic Chemical, Inorganic Chemicals, Refrigerant, Sodium Chlorate.

11.3 Waste Reduction Technique: Source Reduction, Crystallization, Energy Recovery, Equipment Modification, Insulation, Process Redesign, Refrigeration and Heating Equipment, Volume Reduction, Wastewater Reduction.

11.4 Other Keywords: Canada, Dust, Increased Productivity, Increased Efficiency.

(*) Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Wastewater, Refrigeration Waters, Basic Wastewaters, Chlorine, Industrial Inorganic Chemical, Inorganic Chemicals, Refrigerant, Sodium Chlorate, Source Reduction, Crystallization, Energy Recovery, Equipment Modification, Insulation, Process Redesign, Refrigeration and Heating Equipment, Volume Reduction, Wastewater Reduction, Canada, Dust, Increased Productivity, Increased Efficiency

***** DOCNO: 400-033-A-222 *****

INDUSTRY/SIC CODE:	Chemical Industry and Manufacturing of Chemical Products, Petroleum and Coal Derivatives and Plastic and Rubber Products/ISIC 3540
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	Dry neutralization of the alkylates resulting from the manufacturing of ethylbenzene is used instead of wet neutralization. In the low pollution technique, elimination of the salts and impurities from the ethylbenzene solution obtained by an ethylene reaction with benzene is carried out without water. The solution is neutralized in ammonia, then flocculated and decanted. The sediment is centrifuged and vacuum dried. The solid residue obtained can be used to manufacture mixed fertilizers.
FEEDSTOCKS:	Raw ethylbenzene product containing salts and impurities.
WASTES:	The low pollution technique does not produce wastes because solid residues are used in other applications (fertilizer manufacturing). Wastes produced in the standard technique are salts (ammonium and aluminum chloride), aluminum hydroxide, and hydrocarbons dissolved in water.
MEDIUM:	Liquid (ethylbenzene)
COST:	(1978 Francs)
CAPITAL COST:	F 5.25 million
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Wastes discharged to the environment are eliminated.
IMPACT:	The low pollution technique does not require water (as opposed to the standard technique, which requires 1.5 m^3 per ton of ethylbenzene). The amount of other raw materials used is identical (0.27 ton of ethylene, 0.745 ton of benzene, 7 kg of catalysts, 3.5 kg of ammonia per ton ethylbenzene). The output should however, be improved by 1 to 2 per cent in the low pollution process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Dry-Phase Neutralization of Alkylates Generated in the Production of Styrene", Monograph ENV/WP.2/5/Add.33.
KEYWORDS:	Ethylbenzene, Neutralization, Purification, ISIC 3540

***** DOCNO: 400-093-A-319*****

HEADLINE:	Recycling of desalination water in hydrazine production process reduces wastewater generation by over 90%.
INDUSTRY/SIC CODE:	Manufacture of Basic Industrial Chemicals Except Fertilizer/ISIC 3511
POLLUTION PREVENTION OPTIONS SUMMARY:	Produce hydrazine hydrate by oxidizing ammonia with hydrogen peroxide, in the presence of other chemicals. After several processes, these chemicals are recovered and recycled upstream. In addition to hydrazine hydrate, other mineral residues are recovered for use in cement works, and heavy tars are burned away.
FEEDSTOCKS:	Ammonia, hydrogen peroxide, water, energy
WASTES:	Mineral residues (6.7 kg/ton), tar (13.3 kg/ton)
MEDIUM:	Wastewater
COST:	
CAPITAL COST:	52,000,000 francs (15 tons of hydrazine hydrate produced per day)
OPERATION/MAINTENANCE:	40% lower than standard technique
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	7,000,000 francs savings in original investment, 40% lower operating costs.
FEEDSTOCK REDUCTION:	14 m^3 water required for standard techniques compared to 1.6 m^3 for low-waste technique, energy requirements are reduced from 570 MG to 220 MG.
WASTE PRODUCTION:	27 m^3/ton of desalination water are rejected in standard techniques (containing 2.4 tons of chloride ions for one ton of product) compared to negligible waste production in low waste technology.
IMPACT:	The oxidation of ammonia with hydrogen peroxide reduces wastewater generation and investment and operating costs. Mineral residues and other chemicals are also recovered.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Production of Hydrazine Hydrate through Oxidizing Ammonia with Bleach", Monograph ENV/WP.2/5/Add.93.
KEYWORDS:	Inorganic Chemicals, Wastewater, Oxidation, Desalination, Hydrazine Hydrate, Raw Material Substitution, Recovery, ISIC 3511

***** DOCNO: 400-034-A-223 *****

INDUSTRY/SIC CODE:	Chemical Industry and Manufacturing of Chemical Products, Petroleum and Coal Derivatives and Plastic and Rubber Products/ISIC 3511
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de al Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	Cracked hydrogen containing 20 to 22 per cent of carbon dioxide is washed in a solution of potassium carbonate. The solution containing carbon dioxide is heated in an exchanger where the input cracked gas yields heat. It is then treated in a column containing nitrogen and it is regenerated. Wastes are made up of carbon dioxide and nitrogen.
FEEDSTOCKS:	Cracked hydrogen and nitrogen
WASTES:	The wastes produced by the low pollution processes (including washing and ammonia synthesis) contain 0.03 kg of ammonia in solution per ton of ammonia produced.
MEDIUM:	Hydrogen gas
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	
WASTE PRODUCTION:	Eliminates ammonia discharge.
IMPACT:	The low pollution technique allows substantial energy saving through steam saving.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Hydrogen Washing by Potassium Carbonate in Ammonia Production", Monograph ENV/WP.2/5/Add.34.
KEYWORDS:	Ammonia, Hydrogen, ISIC 3511

***** DOCNO: 450-003-A-335 *****

HEADLINE:	Employee training, a materials inventory system, and a waste collection system at Ashland Chemicals resins manufacturing plant reduces feedstock requirements and disposal costs.
INDUSTRY/SIC CODE:	Chemicals and Allied Products/ISIC 37
NAME/CONTACT:	C. Bourdon Ashland Chemicals Mississauga, Ontario L5J 4E7
POLLUTION PREVENTION OPTIONS SUMMARY:	A waste reduction system was introduced at an Ashland Chemicals resins manufacturing plant to prevent reusable resins from being wasted. The system consisted of a clean container, lid and identification tags supplied at waste generation sites, and staff training. The system was pilot-tested in the quality control area and was later extended to the manufacturing and laboratory areas. A return system was also installed at the blending tanks to pump excess sampling material back into the tanks. The system consisted of a funnel and valve placed directly below the tank sampler and connected to the inlet side of the pump used for that system.
FEEDSTOCKS:	Resin wastes
WASTES:	Resin wastes
MEDIUM:	Solid
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	1 week
SAVINGS:	
DISPOSAL & FEEDSTOCK:	$600,000 in reduced treatment costs and improved plant efficiency in 1985.
FEEDSTOCK REDUCTION:	All waste collected is reworked.
WASTE PRODUCTION:	From 1980 to 1983, waste produced was reduced from 31,000 lbs to 7,000 lbs.
IMPACT:	Collection and reworking of waste resins has significantly reduced the amount of plastic resin requiring disposal, and is reducing the disposal costs and the amount of feedstock required.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects", Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 14.
KEYWORDS:	Paint, Plastic, Recycling, Personnel Training, ISIC 37

***** DOCNO: 450-003-A-339*****

HEADLINE:	Dow Chemical uses the injection of hydrogen into the feed of carbon tetrachloride, perchlorethylene, and vinyl chloride processes to create usable hydrochloric acid.
INDUSTRY/SIC CODE:	Chemicals and Allied Products/ISIC 37
NAME/CONTACT:	Dow Chemical Canada, Inc. Sarnia, Ontario N7T 7K7 Harold Quinn
POLLUTION PREVENTION OPTIONS SUMMARY:	Hydrogen is injected into the feed of Dow's carbon tetrachloride, perchlorethylene, and vinyl chloride processes to convert the highly chlorinated by-products to hydrochloric acid which is used elsewhere in the plant. Secondly, brine is being recycled from the propylene oxide and chlorination processes as feed for the chlor-alkali process used to produce chlorine and caustic soda. Even after treatment to remove organics, clean brine poses a problem because it increases the salinity of the river for discharge.
FEEDSTOCKS:	Chlorinated by-products, brine
WASTES:	Chlorine, HCl, brine
MEDIUM:	Gaseous, liquid
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	Reduced brine and HCl requirements
WASTE PRODUCTION:	Chlorinated-byproducts are reduced, and brine is reused rather than discharged to the river.
IMPACT:	Dow has found economical ways to overcome the problems of sodium sulfate and dead bacteria from the biological treatment process in the brine. Discharge problems are eliminated and brine is recycled for use in the chlor-alkali process.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects", Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 22.
KEYWORDS:	Chlorine, Caustic, Brine, Recycling, ISIC 37

***** DOCNO: 400-116-A-329*****

HEADLINE: Recycling and sorption of CCl_3F and TDI generated during the production of polyurethane (PUR) block soft foam.

INDUSTRY/SIC CODE: Manufacture of Synthetic Resins, Plastic Materials and Man-made Fibers Except Glass/ISIC 3513

POLLUTION PREVENTION OPTIONS SUMMARY: The technology involves the sorption and recycling of harmful materials in process gases generated during the production of polyurethane (PUR) block soft foam. Activated charcoal is used for removing CCl_3F and TDI which are emitted with the exhaust air during the conventional production process. Adsorption of TDI is an irreversible process, which eliminates the option of recovering the TDI. The CCl_3F, however, is recovered through regeneration of the charcoal bed with hot steam.

FEEDSTOCKS: Steam, electric power, cooling water, activated charcoal, exhaust stream

WASTES: CCl_3F in purified exhaust air (<20 mg/m^3), CCl_3F in condensed aqueous phase ($<0.01\%$ by weight), TDI converted to innocuous polyurea on activated charcoal (no longer detectable).

MEDIUM: Gaseous, water, solid

COST:
CAPITAL COST: 700,000 DM (1983 for plant capacity of 30,000 m^3 exhaust air per hour)
OPERATING/MAINTENANCE: 557 DM/ton of recovered CCl_3F
MONTHS TO RECOVER: 30

SAVINGS:
DISPOSAL & FEEDSTOCK: The recovery process is an addition to the process.
FEEDSTOCK REDUCTION: 1443 DM/ton of recovered CCl_3F
WASTE PRODUCTION: CCl_3F emitted is <20 mg/m^3 compared to 0-50 g/m^3 without the recovery process (regulatory level is 300 mg/m^3), and TDI is now captured in the charcoal bed compared to emissions of 0-20 mg/m^3 without recovery (regulatory level is 20 mg/m^3).

IMPACT: This sorption and recovery process achieves extremely low CCl_3F emissions from the polyurethane foam manufacturing process and TDI emissions below the detection limit. Additionally, CCl_3F resources are recovered with this process.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Sorption and Recycling of Harmful Materials During the Production of Polyurethane (PUR) Block Soft Foam", Monograph ENV/WP.2/5/Add.117.

KEYWORDS: Gas Collection, Carbon Adsorption, Polyurethane, ISIC 3513

***** DOCNO: 400-081-A-313*****

HEADLINE:	Modification to the dehydration stage of chloral manufacturing reduces wastewater generation by 60%.
INDUSTRY/SIC CODE:	Manufacture of Industrial Chemicals/ISIC 351.
POLLUTION PREVENTION OPTIONS SUMMARY:	This audit presents the modification to the dehydration stage of the chloral manufacturing. Chloral synthesis is achieved by ethanol and chlorine reaction. The resulting product which is approximately 80% chloral is then dehydrated using a solvent. The conventional process uses concentrated sulfuric acid (oleum) for dehydration. The sulfuric acid in the conventional process is separated after the distillation step and then rejected. The solvent in the low-pollution process is recycled after distillation. The chloral is separated from chlorinated by-products which are used by the plant, and from water which is slightly acidic.
FEEDSTOCKS:	Solvent, chloral, ethanol, chlorine
WASTES:	Polluting wastes resulting from the low-pollution technique consist of slightly acidic water. In the case of the conventional technique, sulfuric acid is rejected after dehydration.
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	FF 8,500,000 (1974 figures)
OPERATION/MAINTENANCE:	FF 3,270 per ton of product (1979 figures)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 90 per ton of product (1979 figures)
FEEDSTOCK REDUCTION:	Both techniques require 445 kg of ethanol and 2,100 kg of chlorine for the production of one ton of chloral. In addition, dehydration requires 6 kg of solvent (versus 600 kg of oleum for the conventional technique).
WASTE PRODUCTION:	The low-pollution process generates 140 liters (versus 360 liters) of slightly acidic water which is neutralized and discharged.
IMPACT:	Because it does not use sulfuric acid, the low-pollution technology enhances safety conditions in manufacturing plants.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Manufacturing of Chloral: Dehydration by Means of a Solvent", Monograph ENV/WP.2/5/Add.81.
KEYWORDS:	Chlorine, Solvent, Organic Chemical, Ethanol, Chloral, ISIC 351

***** DOCNO: 400-030-A-219 *****

INDUSTRY/SIC CODE: Chemical Industry/ISIC 3513

NAME/CONTACT: Ministere de l'Environment et due Cadre de Vie
Direction de la Prevention des Pollutions
14, Boulevard General Leclerc
92521 Neuilly-sur-Seine Cedex, France

TECHNOLOGY DESCRIPTION: The company uses incineration of chlorinated wastes followed by recovery of hydrochloric acid. The toxic chlorinated wastes are incinerated in an oven. The combustion gases are first water-cooled in a closed circuit, then the hydrochloric acid that they contain is absorbed in water to give a marketable acid solution. In the standard process, the cooling water circulates in an open circuit and, because it takes on acid, must be neutralized before discharge. In both processes, the gases are neutralized in soda before being discharged into the atmosphere. The discharge of the cooling water is the principal source of pollution in the standard technique.

FEEDSTOCKS: Chlorinated wastes

WASTES: Not reported

MEDIUM: Not reported

COST: (1980 Francs)
CAPITAL COST: F 15,000,000
OPERATION/MAINTENANCE: F 182/ton waste treated
MONTHS TO RECOVER: Not reported

SAVINGS:
DIRECT COST:
FEEDSTOCK REDUCTION:
WASTE PRODUCTION: Reduction in wastewater production from 66.5 m^3 to 1.5 m^3.

IMPACT: Reduces wastewater production and produces usable product.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recovery of Hydrochloric Acid from Incineration of Chlorinated Waste Products", Monograph ENV/WP.2/5/Add.30).

KEYWORDS: Hydrochloric Acid, ISIC 3513, Recovery

***** Doc # 501-016-A-000 *****

1.0 Headline: Pollutants from discharge waters eliminated by new separation step in making caprolactam from toluene.

2.0 SIC Code: SIC 2869, Industrial organic chemicals, not elsewhere classified

3.0 Name and Location of Company:

Societa Chimica Dauna
Manfredonia, Italy

4.0 Clean Technology Category:

A new separation step meshed into an established process for making caprolactam from toluene forms no ammonium sulfate byproduct and eliminates pollutants from discharge waters.

5.0 Case Study Summary

5.1 Process and Waste Information: In the conventional process, ammonia neutralizes the caprolactam-sulfuric acid composite to produce crystals of ammonium sulfate. Caprolactam oil floating on top of the mother liquor is decanted, and extracted first by toluene and then by water. The water raffinate draws off the impurities formed during nitrosation and is discarded.

The technology involves a new separation step. Caprolactam is separated from the sulfuric acid in which it is dissolved during reaction by extraction with an alkylphenol solvent. No ammonia is used, and thus no ammonium sulfate forms. The remaining sulfuric acid is thermally cracked, destroying impurities while forming sulfur dioxide for recycle.

5.2 Scale of Operation: Plant capacity is 80,000 metric ton/year.

5.3 Stage of Development: The technology is implemented.

5.4 Level of Commercialization: The technology is commercially available.

5.5 Material/Energy Balances and Substitutions:

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

This technology eliminates the generation of ammonium sulfate byproduct and eliminates an aqueous wastestream. The composition of the aqueous wastestream was not identified.

8.0 Obstacles, Problems and/or Known Constraints

Increased energy is used in this new process because of the cracking step.

9.0 Date Case Study Was Performed

July 1974

10.0 Contacts and Citation

10.1 Type of Source Material: Book

10.2 Citation: Process Technology and Flowsheets, articles which appeared in Chemical Engineering over the last five years. V. Cavaseno and Staff of Chemical Engineering eds., McGraw-Hill, NY, NY, 1979. Caprolactam from Toluene Without Ammonium Sulfate, Andrew Heath. Pg. 137.

10.3 Level of Detail of the Source Material: Detail of each process step and a process flowsheet are available in the source document.

10.4 Industry/Program Contact and Address: Unknown

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Ammonium sulfate, wastewater

11.2 Process type/waste source: Caprolactam manufacture

11.3 Waste reduction technique: Process modification

11.4 Other keywords: Industrial organic chemicals, solvent extraction, SIC 2869

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Ammonium Sulfate, Wastewater, Caprolactam Manufacture, Process Modification, Industrial Organic Chemicals, Solvent Extraction, SIC 2869

ELECTRICAL EQUIPMENT

***** DOCNO: 450-003-A-345*****

HEADLINE:	W.C. Woods uses powder-coating painting process for appliances which allows for recycling of paint powder and hot air thereby reducing hazardous waste generated.
INDUSTRY/SIC CODE:	Electric and Electronic Machinery/SIC 36
NAME/CONTACT:	W. C. Woods Company, Ltd. Guelph, Ontario
POLLUTION PREVENTION OPTIONS SUMMARY:	A powder-coating process for painting freezers uses a specially formulated fusible paint powder which is applied to the appliance in an enclosed spray booth. The appliance is then heat-cured in an oven to fuse the paint to the surface of the appliance. This technique eliminates solvent emissions, and the paint can be easily recycled compared to conventional liquid paints. No paint sludge is produced and no large volumes of wastewater are generated.
FEEDSTOCKS:	Powder coatings, hot air
WASTES:	Powder coatings
MEDIUM:	Solid
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Lower than a conventional paint line because less material and labor is required.
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Quantities not reported.
FEEDSTOCK REDUCTION:	Hot air from the oven is recycled since it does not contain solvent emissions. As a result, overall energy required is lower.
WASTE PRODUCTION:	Eliminated paint sludge and wastewater
IMPACT:	The powder-coating spray booth allows for a more efficient process, requiring less materials and labor, and generating less hazardous waste. The paint powder and the hot air can be recycled.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects", Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 35.
KEYWORDS:	Paint, Recycle, Heat Recovery, Process Change, SIC 36

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Substitution of metalworking fluid promotes less need for organic solvent degreasing. Substitution of solvent-based paint with powdered paints further minimizes organic solvent emissions.

2.0 SIC/ISIC Code: SIC 3648, Lighting Equipment, NEC

3.0 Name & Location of Company: Garnkonst AB, P.O. Box 305, S-261, 23 Landskrona, Sweden.

4.0 Clean Technology Category: This clean technology scheme involves the substitution of mineral oil-based metalworking fluids with a vegetable-oil replacement, the switch from trichloroethylene degreasing to an alkaline, water-based detergent system, and the utilization of powdered paints instead of solvent-based liquid paints. Program reduced trichloroethylene and mineral solvent emissions.

5.0 Case Study Summary:

5.1 Process and Waste Information: Fixture manufacturing facility utilized a mineral oil-based cutting fluid for metalworking. Manufactured components were then degreased using trichloroethylene solvent. Solvent-based paints were utilized in the final finishing of parts.

The new program relies upon the use of a vegetable oil-based cutting fluid for metalworking operations. Substitution with this material allows parts degreasing with an alkaline detergent solution. Use of powdered paints results in reduced organic solvent vapor emissions and reduced operating costs.

5.2 Scale of Operation: 400,000 pieces/year

5.3 Stage of Development: Clean technology is fully implemented.

5.4 Level of Commercialization: Clean technologies are fully commercialized.

5.5 Material Balances:

Material Category	Quantity Before	Quantity After
Waste Generation:		
Trichloroethylene vapor	N/A	5 tons/year less than before
Mineral Solvent vapor	N/A	30 tons/year less than before

6.0 Economics*:

6.1 Investment Costs: Investment for system for powdered painting was $383,000. No other investment costs provided.

6.2 Operational & Maintenance Costs: Vegetable oil use saves $5,000/year over mineral oil.

Trichloroethylene: trichloroethylene use would have required investment of $50,000 for recycling unit plus additional $9,000/year operating expenses. Previous cost was $10,000/year with $500,000/year operating costs.

Operating costs for powder painting is $415,800/year less than for solvent-based painting. Initial investment for painting system was $383,000.

6.3 Payback Time: Payback for painting system changeover investment was less than 1 year. Payback period calculation for new powder painting system is based upon provided annual cost savings estimate.

7.0 Cleaner Production Benefits: New processes do away with the need for trichloroethylene degreasing; organic solvent emissions are minimized and costs associated with solvent purchases and waste disposal are greatly reduced. Cutting fluid costs are reduced. Workplace exposure to solvents is prevented. In addition, the new system facilitates compliance with air pollution standards.

8.0 Obstacles, Problems & Constraints: Not reported

9.0 Date Study Performed: Clean technology process changeover started in 1987 and was completed in July, 1989.

10.0 Contacts & Citation:

10.1 Type of Source Material: Not specified

10.2 Citation: Siljebratt, Lars et al; Förebyggande miljöskyddssstrategi och miljöanpassad teknik i Landskrona, etapp 2. ISSN 0281-5753

10.3 Level of Detail: Not reported

10.4 Industry/Program Contact: Egon Konradis

10.5 Abstractor Name: UNEP Working Group On (Halogenated) Solvents. Reformatted by Douglas Martin, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords:

11.1 Waste Type: Organic vapors, trichloroethylene, mineral oil

11.2 Process Type: SIC 3648, lighting fixtures, painting, degreasing

11.3 Waste Reduction Technique: Material substitution, powder process

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Organic Vapor, Trichloroethylene, Mineral Oil, SIC 3648, Lighting Fixtures, Painting, Degreasing, Material Substitution, Powder Process

ELECTROPLATING

***** DOCNO: 400-100-A-323*****

HEADLINE:	Copper-plating rinse water is recycled via electrodialysis allowing for recovery of copper ions for reuse while significantly reducing volume of wastes produced.
INDUSTRY/SIC CODE:	Manufacture of Fabricated Metal Products, Machinery and Equipment/ ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	Rinse water from the copper-plating of parts is recycled via electrodialysis. This allows for recovery of the copper ions for reuse in the copper plating process, and recycling of purified rinse water. Conventional technology involves recycling of rinse water by removal of the ions with ion-exchange resins, resulting in the production of toxic effluents from the resin regeneration.
FEEDSTOCKS:	Electrical energy, copper
WASTES:	Metal hydroxide mud resulting from detoxication of rinse waters containing copper and sodium cyanide
MEDIUM:	Sludge
COSTS:	
CAPITAL COST:	463,000 francs (1980 franc)
OPERATION/MAINTENANCE:	110,000 franc reduction in detoxication cost
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	110,000 franc reduction in detoxication cost
FEEDSTOCK REDUCTION:	Reduction in copper and energy requirements
WASTE PRODUCTION:	Volume of metal hydroxide mud is reduced by 90%. Waste waters contained 340 kg of copper compared to 3400 kg in standard technique, and 375 kg of sodium cyanide compared to 3750 kg
IMPACT:	This low waste technology significantly reduces the volume of wastes produced from copper-plating while reducing the raw material and energy requirements for the process. The technique may be applied to the electroplating of other metals.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Copper-plating of Parts Followed by Electrodialysis: Recovery of Copper Contained in Rinsing Water", Monograph ENV/WP.2/5/Add.100
KEYWORDS:	Metal, Electroplating, Recovery, Rinsewater, Recycling, Electrodialysis, ISIC 38

***** Document No. 453-001-A-000 *****

1.0 Headline: Copper recovery from printed circuit board etchant using electrolysis

2.0 SIC Code: 3672, Printed Circuit Boards

3.0 Name and Location of Company:

Finishing Services Ltd.
Woburn Road Industrial Estate
Kempston,
Bedfordshire MK42-7BU, England

4.0 Clean Technology Category

The technology involves reclamation of copper using electrolytic recovery of a PVC-based membrane.

5.0 Case Study Summary

5.1 Process and Waste Information: Finishing Services Ltd. manufactures printed circuit boards. In making printed circuits, unwanted copper foil is etched away by an acid solution of cupric chloride. Dissolved copper reduces the effectiveness of the solution. The solution is typically regenerated by oxidizing the cuprous ion with acidified hydrogen peroxide. The volume of solution, however, increases steadily and the surplus liquor must be stored. The copper in the surplus liquor is precipitated as copper oxide and landfilled. The new technology uses electrolytic recovery with a PVC-based membrane which allows the passage of hydrogen and chloride ions but not the copper. The copper is transferred to the cathode and recovered as pure flakes.

5.2 Scale of Operation: A staff of 55 people are employed in England.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: The technology is commercially available from Finishing Services Ltd.

5.5 Material/Energy Balances and Substitutions: Copper Recovery is 11 te/year.

6.0 Economics*

6.1 Investment Costs: Investment costs are 55,000 English Pounds.

6.2 Operational and Maintenance Costs: Annual cost savings (in English Pounds)reported as:

Cost Savings

Materials	22,000
Savings in disposal costs	6,000
Less extra costs	1,000
Total	27,000

6.3 Payback Time: 2 years

7.0 Cleaner Production Benefits

The quality of the printed circuit boards is improved. Disposal costs for copper are virtually eliminated. The etching solution is maintained at its optimum composition. Copper is recovered in a high value form, and there are no hazardous chemicals to be handled.

8.0 Obstacles, Problems and/or Known Constraints

None identified.

9.0 Date Case Study Was Performed: Unknown

10.0 Contacts and Citation

10.1 Type of Source Material: Government Publication

10.2 Citation: Clean Technology, Environmental Protection Technology Scheme, Department of the Environment, 2 Marsham Street, London SW1P 3EB, 1989, p2.

10.3 Level of Detail of the Source Material: Simple diagram of process provided.

10.4 Industry/Program Contact and Address: Mr. Gareth Weed, Technical Manager, Finishing Services Ltd., Woburn Road Industrial Estate, Kempston, Bedfordshire MK42 7BU, Telephone (0234) 857004

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Etchant liquors

11.2 Process type/waste source: Electronic equipment, United Kingdom

11.3 Waste reduction technique: Copper recovery, solid waste recovery, electrolytic recovery

11.4 Other keywords: SIC 3672

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Etchant Liquors, Electronic Equipment, United Kingdom, Copper Recovery, Solid Waste Recovery, Electrolytic Recovery, SIC 3672

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: An Experimental Project Using an Electrowinning Cell and Ion Exchange Unit Minimizes Water Usage and Hazardous Waste

2.0 SIC Code: SIC 3471, Electroplating, Plating, Polishing, Anodizing, and Coloring

3.0 Name & Location of Company

Kinetico Engineering Systems, Inc.
Newbury, Ohio

4.0 Clean Technology Category

Technology Principle: This experimental technology uses an electrowinning cell and ion exchange system to recover copper and reduce water usage.

5.0 Case Study Summary

5.1 Process and Waste Information: The line on which the experiment was undertaken is composed of a bath for bright acid copper plating, followed by a "dead" rinse and two rinses in counterflow. Nothing about pretreatment is mentioned in the source document. The dead rinse consists of a tank of 1500 gallons used to replenish the volume lost from the plating bath. The first running rinse, also 1500 gallons, overflowed to the waste treatment facility. The second running of 3000 gallons, was fed with 4 gallons of city water per minute. In the first stage of the project, an electrowinning system was introduced in a circulating loop with the dead rinse resulting in reduction in the copper content and in drag-out of copper into the running tanks. The electrowinning cell design consisted of a tank using up to 50 square feet of cathode material and 48 square feet of insoluble anode. A 300 Amp, six volt rectifier powered the cell. Current densities could be varied throughout the study. An air sparger was used to agitate the bath liquid, although no heating was used.

After successful reduction of copper in the dead rinse, and thus in the running rinses, an ion exchage unit was installed to remove copper from the drag-out tank. The deionized water was returned to the last rinse bath. The ion exchange system consisted of a pump which supplied four gallons of water per minute to the system. Two ion exchange tanks containing 1.4 cubic feet of a strong acid resin were used. The dual system allowed one tank to be in service while the second tank automatically regenerated or was in standby position. The technology resulted in reduction of the copper concentration from 15 to 6 g/l in the static rinse tank. In seven months of operation, 360 pounds of salvageable copper have been recovered by the electrowinner. As a consequence, the concentration in the first counterflow rinse dropped from over 200 to below 50 mg/l.

The water coming from the ion exchanger has copper levels well below 0.01 mg/l and is reintroduced into the second counterflow tank. It was necessary to change from city water to softened water at the inlet. Regeneration is necessary every second day and takes about 20 minutes.

The run-off water from the first counterflow rinse contains 6 mg/l of copper. It is transformed into sludge in the waste treatment system.

5.2 Scale of Operation: Information not provided.

5.3 Stage of Development: Implemented, but tests are continuing.

5.4 Level of Commercialization: Information not provided.

5.5 Material/Energy Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Waste Generation: Sludge, 60% dry, lbs/day	18.5	2.5
Water Use (gpm):	4	2
Energy Use:	N/A	current density 8 ASF, surface area of 20 sq.ft., 6V, 950 W

Assumptions: No absolute figures on sludge production are given. It is assumed all wastes of the company are sent to the same facility.

As copper concentrations in the runoff water decreased by over 75% (from over 200 to below 50 mg/l) and the runoff was reduced from 4 to 2 gpm, it is assumed that the amount of copper entering the waste treatment facility from the experimental line decreased 87.5%. In the source document, a 75% reduction was claimed. The sludge production decreased by 16 lbs/day. From these figures, the before and after sludge production were computed.

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational & Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Use of this technology was prompted by tightening control on discharge limits and waste production in the U.S.

Sludge production and water usage are reduced and salvageable copper are recovered.

8.0 Obstacles, Problems and/or Known Constraints

Copper at low concentrations in the electrowinner burned while plating. Lowering current densities also lowers plating to a rate at which the cell cannot keep pace with the drag-out rate. The running rinses had to be fed with demi water.

9.0 Date Case Study Was Performed: November 1990 (date of source document)

10.0 Contacts and Citation

10.1 Type of Source Material: Magazine article

10.2 Citation: Reduce Water Consumption and Hazardous Waste. Jerome Kovach, Kinetico Engineering Systems, Inc., Newbury, Ohio.

10.3 Level of Detail of the Source Material: Additional information is available on the processes in the source document.

10.4 Industry/Program Contact and Address:

Jerome Kovach, Kinetico Engineering Systems, Inc., Newbury, Ohio.

10.5 Abstractor Name and Address: M. Stein, RIVM, Dept. LAE, Anthonie van Leeuwenhoeklaan 1, postbus 1, Bilthoven Netherlands. Reformatted: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: Copper plating bath

11.2 Process type/waste source: Electroplating, copper plating

11.3 Waste reduction technique: Electrowinning, ion exchange, drag-out reduction, copper recovery

11.4 Other keywords: Wastewater reduction

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Copper Plating Bath, Electroplating, Copper Plating, Electrowinning, Ion Exchange, Drag-Out Reduction, Copper Recovery, Wastewater Reduction, SIC 3471

***** DOCNO: 450-003-A-350*****

HEADLINE:	Electrolytic recovery unit at Sun Polishing and Plating reduces loss of nickel through dragout in the first standing rinse, allowing rinsewater to meet regulatory limits and reuse of nickel.
INDUSTRY/SIC CODE:	Fabricated Metal Products/SIC 34
NAME/CONTACT:	Sun Polishing & Plating, Ltd. Toronto, Ontario
POLLUTION PREVENTION OPTIONS SUMMARY:	A nickel plating line for lighting fixtures addressed loss of nickel through dragout in the first standing rinse with an electrolytic recovery unit. The electrolytic chamber contains expanded steel mesh electrodes in a bed of inert glass beads. The rinsewaters are pumped through the bed in successive rinses until a nickel concentration of 3 ppm is achieved. The scouring action of the beads on the surface of the electrodes ensures that the ion concentration is maintained. The electrodes are periodically removed when the deposits reach sufficient thickness, and the nickel is returned to the plating tanks.
FEEDSTOCKS:	Rinsewaters from nickel plating
WASTES:	Rinsewaters, nickel
MEDIUM:	Water, solid
COST:	
CAPITAL COST:	Not reported.
OPERATION/MAINTENANCE:	Requires less than 1/2 hour/day to maintain.
MONTHS TO RECOVER:	60
SAVINGS:	
DISPOSAL & FEEDSTOCK:	18 kg/week nickel recovered at about $7/kg, waste treatment costs eliminated.
FEEDSTOCK REDUCTION:	18 kg/week nickel.
WASTE PRODUCTION:	Eliminates discharge of nickel containing rinsewaters.
IMPACT:	The electrolytic recovery unit reduces the concentration of nickel in rinsewater from 300 ppm to 3 ppm, which meets the regulatory limit of 5 ppm for nickel. Thus, waste treatment costs are greatly reduced, and 18 kg/week of nickel can be reused.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects", Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 42.
KEYWORDS:	Recovery, Rinsewater, Electroplating, Electrolytic Recovery, SIC 34

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Use of a fluid bed reactor in an electroplating plant recovers nickel and reduces sludge generation

2.0 SIC Code: 3471, Electroplating, Plating, Polishing, Anodizing, and Coloring

3.0 Name & Location of Company:

Chroomwerk
Kerkrade

4.0 Clean Technology Category: This technology uses a fluid bed reactor to recover nickel from plating wastewater. The reactor is half filled with a special sand. Wastewater from the plating lines is mixed with soda (Na_2CO_3) and enters from below. The nickel crystallizes as carbonate on the sand grains which then sink to the bottom of the column and are removed. The sand, 10% of the weight of the material removed, is reused in the reactor. The sedimented nickel is very pure and can be reused after acidification. The effluent from the reactor is led over a filter, and partially reused.

5.0 Case Study Summary

5.1 Process and Waste Information: Wastewater from plating processes was originally treated in a DND device. Over 80% of the nickel from the static rinses in three plating lines was recovered. Use of the reactor and a filter removed over 99% of the nickel from the wastestream. Using the new technology results in a considerable reduction in both the amount of sludge produced from the DND device and the effluent produced.

5.2 Scale of Operation: Not provided.

5.3 Stage of Development: A test installation proved to work satisfactorily so a full scale installation was ordered in 1989. The new device will also be connected to four zinc plating automations for zinc recovery.

5.4 Level of Commercialization: The equipment was purchased from DHV at Amersfoort, the Netherlands.

5.5 Material/Energy Balances and Substitutions: No quantitive figures were given but the purchase of metal salts, the amount of sludge produced, and the final effluent is reduced.

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational & Maintenance: Not reported

6.3 Payback Time: Not provided and could not be calculated.

7.0 Cleaner Production Benefits: The installment of the fluid bed reactor was inspired by both economical and envionmental considerations, due to growth of the company and the concommitant increase in sludge production. The amounts of sludge and effluent produced are less. Savings result from reduced purchasing of metal salts.

8.0 Obstacles, Problems and/or Known Constraints: There were many start-up problems with the test equipment but these were not specified in the source document.

9.0 Date Case Study Was Performed: 1989

10.0 Contacts and Citation

10.1 Type of Source Material: Article

10.2 Citation: The fluid bed reactor in practice, advantages and disadvantages. W.L.J. Janssen. Tijdschriift voor oppervlaktetechnieken en corrosiebestrijding. Vol. 33, No. 12, December, 1989.

10.3 Level of Detail of the Source Material: Very little detail on cost and waste information was available in the source document.

10.4 Industry/Program Contact and Address:

H.W. du Mortier
VOM
Jan van Eycklaan 2
Postbus 120
3720 AC Bilthoven
Netherlands
Phone 030-287111
Fax 030-287674

10.5 Abstractor Name and Address: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: Wastewater

11.2 Process type/waste source: Nickel plating

11.3 Waste reduction technique: Recovery, reuse

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Electroplating, Fluid Bed Reactor, Nickel Plating, Wastewater, Recovery, Reuse, SIC 3471

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Membrane Electrolysis Results in almost Complete Recovery of Nickel from Electroplating Wastewaters

2.0 SIC Code: 3471, Electroplating, Plating, Polishing, Anodizing, and Coloring

3.0 Name & Location of Company

Egidius Jansen
Witveldweg 14
5951 AV Belfeld
The Netherlands
Phone 04705-1444

4.0 Clean Technology Category

Technology Principle: This technology involves in-process modifications using membrane electrolysis to recover nickel and reduce rinse water flow from electroplating processes.

5.0 Case Study Summary

5.1 Process and Waste Information: Water purification was previously accomplished in a DND installation. For the new process, membrane electrolysis was selected because the high iron concentration in the solution can impair electrolysis operation. The wastewater is sent to ion exchangers where the stream of 4 m^3/hr with 0.5 g/l of nickel is concentrated to 10 m^3/week with a concentration of about 12 g/l. The wastestream is then passed to a membrane electrolysis cell where 99.8% or 5000 kg/year of nickel is reclaimed through batch treatment. The nickel content in the stream is reduced to less than 6 mg/l. The membrane in the cell is composed of perfluorinated PTFE. The cell operates at 7 V and with 900 A 4 days/week. The new technology reduces the rinse water flow, eliminates chlorine and sludge production, and recovers nickel for sale or reuse. There is no effect on the final product.

5.2 Scale of Operation: No information was provided.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: From the case study, it was not clear whether the equipment was purchased or developed in the plant itself. On further inquiry, it became apparent that the equipment comes from Esmil, Diemen in the Netherlands.

5.5 Material/Energy Balances and Substitutions

5000 kg/year of nickel are reclaimed from the rinsewater.

6.0 Economics

6.1 Investment Costs: Investment costs for the electrolysis system were reported as Dfl 715,000. Capital costs wefe reported as Dfl 100,000. No further breakdown was provided.

6.2 Operational & Maintenance Costs: Operating and maintenance costs were reported to be Dfl 5,000 for energy, Dfl 15,000 for labor, and Dfl 14,000 for maintenance.

6.3 Payback Time: Nickel savings can be estimated to be about Dfl 100,000 since 5000 kg/year of nickel are recovered at a rate of Dfl 20/kg. Savings on sludge hauling were not specified, however, the amount of sludge not produced was indicated as "tens of tons" and hauling rates are estimated at Dfl 300 to 500.

7.0 Cleaner Production Benefits

This process recovers nickel for sale or reuse, reduces the quantity of wastewater requiring further treatment, and eliminates chlorine and sludge production. Benefits from improved public relations, reduced liabilities, and changes in regulatory compliance were not discussed.

8.0 Obstacles, Problems and/or Known Constraints

One problem which arose during implementation of the technology was the plugging of anode compartments with iron sludge from steel anodes. This was solved by using activated titanium anodes with a layer or iridium oxide which also increased efficiency. At the end of the process, a basic mist was produced above the anode compartments. This problem was eliminated by placing mist filters above the anode compartments.

It was found that removal of nickel from the electrodes took about 5 to 6 hours. Using cathode cylinders treated with a contact oil before starting the process decreased the time to about 2 hours. The problem of the control of the voltage rectifier being destroyed frequently was corrected by using oil cooling instead of air cooling.

9.0 Date Case Study Was Performed: January 1990 (date of source document)

10.0 Contacts and Citations

10.1 Type of Source Material: Article

10.2 Citation: Membrane electrolysis in practice. J. Manders. Tijdschrift voor oppervlaktetechnieken en corrosiebestrijding. Vol. 34, No. 1, January 1990, p.14-16.

10.3 Level of Detail of the Source Material: Schematic diagrams of plating and membrane electrolysis processes, including additional efficiency and mass balance data, are available in source document.

10.4 Industry/Program Contact and Address

Jan Ros
RIVM, dept LAE
Anthonie van Leeuwenhoeklaan 1
Bilthoven
Netherlands

10.5 Abstractor Name and Address: M. Stein, RIVM, anthonie van Leeuwenhoeklaan 1, Bilthoven, Netherlands.

Reformatted: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: Electroplating rinsewater, metal-bearing wastes

11.2 Process type/waste source: Electroplating, nickel plating, SIC 3471

11.3 Waste reduction technique: Electrolysis, ion exchange, nickel recovery, reclamation, drag-out tanks

11.4 Other keywords: Sludge reduction, chlorine reduction, Netherlands

Keywords: Electroplating Rinsewater, Metal-Bearing Waste, Electroplating, Nickel Plating, SIC 3471, Electrolysis, Ion Exchange, Nickel Recovery, Reclamation, Drag-Out Tanks, Sludge Reduction, Chlorine Reduction, Netherlands

***** DOCNO: 400-073-A-310*****

HEADLINE:	Ion exchange of chromium plating rinse tanks recovers chromium and reduces wastewater generation rate.
INDUSTRY/SIC CODE:	Manufacture of Metal Products, Machines and Equipment/ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	This audit presents a modification of the rinsing stages of the conventional chromium plating technology. After chromium plating, the parts are rinsed. The first rinsing bath which is high in chromic acid, is recycled and the last cold rinsing bath is regenerated on ion-exchange resins and recycled. In the conventional process, the last cold rinsing bath is discarded.
FEEDSTOCKS:	For 1,000 m^2 of treated surface: 18 kg chromic acid; 24 kg caustic soda and 60 kg sulfuric acid for resin regeneration; 2 kg barium carbonate for sulphate precipitation; 15 m^3 water.
WASTES:	The only polluting residuals generated by the low-waste technology are eluates from the regeneration process and the barium sulfate sludge. In the standard technology, the most polluting residual stream is the last cold rinsing bath.
MEDIUM:	Aqueous, solid
COST:	
CAPITAL COST:	FF 2,200,000 (1978 figures), additional
OPERATION/MAINTENANCE:	FF 92 per 1,000 m^2 of chromium plating surface (1979 figures), additional.
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	No savings due to additional labor expenses
FEEDSTOCK REDUCTION:	Not applicable
WASTE PRODUCTION:	Elutes and sludge from regeneration
IMPACT:	The low-waste technology can be applied to a large number of other surface treatment related operations.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Chromium Metal Plating Followed by Rinsing and by Regeneration of Rinse Water on Ion Exchange Resins with Recycling", Monograph ENV/WP.2/5/Add.73.
KEYWORDS:	Metal Finishing, ISIC 38, Ion Exchange, Resin Adsorption, Chrome Wastes, Electroplating, Rinsewater, Recycle, Regeneration

*****DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Replacement of hexavalent chromium with trivalent chromium in decorative chrome plating reduces sludge generation

2.0 SIC Code: ISIC 3471, Electroplating, Plating, Polishing, Anodizing, and Coloring

3.0 Name & Location of Company:

W. Canning Materials Ltd.
P.O. Box 288
Great Hampton Street
Birmingham B18 6AS
UK
Phone 021-236-8621
Fax 021-236-0444

4.0 Clean Technology Category: The cleaner production is achieved by plating with trivalent rather than hexavalent chromium. The tendency of trivalent chromium to be oxidized to hexavalent chromium was overcome by using a special membrane surrounding the anodes. This also allows use of anodes made of lead. The low deposition rates associated with trivalent chrome plating were grossly increased by using specially developed in-house organic additives to modify the reactions and give performances superior to the traditional process. This results in production which is 20-40% higher.

5.0 Case Study Summary

5.1 Process and Waste Information: Although the composition of the plating line was not clear from the source document, it is assumed that the sequence consists of bright nickel plating with drag-out recovery, two clean running rinses, chrome plate, two additional rinses, and a final hot rinse. In the traditional process, hexavalent concentrations are sometimes as high as 120 g/l. Trivalent chromium replaces hexavalent chromium in the new process and organic compounds are added. This results in a decrease in sludge generation of over 95%, energy consumption reduced by over 50%, lower current densities, no chloride in the electrolyte, and a 98% reduction in waste treatment costs. No reduction chemicals are needed with the new process. Product quality was greatly improved due to better coverage and more uniform plating.

5.2 Scale of Operation: Not provided.

5.3 Stage of Development: The technology has been fully implemented and in operation since about 1985.

5.4 Level of Commercialization: It appears the company has developed the procedure and sells it under the name "Envirochrome-90". The membranes were developed for mercury-free electrolysis of sodium chloride. Canning is a supplier of machineries to the electroplating industry.

5.5 Material/Energy Balances and Substitutions:

Material Category		Quantity Before*	Quantity After*
Waste generation:		100%	95%
Energy use:	Consumption	100%	50%

Current densities		10-15Amp/dm² 8-12V	3.2-8Amp/dm²

*Exact quantities were not supplied.

6.0 Economics*:

6.1 Investment Costs: Actual figures on investments are not given, and these estimates may be low. A comparison is made on the investment costs for a traditional plating line and the new plating process for a plant producing 3 million nickel and chrome plated water fittings per year.

	Traditional Technology	New Technology
Plating plant	175,000	135,000
Effluent plant	70,000	52,000

6.2 Operational & Maintenance: Only costs for water treatment were given for the traditional and new technologies as follows:

	Traditional Technology	New Technology
Chrome reduction	6,459	0
Hydroxide precip.	1,605	120
Sludge disposal	2,905	130
Labor and materials	2,050	50
Total	13,064	300

No costs were given for labor, maintenance of membranes, or energy consumption for other operations. Membrane life is assumed to be indefinite since no signs of wear occurred after five years of operation.

6.3 Payback Time: It is not possible to calculate a payback time due to lack of data but appears the technology is relatively cheap compared to the traditional technology.

7.0 Cleaner Production Benefits: Sludge production decreased by 95%, waste treatment costs decreased by 98%, and power consumption decreased by over 50%. Electrical current densities are lower and the electrolyte is less corrosive since no chloride is present. The technology appears to be cheaper than the traditional process and results in improved product quality. Benefits from improved public relations, reduced liabilities, and changes in regulatory compliance were not discussed.

8.0 Obstacles, Problems and/or Known Constraints: No problems were encountered although the brownish color of trivalent chrome may be a problem for some people.

9.0 Date Case Study Was Performed: 1985

10.0 Contacts and Citation:

10.1 Type of Source Material:

Document 1: UNEP report
Document 2: British government leaflet
Document 3: Plant leaflet

10.2 Citation:

Document 1: Title not given. B. Johnson, W. Canning Materials Ltd., P.O.Box 288, Great Hampton Street, Birmingham B18 6AS, UK. Phone 021-236-8621, Fax 021-236-0444.

Document 2: Clean Technology. EPT Office, Department of the Environment, Room B 357, Romney House, 43 Marsham Street, London SW1P 3PY, UK. Phone 01-276-8318.

Document 3: Envirochrome Process Operating Guide. W. Canning Materials Ltd., P.O. Box 288, Great Hampton Street, Birmingham B18 6AS, UK. Phone 021-236-8621, Fax 021-236-0444.

10.3 Level of Detail of the Source Material: Additional detail is available in the source documents on some aspects of the manufacturing process.

10.4 Industry/Program Contact and Address:

Mr. Brian Johnson
W. Canning Materials Ltd.
P.O. Box 288
Great Hampton Street
Birmingham B18 6AS
UK
Phone 021-236-8621
Fax 021-236-0444

10.5 Abstractor Name and Address:

Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords:

11.1 Waste type: Electroplating waste, metal-bearing waste

11.2 Process type/waste source: Chrome plating, membrane plating, SIC 3471

11.3 Waste reduction technique: Process modification, material substitution

11.4 Other keywords: Sludge reduction, chloride reduction, drag-out reduction, energy reduction, United Kingdom

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Electroplating Waste, Metal-Bearing Waste, Chrome Plating, Membrane Plating, SIC 3471, Process Modification, Material Substitution, Sludge Reduction, Chloride Reduction, Drag-Out Reduction, Energy Reduction, United Kingdom

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Iron removal from a hardchrome plating bath is accomplished by membrane extraction.

2.0 SIC Code: SIC 3471, Electroplating, Plating, Polishing, Anodizing, and Coloring

3.0 Name & Location of Company:

Twentsche Hardchroom
Slijpsteen 10
Enschede
Netherlands

4.0 Clean Technology Category

5.0 Case Study Summary

5.1 Process and Waste Information: In the original process, the plating baths were substituted about once every four years by a completely fresh bath solution. The old bath liquor originally was disposed of, later on it was stored.

A continuous flow of hard chrome plating bath liquor is separated from a continuous flow of oxalic acid by membranes selectively impermeable to iron ions (and possibly also other metallic ions). The metal ions are induced to cross the membranes by an electrical driving force. The equipment operates at 7 volts and 120 Amp. To prevent long pipelines running through the plant, a semi-batch approach was chosen. The company decided to handle a volume of 1,000 ($1m^3$) of bath liquor at the time. This volume is pumped into a container and moves close to the actual iron extraction device. Analysis of the bath liquor in the 1000 liter container over a ten day period confirms that 200 grams/day of iron are removed. Savings are achieved due to lower energy requirements, purchases of bath solution, and hauling and disposal of baths. There were no effects on products.

5.2 Scale of Operation: The company employs 15 people in two shifts of eight hours/day, five days/week. Several baths are in operation, the largest one has a content of 6,000 liters.

5.3 Stage of Development: The equipment, although commercially available, was still in the testing stage. The producer is not yet very experienced with this type of device.

5.4 Level of Commercialization: The equipment is commercially available.

5.5 Material/Energy Balances and Substitutions:

No wastes are produced.

6.0 Economics*:

6.1 Investment Costs: Precise figures were not available but approximate costs were 100,000 guilders (Dfl) (1990).

6.2 Operational & Maintenance Costs: These costs are estimated to be 1,000 Dfl/year. One man-hour is required per week to clean the membranes.

6.3 Payback Time: Savings are estimated at 55,000 Dfl/year since the bath liquor does not neet to be replaced at a rate of 4,000 liters/year. The payback time was estimated at between 2 and 3 years.

7.0 Cleaner Production Benefits

Use of this technology was inspired by the following motives:

When a 600 liter bath, due to high iron content, had to be substituted, the electricity bill of the company dropped Dfl 4,000 per month

The high costs of new bath liquor and haulage of the waste bath liquor

A stock of 20,000 liters (20 m^3) of bath liquor with an iron content of 10 g/l

The reluctancy of the plant manager to let the disposed liquor be transported

The dissatisfaction of DND water purification, where waste is transformed from one form to another but no waste prevention results.

Use of the technology resulted in decreased energy consumption, savings on bath solution purchases, and savings on bath hauling and disposal.

Economic benefits were estimated as follows:

Decreased energy consumption	24,000 Dfl/year
Purchase of bath solution	25,000
Bath haulage and disposal	6,000

Total	55,000

8.0 Obstacles, Problems and/or Known Constraints

No problems were encountered, although the equipment was in operation for only three weeks at the date of the case study.

9.0 Date Case Study Was Performed: December 1990

10.0 Contacts and Citation

10.1 Type of Source Material: Plant visit

10.2 Citation: Plant visit

10.3 Level of Detail of the Source Material:

10.4 Industry/Program Contact and Address:

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Netherlands
Phone 030-287111 Fax 030-287674

10.5 Abstractor Name and Address: Submitted by UNEP Workgroup. M. Stein, RIVM, Dept. LAE, Postbus 1, Anthonie van Leeuwenhoeklaan 1, Bilthoven, Netherlands.

11.0 Keywords

11.1 Waste type: Electroplating baths

11.2 Process type/waste source: Electroplating, SIC 3471, hard chrome plating

11.3 Waste reduction technique: Membrane electrolysis, iron removal

11.4 Other keywords: Material conservation, energy conservation, Netherlands

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Electroplating Baths, Electroplating, SIC 3471, Hard Chrome Plating, Membrane Electrolysis, Iron Removal, Material Conservation, Energy Conservation, Netherlands

***** DOCNO: 450-003-A-381*****

HEADLINE:	G.G. Buffing and Plating uses ion-exchange chromium recovery system to meet space and waste reduction requirements.
INDUSTRY/SIC CODE:	Transportation Equipment/ISIC 32
NAME/CONTACT:	G. G. Buffing & Plating Longuevil, Quebec T. Nadeau
POLLUTION PREVENTION OPTIONS SUMMARY:	A chemical recovery system was built above a plating line of an electroplating plant that plates decorative copper, nickel and chromium on a variety of components and trim for automobiles and motorcycles. Short-bed ion exchange systems, designed and built by Eco-Tec of Ontario, were installed on the copper, nickel and chromium rinses. This system was chosen over a conventional waste treatment system, because limited space (20 x 15 feet) was available, and the payback was more attractive.
FEEDSTOCKS:	Copper, nickel, chromium rinsewaters
WASTES:	Rinsewaters, unrecovered metals
MEDIUM:	Water
COST:	
CAPITAL COST:	$125,000 (comparable to that of a destruction/precipitation treatment system)
OPERATION/MAINTENANCE:	The plating manager monitors and maintains the units for approximately 1-1/2 hrs/day.
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	$13,257 for first year, projected to be $60,222 when line reaches full capacity of 6,000 hrs/year.
FEEDSTOCK REDUCTION:	Recovered metals reduce quantities of raw material to be purchased.
WASTE PRODUCTION:	Recovered metals no longer require disposal.
IMPACT:	In addition to meeting the company's space requirements, this ion-exchange system recovers metal from plating baths, reducing the waste for disposal as well as raw material needs.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects", Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 96.
KEYWORDS:	Electroplating, Metal, Ion Exchange, Recovery, ISIC 32

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Electrolysis and Ultrafiltration in an Lead-Plating Plant Virtually Eliminates Heavy Metals from Wastewaters

2.0 SIC Code: ISIC 2085, Metal Plating

3.0 Name & Location of Company: Confidential

4.0 Clean Technology Category

Technology Principle: This process involves removing heavy metals from plating wastewaters by electrolysis and ultrafiltration.

5.0 Case Study Summary

5.1 Process and Waste Information: The facility has one lead plating line where workpieces are treated with sulfuric acid and copper is dissolved. A recirculating system is used for spray rinsing followed by staining in a zinc chloride bath. Thermal lead plating in a bath containing 6% tin is then followed by immersion in a cooling bath. A spray bath and a final immersion bath complete the process. Changes to the process included the addition of the cooling bath after the actual plating bath and the regeneration cell parallel to the acid bath. The wastewater has been separated from the sanitary wastewater at the plant. The remaining wastewater is first sent to a collection pit and a storage tank. It is then treated in a mixing tank with lye and after flocculation goes to an ultrafiltration system. The permeate is sewered and the concentrate thickened in a filter press.

The new measures involved constructing a regeneration cell parallel to the sulfuric acid bath to recover the dissolved copper. This has resulted in a considerable increase in the lifetime of this bath. The immersion bath cools the workpieces and removes copper oxides.

Water consumption at the facility is greatly reduced with the process modification. Wastewater flows of 18,000 m^3/year, containing 4,000 - 5,000 kg of heavy metals, has been reduced to 10,000 m^3/year, containing 700 kg of heavy metals. The new process requires small amounts of chemicals for neutralization and flocculation. Sludge is a new waste product resulting from the new process. No effects on product quality were experienced.

5.2 Scale of Operation: The facility employs one worker for 1800 hours/year and has a production capacity of 30 tons of lead per year, deposited in a layer less than 100μm thick.

5.3 Stage of Development: The measures are fully implemented.

5.4 Level of Commercialization: All equipment needed is widely available.

5.5 Material/Energy Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Waste Generation (kg/year):		
Heavy metals	4,000-5,000	<2
Sludge, 23% dry matter	0	10,000

Copper	N/A	<1
Zinc	N/A	<1
Nickel, chrome, lead	N/A	immeasurable
Water Use (m^3/year): (including 2,000 m^3/year sanitary)	20,000	12,000

6.0 Economics*

6.1 Investment Costs: Investment costs (Dfl) for the new process are as follows:

Regeneraton cell at acid bath	36,000
Separation of wastewater streams	33,000
Wastewater treatment system	235,000

Capital costs reported separately in the source document were included here with investment costs.

6.2 Operational & Maintenance Costs: The following costs (Dfl) are required to operate the system:

Inline:	
Cooling bath	1,500
Regeneration cell maintenance	2,000
Regeneration cell operation	2,000
Wastewater treatment system:	
Chemicals (e.g. NaOH)	800
Sludge removal	4,000
Operation (6 manhours/week)	10,000
Energy	2,000
Analyses	1,000

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Installation of the equipment was promoted by water regulation demands. Water consumption, wastewater quantities, and the quantity of heavy metal contained in wastewaters are decreased.

8.0 Obstacles, Problems and/or Known Constraints

Some minor start-up difficulties were experienced but not specified.

9.0 Date Case Study Was Performed: August 1986

10.0 Contacts and Citation

10.1 Type of Source Material: Report on company interviews

10.2 Citation
Wastewater Problems in the Metal Industry. Results of interviews in 48 companies. Dr. W.H. Rulkens, TNO, Maatschappelijke Technologie, postbus 342, 7300 AH Apeldoorn, Netherlands, tel (055) 773-344.

10.3 Level of Detail of the Source Material: Not reported

10.4 Industry/Program Contact and Address:

H.W. du Mortier
VOM
Postbus 120
3720 AC Bilthoven
Netherlands
Phone 030-287111

10.5 Abstractor Name and Address: M. Stein, RIVM, Dept. LAE, Anthonie van Leeuwenhoeklaan 1, Postbus 1, Bilthoven, Netherlands. Reformatted: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: Plating wastes, metal-bearing wastes

11.2 Process type/waste source: Lead plating, ISIC 2085

11.3 Waste reduction technique: Electrolysis, ultrafiltration, regeneration cell, cooling bath, reclamation, copper recovery

11.4 Other keywords: Wastewater reduction, Netherlands

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Plating Wastes, Metal-Bearing Waste, Lead Plating, ISIC 2085, Electrolysis, Ultrafiltration, Regeneration Cell, Cooling Bath, Reclamation, Copper Recovery, Wastewater Reduction, Netherlands

***** DOCNO: 400-124-A-331*****

HEADLINE:	Rotalyt-Alutop process for aluminum plating reduces discharge of cadmium into the environment while also reducing costs.
INDUSTRY/SIC CODE:	Corrosion Protection of Small Components/ISIC 3844
POLLUTION PREVENTION OPTIONS SUMMARY:	The Rotalyt-Alutop process for aluminum plating is based on the chemo-mechanical plating of pieces in a medium containing an impact body, and metal particles and catalysts, using relative movement. The pieces are loaded into a perforated drum, and lowered into a plating bath where glass balls are added as the impact body and the aluminum flakes are added. The drum passes through a separation tank where the glass balls are separated for reuse, to a centrifuge unit, and to an unloading station for drying. The cathodic corrosion protection properties are considerably improved by the use of zinc containing aluminum alloys, or preplating to add a zinc/tin layer.
FEEDSTOCKS:	Electric energy-140 kWh/ton, Al metal-14 kg/ton, rinse water-200 l/ton, catalyst-5 kg/ton, pre- and post-treatment-20 kg/ton
WASTES:	Wastewaters, chemical baths
MEDIUM:	Aqueous
COSTS:	
CAPITAL COST:	500,000 DM (1983)
OPERATION/MAINTENANCE:	294 DM/ton treated goods
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	100,000 DM reduction in capital cost, 94 DM/ton of treated goods reduction on process costs.
FEEDSTOCK REDUCTION:	Electrical requirements reduced by 780 kWh/ton, rinsewater by 800 l/ton, 14 kg/ton Al required compared to 15 kg/ton Cadmium, treatment chemicals by 100 kg/ton.
WASTE PRODUCTION:	Wastewaters produced from conventional process contains cadmium, cyanide, and chromium compounds. The waters are neutralized, precipitated, and dumped. The low waste technology reduces the toxicity of the waste.
IMPACT:	Reduction of environmental pollution from the proven toxicity of cadmium while reducing costs.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, Monograph "Rotalyt-Alutop" ENV/WP.2/5/Add.124.
KEYWORDS:	Electroplating, Aluminum, Wastewater Treatment, Metal Treating, Corrosion, Rotalyt-Alutop, ISIC 3844

***** DOCNO: 400-125-A-332*****

HEADLINE:	Aluminum is used instead of cadmium in the conventional electroplating technology for the elimination of Cd and CN containing waters and hydroxide sludge, while reducing operating costs.
INDUSTRY/SIC CODE:	Manufacture of Structural Metal Products/ISIC 3813
POLLUTION PREVENTION OPTIONS SUMMARY:	Conventional electroplating technology using aluminum instead of cadmium as the plating metal. A thin layer of nickel is initially deposited on ferrous and aluminum die casting materials. The pieces are dried using fluorohydrocarbons, and passed to the aluminum plating cell. Using an electrolyte solution, an aluminum layer is applied to the nickel coating. A post-treatment process may be applied to improve corrosion protection or for decorative appearance.
FEEDSTOCKS:	Nickel-18 g/m^2, Al-27 g/m^2, electrolytic bath (recycled), electrical energy
WASTES:	No wastewaters (electrolyte is recycled), evaporation of toluene from the bath (1-2 kg/hr)
MEDIUM:	Vapor
COSTS:	
CAPITAL COST:	6 million Dfl - 40 m^2/hr plant
OPERATION/MAINTENANCE:	50 - 75 Dfl/m^2
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	10 - 15 Dfl/m^2 reduction in operating costs, elimination of wastewater treatment and disposal costs.
FEEDSTOCK REDUCTION:	18 g of Ni, and 27 g Al is require compared to 180 g Cd, and 5 g CN in conventional technology.
WASTE PRODUCTION:	Cd and CN containing wastewaters are eliminated. 1-2 kg/hr toluene vapor is produced.
IMPACT:	Elimination of Cd and CN containing waters and hydroxide sludge, with reduced operating costs. Discharge of the bath contents occurs after two years, and the materials are recycled.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, Monograph "A Low-waste Electroplating Process of Aluminum in Non-aqueous Solvent (Sigal-Process)" ENV/WP.2/5/Add.125.
KEYWORDS:	Electroplating, Aluminum, Wastewater Treatment, Metal Treating, Recycling, ISIC 3813

***** DOCNO: 400-126-A-333*****

HEADLINE: Blue Passivation process in the Galvanic Industry uses trivalent chromium (instead of hexavalent chromium) to allow for reuse of chemical bath, less aggressive rinsewaters and lower operating costs.

INDUSTRY/SIC CODE: Manufacture of Structural Metal Products/ISIC 3813

POLLUTION PREVENTION OPTIONS SUMMARY: The use of trivalent chromium for the Blue Passivation process in the Galvanic Industry instead of hexavalent chromium leads to a no-dump bath. The conventional technology for the chromating of zinc coatings utilizes hexavalent chromium and mineral acid, which reacts with the metal. In addition to the chemicals present in the bath, the wastewater also contains zinc that was dissolved from the metal surface. The low-waste technology utilizes Cr(III) and H_2O_2 which dissolves little zinc and the bath can be replenished with concentrate and reused.

FEEDSTOCKS: Cr(III), H_2O_2 (30%), citric acid

WASTES: Wastewater containing Cr(III) - 200 g, H_2O_2 - 8 ml, citric acid - 600 g, zinc - 750 g (treated by reduction and precipitation of hydroxide) per 1000 m^2 chromated.

MEDIUM: Aqueous

COSTS:
CAPITAL COSTS: Only material and discharge costs involved.
OPERATING/MAINTENANCE: 40 Dutch guilders/1,000 m^2 of passivated metal surface.
MONTHS TO RECOVER: Not reported

SAVINGS:
DISPOSAL & FEEDSTOCK: Operating costs are reduced by 190 Dutch guilders/1,000 m^2 of passivated metal.
FEEDSTOCK REDUCTION: 0.75 kg zinc dissolved in bath compared to 7.5 kg of lost zinc using conventional technique, allowing for reuse of the bath.
WASTE PRODUCTION: Chemical baths are reused, rinsewaters contain less aggressive H_2O_2 and citric acid, compared to conventional method, resulting in savings of 171.50 Dutch guilders in discharge costs.

IMPACT: The use of trivalent chromium over hexavalent chromium in passivating zinc metals allows for reuse of the chemical bath, less aggressive rinsewaters and lower operating costs.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, Monograph " A No-dump Bath Using Trivalent Chromium for the Blue Passivation Process in the Galvanic Industry" ENV/WP.2/5/Add.126.

KEYWORDS: Metal Finishing, Recycling, Chrome, Chromating, ISIC 3813

*****DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 **Headline: Removal of cations from chromic acid and evaporation result in decreased sludge production and energy consumption**

2.0 SIC Code: SIC 3471, Electroplating

3.0 Name & Location of Company:

Koni BV
Langeweg 1
Oud-Beyerland
Netherlands
Phone (01860)12500
H. van Zessen

4.0 Clean Technology Category: This technique involves use of a cation exchanger for continuous cleaning of drag-out baths and evaporation followed by water reuse.

5.0 Case Study Summary

5.1 Process and Waste Information: The plant operates a three step cascade rinse behind the plating baths and the water is used to replenish the water evaporating from the process baths. This is supplemented with demi water. In the original process, a final rinse with tap water occurred after the cascade.

Because of a build-up of undesired cations such as iron, copper, and nickel in the process baths, drag-out baths are now treated over a cation resin. The water of the final rinse has been substituted with demi water and is also treated over the resin. The process liquor is too aggressive to be treated. By using the waste heat of the cooling system and controlling the process bath temperature, an extra amount of water is evaporated. The resulting wastewater is still treated in a DND installation. Lifetime of the untreated baths was about five years with the original process.

In the original process, the starting power was 10 V and 15,000 Amp. The voltage increased at a rate of 1 V/A. Due to limitations in the transformers, this meant that after about five years the process baths had to be thrown away. In the current situation, the voltage increased two volts in five years of operation, and then remained stable.

Sludge production decreased from 10 tons to 0.4 tons in five years and 60 regenerations of the cation exchanger were performed using 1500 liters of hydrochloric acid. Tap water consumption decreased from 1330 to 15 m^3/year and demi water consumption went up 1320 m^3/year. Energy consumption decreased from 99 MWh/year to 59 MWh/year or more than 40%. The consumption of chromic acid decreased by 2,000 liters/year and chemicals for the DND installation decreased from 2,000 to 20 liters/year.

No effects on product quality were reported in the source document although quality should have improved since foreign elements have been removed.

5.2 Scale of Operation: Not reported

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: All necessary parts are widely available.

5.5 Material/Energy Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Waste Generation:		
Sludge (tons)	10	0.4
Feedstock Use:		
New chromic acid (tons)	10	N/A
HCl (liters in 5 yrs.)	0	1500
Chemicals for DND (tons)	10	0.1
Water Use:		
Tap water (m^3/year)	1330	15
Demi water (m^3/year)	N/A	increased by 1320 m^3/year
Energy Use: (MWh/year)	99	59

6.0 Economics*:

6.1 Investment Costs: Not reported

6.2 Operational & Maintenance Costs: Costs for the five year period are as follows:

	Old Process (Dfl)	New Technology (Dfl)
New chromic acid	15,000	--
Waste disposal	3,500	140
Chemicals for DND	40,000	400
Power loss	74,250	44,550
Tap water	8,600	100
Extra demi water	--	33,000
Sewage costs	9,550	100

6.3 Payback Time: Costs over five years have decreased by Dfl 71,710. Since no investment costs were given, a payback period cannot be calculated. However, based on the cost information given and the cost of an ion exchanger, it can be estimated that the payback period would be less than one year.

7.0 Cleaner Production Benefits: The new technology resulted in decreases in power consumption, undesired metals in the deposited layer, sludge production, chromic acid, and chemicals needed for wastewater treatment. The following are savings realized using the new process:

Less chromic acid	3,000 Dfl/year
DND treatment chemicals	8000
Waste disposal	700
Power consumption 5340	
Tap water	1900

8.0 Obstacles, Problems and/or Known Constraints: No obstacles or problems were discussed.

9.0 Date Case Study Was Performed: Probably early 1990

10.0 Contacts and Citation

10.1 Type of Source Material: Example report

10.2 Citation: Removal of cations from chromic acid by continuous cleaning of drag-out baths through a cation resin and evaporation before reuse. Jan Ros, RIVm, Dept. LAE, anthonie van Leeuwenhoeklaan 1, Postbus 1, 3720 BA Bilthoven, Netherlands.

10.3 Level of Detail of the Source Material: More detailed information is available on the process.

10.4 Industry/Program Contact and Address:

H.W. du Mortier
VOM
Jan van Eycklaan 2
Postbus 120
3720 AC Bilthoven
Netherlands
Phone 030-287111
Fax 030-287674

10.5 Abstractor Name and Address: M. Stein, RIVM, Dept. LAE, Anthonie van Leeuwenhoeklaan 1, Postbus 1, 3720 BA Bilthoven, Netherlands. Reformatted: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords:

11.1 Waste type: Plating baths

11.2 Process type/waste source: Electroplating, SIC 3471

11.3 Waste reduction technique: Ion exchange, evaporation

11.4 Other keywords: Sludge reduction, energy reduction, Netherlands

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Plating Baths, Electroplating, SIC 3471, Ion Exchange, Evaporation, Sludge Reduction, Energy Reduction, Netherlands

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Clean technology measures result in minimal waste production in electroplating shop of a large company

2.0 SIC Code: SIC 3471, Electroplating, Plating, Polishing, Anodizing and Coloring

3.0 Name & Location of Company: Confidential

4.0 Clean Technology Category

Technology Principle: Processes were designed to minimize heavy metal concentrations in rinsewaters and continuous treatment of process bath liquid in order to result in minimal water usage and waste generation.

5.0 Case Study Summary

5.1 Process and Waste Information: The plant operates twelve lines for all kinds of electrolytical surface treatment. Not all lines contain static rinses and one line contains cascade rinsing. In order to minimize waste generation, the lines are operated manually and drip plates are used between baths. Long drip-off times are achieved with slow movements in the process and workpieces are hung carefully. Static rinses are used where possible and a complete return of static rinse water into the process baths is achieved. Continuous treatment of process bath liquid maintains a constant bath quality. This includes electrolytic recovery of silver, activated carbon treatment, and filtration. Intense monitoring of baths maintains a constant composition and the lowest concentration of process chemicals possible is used.

The rinsewater streams of all lines are collected into one stream and sent to a water treatment system. Wastewater and concentrates of outside dischargers are also treated in the system. The contaminated water (200,000 m^3/year) is treated in an ion exchanger then is returned to the plant. A small part of the processed water is first sent to an extra mixed bed ion exchange device for more purification, and then returned to the plant. The regenerate of the ion exchanger is treated in a DND device, the neutralized water is filtered by a filter press and, if necessary, led over a selective ion exchanger to remove cadmium. The pH is corrected and the water is sewered. The sludge is removed as chemical waste and transported to Western Germany.

The rinsewater leaving the electroplating plant (200,000 m^3/year) has an estimated concentration of 5 - 30 mg/l of heavy metals. The final water released to the local sewer system has heavy metal concentrations far below the regulatory limits. Due to treatment of water and concentrates from outside dischargers, 600 m^3/year - 1500 m^3/year are released to the sewer system. The process was installed, as described above, at the outset of operation. These measures are not changes to the process.

5.2 Scale of Operation: Five people work in the electroplating shop. The plant capacity was not provided. Three people are employed in the water treatment unit which has a capacity exceeding 200,000 m^3/year.

5.3 Stage of Development: The plant has been operative since 1968 and has undergone only slight modifications for process improvements since then.

5.4 Level of Commercialization: All necessary components are widely available.

5.5 Material/Energy Balances and Substitutions:

The measures were installed when the plant became operational so there is no "before" situation. The electroplating shop produces 200,000 m^3/year of contaminated liquids but this amount is completely reused after purification. The sludge production is 150 tons/year of about 30% dry materials.

6.0 Economics*

6.1 Investment Costs: Investment costs include Dfl 1,700,000, of which Dfl 300,000 were from construction of buildings. Capital costs were Dfl 1,000,000. The costs of the in-process measures cannot be estimated since they were part of the original investment. These costs are from 1970. According to the company these costs would have tripled by 1986.

6.2 Operational & Maintenance Costs: Annual costs for the water purification system are as follows:

Maintenance and operation	200,000 Dfl
Energy	30,000
Chemicals, 100 tons/year	100,000
Sludge removal, 150 tons/year	50,000

6.3 Payback Time: Payback time could not be calculated.

7.0 Cleaner Production Benefits

Reusing the water saves the company about Dfl 200,000/year. Recovery of metals saves about 150,000/year based on estimates of interviewers.

8.0 Obstacles, Problems and/or Known Constraints

None were reported.

9.0 Date Case Study Was Performed: August 1986 (date of source document)

10.0 Contacts and Citation

10.1 Type of Source Material: Report based on interviews with 48 companies.

10.2 Citation: Wastewater problems in the Metal Industry: Results of Interviews with 48 Companies. Dr. Ir WH. Rulkens, TNO, Maatschappeliijke Technologie, Postbus 342, 7300 AH Apeldoorn, Netherlands. tel (055) 773 344.

10.3 Level of Detail of the Source Material:

10.4 Industry/Program Contact and Address

H. W. du Mortier
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11.0 Keywords

11.1 Waste type: Electroplating rinsewater

11.2 Process type/waste source: Electroplating, SIC 3471

11.3 Waste reduction technique: In-process measures, cascade rinsing, electrolytic recovery, silver recovery, carbon adsorption, ion exchange, wastewater treatment

11.4 Other keywords: Germany

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Electroplating Rinsewater, Electroplating, SIC 3471, In-Process Measures, Cascade Rinsing, Electrolytic Recovery, Silver Recovery, Carbon Adsorption, Ion Exchange, Wastewater Treatment, Germany

***** DOCNO: 400-101-A-262 *****

INDUSTRY/SIC CODE:	Manufacture of Fabricated Metal Products, Machinery and Equipment/ISIC 38
TECHNOLOGY DESCRIPTION:	The "Chemelec" electrolytic cell recovers pure metal from a moderately dilute static rinse. The metal is recycled directly to the plating bath as dissolving anodes. The "Chemelec" cell is an electrolytic device which economically deposits metal of high quality from solutions containing 100 to 1,000 mg/l of heavy metal. Expanded metal mesh electrodes immersed in a bed of 0.5 mm glass beads impinge on the electrodes, continually renewing the depleted boundary layer adjacent to them, and providing an enhanced rate of deposition. The cell is used to maintain an electroplating drag-out tank at a low concentration, so that metal losses into the drain or as hydroxide sludge are reduced by a factor of about 100. The recovered material is recycled directly to the plating bath as dissolving anode material.
FEEDSTOCKS:	Not reported
WASTES:	Aqueous metal-laden plating waste.
MEDIUM:	Aqueous
COST:	British Pounds
CAPITAL COST:	5,200 for a cell with steel anodes and cathodes for alkaline cyanide solution (i.e., zinc, cadmium); 8,100 for a cell with titanium cathodes and noble-metal-oxide-coated titanium anodes for acidic solution (i.e. nickel, copper)
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	The amount of hydroxide treatment sludge is reduced. This development is of great relevance to the sewage sludge disposal problems encountered in public effluent treatment.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "The "Chemelec" cell for Recycling of Metal in the Electro-plating Industry", Monograph ENV/WP.2/5/Add101.
KEYWORDS:	ISIC 38, Chemelec, Electrolytic Recovery, Electroplating

***** DOCNO: 400-127-A-334*****

HEADLINE:	Providence Method, for rinsing of electroplated parts, is designed to remove the majority of contaminating metals from the rinsewater allowing reduction of the volume of metal containing wastewaters and for recovery of the dragout.
INDUSTRY/SIC CODE:	Manufacturing of Fabricated Metal Products, Machinery, and Equipment/ISIC 3800
POLLUTION PREVENTION OPTIONS SUMMARY:	The "Providence Method" (PM) is a low-waste process for rinsing of electroplated parts. The method is designed to remove the majority of contaminating metals from rinsewater in a small volume before utilizing the conventional flowing rinse which flows at a fairly high rate to ensure good product quality. The PM tank is frequently set up as a counter-current tank in order to remove a sufficient quantity of dragout (metals). Some of the solution from this counter-current PM is used as make-up solution to raise the level in the plating tank following evaporation or excess dragout.
FEEDSTOCKS:	Rinsewaters, spent solutions from plating and cleaning operations
WASTES:	Contaminated wastewaters
MEDIUM:	Aqueous
COSTS:	
CAPITAL COSTS:	$24,000 - $89,000 (dependent on capacity of plant)
OPERATION/MAINTENANCE:	$9740 - $133,570
MONTHS TO RECOVER:	Total capital and operating costs are lower than conventional technology.
SAVINGS:	
DISPOSAL & FEEDSTOCK:	For conventional processes of equal capacities, ranges are $63,750 - $421,600 for capital costs and $26,960 - 180,430 for operating costs.
FEEDSTOCK REDUCTION:	Some make-up solution is recycled from the PM process.
WASTE PRODUCTION:	Total volume of waste requiring treatment is reduced as well as the concentration of the waste.
IMPACT:	The use of low-volume rinsing in surface finishing, and electroplating processes reduces the volume of metal containing wastewaters, and allows for recovery of the dragout. Additionally, investment and operating costs are reduced primarily due to reduced treatment costs.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, Monograph "Use of Low-volume Rinsing in surface Finishing, Electroplating Processes" ENV/WP.2/5/Add.127.
KEYWORDS:	Metal Finishing, Metal Recovery, Counter-Current Rinsing, Wastewater Treatment, Dragout, Electroplating, Providence Method, ISIC 3800

***** DOCNO: 450-012-A-001*****

1.0 Headline: Quebec Electroplating Company Decreases Effluent and Saves Money on Chemical and Treatment Costs

2.0 SIC Code: 3471

3.0 Name and Location of Company

Galvano
Saint-Mathieu-de-Beloeil, Quebec

4.0 Clean Technology Category: This technology involves wastewater reduction, process/equipment modification, and waste segregation/separation.

5.0 Case Study Summary

5.1 Process and Waste Information

Because of elevated levels of zinc found in the groundwater surrounding Galvano's factory, the owners decided to implement a new system in 1981 to treat the wastewaters from this electroplating company. They decided to implement a system that would decrease the amount of effluent while incorporating a treatment system that would precipitate metals out of the effluent. In order to decrease the volume of the waters to be treated, the company separated refrigeration waters from the contaminated effluent. This action alone decreased the amount of waters to be treated from 810 to 270 liters/min. A system of counter-current rinsing was put in place to further decrease the volume of effluent. Also, deflectors were positioned between the acid and alkaline basins to recover drippings from metals pieces so that the liquids could be returned to their respective solutions. Using counter-current rinsing and the deflectors decreased water usage from 270 liters/min. to 100 liters/min. The decrease in water consumption resulted in savings of $20,000. Total reduction in the effluent volume was 87%. By eliminating and reorganizing the rinsebaths, the company was able to rearrange enough space to add more plating lines and increased production by 100%.

The company realized, however, that a reduction in the volume of effluents didn't necessarily mean that the contamination of these waters would be decreased. By centrifuging the basket where "hot zincing" takes place and by increasing the time between cleanings by 50%, the company was able to recover 1 ton of zinc/day and save $1,000/day. By using a special pump to adjust the levels of water in the rinsebaths, the concentration of contaminants was able to be controlled. This action conserved mineral salts necessary to the process and decreased the amount of zinc and potassium chloride and boric acid used. Also, the company's normal sand filtering system was replaced by another in which more filters were added to decrease the cumber of times the rinsebaths needed cleaning and decreased the number of chemicals needed to maintain the baths. The pumping system and the new filters enabled the company to save $28,000/year in chemical costs. This decrease in chemicals decreased the amount of residual sludge which saved $20,000/year in treatment costs. Total treatment cost savings were approximately $70,000/year due to a 10% reduction in sludge. Total cost savings were approximately $368,000/year due to the decrease in the amount of effluent and increase in the capture of metals. The company was also able to increase its production by 100%.

5.2 Scale of Operation: Galvano operates 24 hours/day and employs about 50 people. It is the most productive electroplating plant in Quebec, plating approximately 2,500 tons/year of bolts, screws, nails, and similar products.

5.3 Stage of Development: This technology was fully implemented at the time of this case study.

5.4 Level of commercialization: This technology was commercially available at the time of this case study.

5.5 Material/Energy Balances and Substitutions

Quality of Effluent

Chemicals	Before Treatment mg/l	After Treatment mg/l	Standards mg/l
Cr	.91	.1	1
Zn	500	.69	1
H and G	215	4.6	15
Fe	100	1.0	17
pH	1.0-8.0	7.5-8.5	5.5-9.5

6.0 Economics*

6.1 Investment Costs: Information not provided.

6.2 Operation and Maintenance Costs: Operation and maintenance costs were not provided.

6.3 Payback Time: With the system fully implemented, payback starts immediately.

7.0 Cleaner Production Benefits: Savings in chemical and treatment costs are as follows:

Technology		Savings
1) Decreasing consumption of water		$20,000
2) Decreasing consumption of chemical products		$28,000
3) Reduction of contaminated sludges		$20,000
4) Recovering zinc and increasing the period between cleanings of baskets		$300,000
	Total	$368,000

It is assumed that costs were reported in Canadian dollars.

Production was increased by 100% after rinse baths were eliminated or reorganized. The company is now in compliance with the effluent standards of Quebec.

8.0 Obstacles, Problems and/or Known Constraints: Information not provided

9.0 Date Case Study Was Performed: The case study was performed in 1981.

10.0 Contacts and Citations

10.1 Type of Source Material: Report

10.2 Citation: Secteur Revetement de Surface, Technologies Propres, Electrogalvanization et zingage a chaud, Gouvernement de Quebec, Ministre de l'Environnement, Gestion et Assainissement des Eaux, revised June 1988. Source document is in French.

10.3 Level of Detail of the Source Material: More detail is provided about the general process of electroplating.

10.4 Industry/Program Contact and Address: Regional offices, addresses and phone numbers are given on the back of the report.

10.5 Abstractor Name and Address: Blair M. Raber, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA, 22043.

11.0 Keywords

11.1 Waste Type: Electroplating rinsewater, Acidic Wastewaters, Alkaline Solution, Zinc.

11.2 Process Type/Waste Source: Electroplating, Plating and Polishing, Rinsate, Sludge, Zinc Galvanization.

11.3 Waste Reduction Technique: Counter-Current Rinsing, Metal Recovery, New Equipment, Process Modification, Pumps and Pumping Equipment, Volume Reduction, Wastewater Reduction, Source Reduction, Drip Confinement, Sand Filter.

11.4 Other Keywords: Bolts, Nuts, Screws and Rivets; Increased Productivity, Metal Products.

(*) Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Electroplating Rinsewater; Acidic Wastewaters; Alkaline Solution; Zinc; Electroplating; Plating and Polishing; Rinsate; Sludge; Zinc Galvanization; Counter-Current Rinsing; Metal Recovery; New Equipment; Process Modification; Pumps and Pumping Equipment; Volume Reduction; Wastewater Reduction; Source Reduction; Drip Confinement; Sand Filter; Bolts, Nuts, Screws and Rivets; Increased Productivity; Metal Products

FERTILIZER

***** DOCNO: 400-010-A-201 *****

INDUSTRY/SIC CODE:	Fertilizer Industry, Nitric Acid Production/ISIC 3512
NAME/CONTACT:	National Authority for Environmental Protection and Nature Conservation - Veszprem University of Chemical Engineering -Nitrogen Works Pet, Hungary
TECHNOLOGY DESCRIPTION:	The company uses a pressurized process with catalytic end-gas reduction (GIAP). This includes: Oxidation ammonia - oxidation HO - absorption NO_x - catalytic end-gas reduction. End gas 3.300 m^3 with NO_x content (vol. %) 0.1 - 0.15 (The conventional process produces an end-gas with an NO_x content (vol.%) of 0.2 - 0.4) Acidic wastewater effluent of 1-3 m^3/day with NO_3 - content of 5g/1. (The wastewater volume from the conventional process is about 5-15 m^3/day.) End-gas amounting to 4.100 NH_3/ton of HNO_3 with an NO - content (vol %) of 0.005 per cent, CO-content of 0.1 per cent, and CO_2 - content of 2.5 percent.
FEEDSTOCKS:	Not reported
WASTES:	Not reported
MEDIUM:	Not reported
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Dramatically reduced energy consumption, but dramatically increased catalyst consumption. Stack gases and waste heat increase but wastewaters are decreased significantly.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Comparison Between Conventional and Low-Waste Nitric Acid Production Technologies", Monograph ENV/WP.2/5/ Add.10.
KEYWORDS:	Nitric Acid, ISIC 3512, Fertilizer, End Gas Reduction

***** DOCNO: 400-048-A-237 *****

INDUSTRY/SIC CODE:	Manufacture of Fertilizers and Pesticides/ISIC 3512
NAME/CONTACT:	Zentrum Fur Umweltgestaltung Schnellerstrasse 140 DDR - 1190 Berlin German Democratic Republic
TECHNOLOGY DESCRIPTION:	The company performs continuous absorption of fluorine - containing waste gas. This low-waste technology is a continuous method for absorption of SiF_4 from waste gas of the phosphate-fertilizer industry. It works upon the principle of turbogrid absorption. In an absorption tower, the waste gas is cleaned of fluorine streams through several, specifically-designed turbogrid trays, one after the other. These turbogrid trays are sprayed with aqueous hexafluorosilicic acid. In the turbogrid trays, stable dynamic bubbling layers develop which offer a big mass-transfer surface for the absorption.
FEEDSTOCKS:	Waste gas of the phosphate fertilizer industry (especially superphosphate industry)
WASTES:	Purified waste gas
MEDIUM:	Not reported
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	The quantity of filter-wet sludge amounts to approximately 30 kg per 1 metric ton of P_20_5 superphosphate (20 percent solids - SiO_2; 80 percent adhesive liquids - some 10 to 15 percent H_2SiF_6, remainder H_2O). With low-waste technology there is a discharge of 20 to 30 mg/m^3 purified waste gas, whereas the conventional technology had 1,000 mg f/m^3.
IMPACT:	Prior to the introduction of turbogrid absorption of fluorine-containing waste gas, the superphosphate factories of the German Democratic Republic applied conventional spray-roll chambers for depositing SiF_4 from waste gas. These chambers had the disadvantages of discontinuous operation and of a maximum efficiency of 90 percent due to limited contact surface; thus up to 1,000 mg F/m^3 were emitted. In order to maintain even this inadequate efficiency, frequent and very high manual cleaning expenditures were required for regularly removing the silicic acid deposited in the chambers which became extremely hard.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Continuous Absorption of Fluorine-Containing Waste Gas", Monograph ENV/WP.2/5/Add.48.

KEYWORDS: Fertilizer, Absorption, ISIC 3512

***** DOCNO: 400-011-A-202 *****

INDUSTRY/SIC CODE:	Complex Fertilizer or NP/NPK industry/ISIC 3512
NAME/CONTACT:	Horsl: Hydro a.s, P.O. Box 2594 Solli, Oslo 2 - Norway
TECHNOLOGY DESCRIPTION:	The company uses the Nitrophosphate (ODDA) process with conversion of calcium nitrate and recirculation of nitrogen and phosphorous effluents. The nitrophosphate process includes nitric acid digestion of phosphate rock and deep cooling precipitation of calcium nitrate with subsequent conversion into fertilizer products. The nitrophosphate process includes the use of waste CO_2 from an NH_3 plant and avoids the use of sulfur. 1.1 tons of steam and 35 kg of oil is saved per ton of P_20_5 by this process. A wide range of commercial phosphate rocks may be used in the process. The Norsk Hydro Nitrophosphate products are not subject to self-sustaining decomposition.
FEEDSTOCKS:	Not reported
WASTES:	Not reported
MEDIUM:	Not reported
COST:	
CAPITAL COST:	$1,000,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	The Nitrogen efficiency of the process is 98-99 per cent, the P_20_5 efficiency better than 99 percent and the K_20 efficiency better than 99.8 percent.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Production of NPK Fertilizers Through the Nitro-Phosphate (ODDA) Process with Conversion of Calcium Nitrate and Recirculation of Nitrogen and Phosphorous Effluents", Monograph ENV/WP.2/5/Add.11.
KEYWORDS:	Fertilizer, ISIC 3512, Nitrophosphorous, Urea, Ammonia

***** DOCNO: 400-062-A-243 *****

INDUSTRY/SIC CODE:	Fertilizer Industry/ISIC 3512, SIC 2873
TECHNOLOGY DESCRIPTION:	NPK fertilizers, a nitro-phosphate type fertilizer, is produced through the Norsk-Hydro-ODDA technology. This technology has been modified to incorporate an effective wastewater evaporator system which reduces the amount of contaminated cooling water discharge. The wastewater passes through a series of evaporation steps whereby the vapors are used as wash water in the calcium carbonate filters and the concentrated solution is pumped to the neutralizers where it is mixed with the acidic NP solution and used to regulate the N/P_2O_5 nutrient ratio of the fertilizer. Through this modified technology, steam and electric energy consumption increases somewhat but such increases are balanced by the more effective utilization of nitrogen and the reduction of the wastewater stream discharge.
FEEDSTOCKS:	Phosphate rock, Ammonia, Nitric Acid, Potassium Chloride
WASTES:	Wastes produced include wastewater, NH_4NO_3, SiF_4, NH_3 and flue gas.
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	50 million forints
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	
FEEDSTOCK REDUCTION:	Savings in raw materials and water are five times grater than the added cost of steam and energy.
WASTE PRODUCTION:	Eliminates wastewater discharge
IMPACT:	The evaporator, used for the elimination of wastewater, can also be applied for the reduction of waste streams of low salt concentration in various sectors of the chemical industry.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Wastewater Evaporation Process For Fertilizer Production Technology", Monograph ENV/WP.2/5/Add62.
KEYWORDS:	Fertilizer, Ammonium Vent Gas, ISIC 3512, SIC 2873, Wastewater Evaporation

***** DOCNO: 400-029-A-218 *****

INDUSTRY/SIC CODE:	Fertilizer Industry/ISIC 3512
NAME/CONTACT:	Ministere de l' Environment et due Cadre de Vie Direction de la Prevention des Pollutions 14 Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France August 1980
TECHNOLOGY DESCRIPTION:	The company performs ammonium nitrate synthesis accompanied by recovery and recycling of the ammonia contained in the vapor. The synthesis of ammonium nitrate is carried out in both techniques through a nitric acid reaction on the ammonia. When the reaction takes place, vapor is formed, containing a small amount of ammonia. Whereas in the formerly used process the vapor was discharged, it is now washed in nitric acid, which permits recovery and recycling of the ammonia that it contains.
FEEDSTOCKS:	Ammonia
WASTES:	Vapor containing nitrate and ammonia.
MEDIUM:	Vapor
COST:	(1976 Francs)
CAPITAL COST:	F 350,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Reduced production of waste nitrogen by 75%.
IMPACT:	Reduced waste nitrogen production and reduced virgin ammonia requirements.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recovery and Recycling of Ammonia Contained in Gases from Ammonium Nitrate Production", Monograph ENV/WP.2/5/Add 29).
KEYWORDS:	Ammonium Nitrate, ISIC 3512, Recovery

FOOD

***** DOCNO: 400-043-A-232 *****

INDUSTRY/SIC CODE:	Food and Fermentation Industries/ISIC 3111, 3112, 3113, 3114, 3118, 3131, 3132, and 3133
NAME/CONTACT:	AB Sorigona Box 139, S-24500 Staffenstorp, Sweden
TECHNOLOGY DESCRIPTION:	Wastewaters from the industry are treated with anaerobic microorganisms for recovery of methane. The water treated in this way is then treated with aerobic microorganisms for achieving a very good effluent quality. The aerobically-produced excess biosludge is recycled back to the anaerobic step. The recovery of methane is about 300 l/kg COD treated.
FEEDSTOCKS:	Industrial effluents containing large amounts of biodegradable organic material (e.g., wastewaters from food and fermentation industries).
WASTES:	Crude digestion gas, small amounts of excess sludge.
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "The Ahamet Process for Wastewater Purification", Monograph ENV/WP.2/5/Add.43.
KEYWORDS:	Activated Sludge, Methane, Ahamet Process, ISIC 3111

***** DOCNO: 453-001-A-000 *****

1.0 Headline: Recovery and use of methane from sugar beet processing effluent

2.0 SIC Code: SIC 2063, Beet Sugar

3.0 Name and Location of Company:

British Sugar plc
Oundle Road
Peterborough PE2 9QU, England

4.0 Clean Technology Category:

This technology uses an anaerobic stage to recover methane from sugar beet effluent for use as a process fuel.

5.0 Case Study Summary

5.1 Process and Waste Information: The facility processes sugar beets generating a wastewater effluent with a high chemical oxygen demand. Traditionally, this effluent was dealt with aerobically by a water treatment plant and its organic content wasted. The clean technology was to add an anaerobic stage to the water treatment section to convert the organic content of the effluent to usable methane. The fermentation takes place in the digestion vessel, the off-gas consists largely of methane with some carbon dioxide. Key features of the process are the pre-heating of the incoming stream using low-grade heat, careful control of the pH and the recirculation of sludge. The methane provides process heat to dry the pulp for use as an animal feed.

5.2 Scale of Operation: British Sugar operates 12 beet factories and employs 3,000 people. The Peterborough facility produces 100,000 tons of sugar per year.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: No information provided.

5.5 Material/Energy Balances and Substitutions: No information provided.

6.0 Economics:* It is assumed that the economics cited in the source document are on a per plant basis and not the total of all 12 British Sugar plants.

6.1 Investment Costs: The capital cost of the technology is 750,000 English Pounds.

6.2 Operational and Maintenance Costs: Annual savings in lower sewage charges are 26,000 English Pounds and 8,000 English Pounds in electricity cost savings. The value of recovered gas is 25,000 English Pounds.

6.3 Payback Time: Payback time is 12 years.

7.0 Cleaner Production Benefits

The technology resulted in reduced chemical oxygen demand in the wastewater effluent. Recovery and use of methane from organic matter in the wastewater effluent were achieved. Lower operating costs and energy conservation were added benefits of the technology.

8.0 Obstacles, Problems and/or Known Constraints

None were identified.

9.0 Date Case Study Was Performed

Unknown

10.0 Contacts and Citation

10.1 Type of Source Material: Government Publication.

10.2 Citation: Clean Technology, Environmental Protection Technology Scheme, Department of the Environment, 2 Marsham Street, London SW1P 3EB, 1989, p. 21.

10.3 Level of Detail of the Source Material: No additional detail is provided.

10.4 Industry/Program Contact and Address: Mr. J.N. Smith, Chief Safety and Environment Officer, British Sugar plc, Oundle Road, Peterborough PE2 9QU, England, Telephone (0733) 63171.

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Chemical oxygen demand, wastewater effluent, sugar beet processing effluent

11.2 Process type/waste source: Sugar products, agricultural processing

11.3 Waste reduction technique: Anaerobic digestion

11.4 Other keywords: Methane, United Kingdom, SIC 2063

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Chemical Oxygen Demand, Wastewater Effluent, Sugar Beet Processing Effluent, Sugar Products, Agricultural Processing, Anaerobic Digestion, Methane, United Kingdom, SIC 2063

***** DOCNO: 400-041-A-230 *****

INDUSTRY/SIC CODE:	Food Industry/ISIC 3118
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14 Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company demineralizes beet juice with valorization eluates. The demineralization eluates are separated from the other effluents. After having been homogenized, these eluates are concentrated by evaporation and then crystallized. Centrifugation permits the separation of salts that are marketed as fertilizer and the mother liquor, rich in proteins, that is marketed for animal feed.
FEEDSTOCKS:	Beet juice, salt
WASTES:	Not reported
MEDIUM:	Not reported
COST:	(1973 Francs)
CAPITAL COST:	F 3.0 million
OPERATION/MAINTENANCE:	12 Francs/ton demineralized beets
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	This process is more reliable than a standard purification process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Demineralization of Beet Juice with Re-Use of Eluates", Monograph ENV/WP.2/5/Add.41.
KEYWORDS:	Foodstuff, Beets, Demineralization, ISIC 3118

***** DOCNO: 400-049-A-238 *****

INDUSTRY/SIC CODE: Manufacture of Food, Beverages and Tobacco/ISIC 31

NAME/CONTACT:
Ministere de l'Environnement
Direction de la Prevention des Pollutions
14 Boulevard du General Leclerc
92522 Neuilly-sur-Seine Cedex, France

TECHNOLOGY DESCRIPTION: The company treats sauerkraut juice resulting from fermentation and production of yeast on this effluent. Both techniques use the same method for the production of sauerkraut: after paring, the cabbage is shredded, salted, and stored in seven ton fermentation vats for three weeks. The sauerkraut is then ready for canning.

After fermentation, there is an overflow from each vat of about 500 liters of brine, rich in lactic acid and oxidizable matter. In the standard technique, the brine is first lime-neutralized and then rejected. In the low-waste technology, the brine is fermented, centrifuged and rejected. At the time of centrifugation, yeast cream is recovered for drying.

FEEDSTOCKS: Sauerkraut juice (brine)

WASTES: Waste brine containing oxidizable matter.

MEDIUM: Aqueous

COST:
CAPITAL COST: Not reported
OPERATION/MAINTENANCE: Not reported
MONTHS TO RECOVER: Not reported

SAVINGS:
DIRECT COST: Not reported
FEEDSTOCK REDUCTION: Not reported
WASTE PRODUCTION: The quantity of waste is almost the same with either technology: 74 liters per ton of sauerkraut with the low-waste technology versus 75 liters with the standard technique. The biochemical oxygen demand is 0.25 kg versus 2.6 kg; chemical oxygen demand: 1 kg versus 4.1 kg; lactic acid: 0.03 kg; phosphorous: 1.5 g versus 21.8 g.

IMPACT: In the standard technology the lactic acid is neutralized by lime. In the low-waste technology, wastes are deacidified with yeast and no longer require lime-neutralization.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Treatment of Juice from Sauerkraut Fermentation and Production of Yeast in this Effluent", Monograph ENV/WP.2/5/Add.49.

KEYWORDS: Foodstuff, Fermentation, Brine, ISIC 31

***** DOCNO: 400-084-A-255*****

INDUSTRY/SIC CODE:	Food Manufacturing/ISIC 311
TECHNOLOGY DESCRIPTION:	Extraction of potato starch without water washing of the finely divided potatoes. The potatoes are separated into solid and liquid phases, which are then processed independently.
FEEDSTOCKS:	Five tons of potatoes, 0.2 GJ of electric power and 0.1 GJ in the form of steam, per ton of potato powder.
WASTES:	Wastewater
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	0.2 million rubles for new process.
OPERATION/MAINTENANCE:	380 rubles per ton of potato powder.
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	0.4 million rubles in initial investment, due to need for water-treatment station in conventional process. 150 rubles savings per ton of starch produced due to reduced operating costs.
FEEDSTOCK REDUCTION:	None
WASTE PRODUCTION:	In the low-pollution technique, the water required is 3.5 m^3 per ton of end-product compared to 14.5 m^3 in the conventional process.
IMPACT:	Elimination of wastewater generated from wash water and internal vegetation water in the standard starch process. In the low-pollution process of potato powder production, one obtains undiluted potato cell fluid which undergoes direct processing.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Dry Extraction of Potato Starch Substitute", Monograph ENV/WP.2/5/Add84.
KEYWORDS:	Wastewater Treatment, Food Processing, Potato, Starch, ISIC 311

***** DOCNO: 400-039-A-228 *****

INDUSTRY/SIC CODE:	Food Industry/ISIC 3121
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company performs extraction of potato starch with recovery and valorization of proteins in internal vegetation water. Coagulation followed by centrifugation of the proteins contained in the internal vegetation water permits them to be separated from the water whereas with the standard technique the vegetation water, still full of proteins, was discharged into the river after having been stored for a month.
FEEDSTOCKS:	Internal vegetation water
WASTES:	Wash water and manufacturing water.
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	FF 8.6 million
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	The discharge flow, 17.5 m^3/ton of potato starch, remains the same, but the pollution is reduced by about 40 per cent. The biochemical oxygen demand is 70 kg/ton and the chemical oxygen demand is 145 kg/ton compared to 120 kg/ton and 205 kg/ton, respectively, in the standard process.
IMPACT:	Although this technique is already operational it may still undergo improvements that will permit an increase in the efficiency of the recovery and valorization of the products recovered.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Extraction of Potato Starch with Recovery and Use of Proteins in Internal Liquid", Monograph ENV/WP.2/5/Add.39.
KEYWORDS:	Foodstuff, ISIC 3121

***** DOCNO: 400-035-A-224 *****

INDUSTRY/SIC CODE: Manufacturing of Foodstuffs, Drinks and Tobacco/ISIC 3113

NAME/CONTACT: Ministere de l'Environnement et du Cadre de Vie
Direction de la Prevention des Pollutions
14, Boulevard du General Leclerc
92521 Neuilly-sur-Seine Cedex, France

TECHNOLOGY DESCRIPTION: In the low pollution technique the washed tubers are peeled in an peeling-machine composed of abrasive rolls, with water. The wastewater containing peelings is filtered and recycled at the peeling stage. The filter contains only peelings of less than 5 mm and it is periodically cleaned.

In the standard technique the washed tubers are dipped into a soda solution, then peeled and dipped into a citric acid solution for neutralization.

In the low pollution technique, material requirements are substantially reduced: water needs are down from 25 m^3 to 5 m^3 per ton of tubers treated, no soda is used (as opposed to 10 kg/ton) and citric acid use is down from 6 kg per ton in the standard technique to 1 kg per ton.

FEEDSTOCKS: Fruits and vegetables

WASTES: Fruit and vegetable peelings

MEDIUM: Not reported

COST:
CAPITAL COST: Not reported
OPERATION/MAINTENANCE: Not reported
MONTHS TO RECOVER: Not reported

SAVINGS:
DIRECT COST: Not required
FEEDSTOCK REDUCTION: Water requirements reduced by 20 m^3/ton of tubers, reduced citric acid usage, and eliminates soda usage.
WASTE PRODUCTION: The wastes produced by the low pollution technique are made of tuber wastes and citric acid which are contained in the water discharged. Peelings retained by the filter are sent for dumping. For each ton of tubers treated, 5 m^3 of wastes are produced, which contain 15 kg of tuber wastes and 1 kg of citric acid; 170 kg of peelings are sent for dumping.

IMPACT: Apart from pollution reduction, the low pollution technique ensures an improved output, higher quality of products, and a reduction in raw materials.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Mechanical Peeling of Vegetables/Fruits", Monograph ENV/WP.2/5/Add.35.

KEYWORDS: Foodstuff, Abrasives, ISIC 3113

***** DOCNO: 400-050-A-239 *****

INDUSTRY/SIC CODE:	Manufacture of Food, Beverages and Tobacco/ISIC 31
NAME/CONTACT:	Ministere de l'Environnement Direction de la Prevention des Pollutions 14 Boulevard du General Leclerc 92522 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company produces lactoserum powder with recovery of powder and heat from the discharged air. In both techniques, the lactoserum is injected into the drying tower where hot air(180°C) circulates. The lactoserum is recovered at the tower base. The outgoing hot air, loaded with powder, is used for pre-heating the incoming air and then washed with enriched hot lactoserum in order to recover lactoserum particles. With the standard technique, the air simply goes through two hydrocyclones and is discharged hot and heavily loaded with particles.
FEEDSTOCKS:	Liquid lactoserum
WASTES:	Emissions to the atmosphere have the following characteristics: particles: 3 kg per ton of powder (versus 10.5 kg). Temperature: 45°C (versus 87° C).
MEDIUM:	Air
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Production of Lactoserum Powder with Recovery of Powder and Heat from Discharged Air", Monograph ENV/WP.2/5/Add.50.
KEYWORDS:	Foodstuff, Lactoserum, ISIC 31

***** DOCNO: 400-051-A-240 *****

INDUSTRY/SIC CODE:	Manufacturing of Food, Beverages and Tobacco/ISIC 31
NAME/CONTACT:	Ministere de l'Environnement Direction de la Prevention des Pollutions 14 Boulevard du General Leclerc 92522 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company manufactures preserved patés with recovery of fats by centrifugation. Pork fats are cooked in water circulating in a closed circuit. The cooking water which is normally rejected every day, is centrifuged. Other liquid effluents from washing equipment, floors, etc., go through a fat separator. In the standard technology there is no centrifuge. Polluted water is discharged from the fat separator.
FEEDSTOCKS:	Not reported
WASTES:	Wastewater from the fat separator.
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	The water resulting from cooking is equal to 285 liters per ton of paté, containing: 2 kg of fats; biochemical oxygen demand, 3.5 kg; chemical oxygen demand, 8 kg (versus respectively, 285 liters, 10 kg, 10 kg, 20 kg with the standard technology).
IMPACT:	
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Manufacture of Preserved Patés with Recovery of Fats by Centrifugation", Monograph ENV/WP.2/5/Add.51.
KEYWORDS:	Foodstuff, Fat Recovery, Centrifugation, ISIC 31

***** DOCNO: 400-078-A-311*****

HEADLINE:	Recovery of animal fats reduces wastewater generation by 90% and reduces energy costs.
INDUSTRY/SIC CODE:	Manufacture of Food, Beverages and Tobacco/ISIC 31
POLLUTION PREVENTION OPTIONS SUMMARY:	Manufacture of fats by continuous melting process with recovery of fats and protein from wastewater. Tallow is ground and melted in a steam-fed melting pot. Extracted fats are refined. Process water is treated in a concentrator to further recover fats and proteins. Concentrates are dehydrated and together with the grease can be sold as animal feed. The evaporated process water is condensed before being reused. In the standard technology, the process wastewater is degreased, processed through a florentine flask, and discharged.
FEEDSTOCKS:	Water, steam, tallow
WASTES:	Wastewater
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	FF 795,000 (1979 figures)
OPERATION/MAINTENANCE:	FF 14 per ton of tallow (1979 figures)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	200 liters of water per ton of tallow.
WASTE PRODUCTION:	For each ton of tallow processed, the wastewater generation is reduced from 500 l for the standard technology to 50 l for the modified technology. The energy required for processing wastewater with the modified process is 670 MJ versus 21 MJ with the standard process. Also, with the low-waste technology, it is possible to recover 5.7 kg of proteins per ton and 3 kg of animal fats per ton of tallow.
IMPACTS:	The volume and the quality of wastewaters in terms of BOD and COD concentrations are improved significantly by the modified process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Manufacture of Fats by Continuous Melting with Recovery of Fats and Proteins from the Wastewater", Monograph ENV/WP.2/5/Add.78.
KEYWORDS:	Food Processing, Fat Recovery, Condensates, Wastewater, ISIC 31

***** DOCNO: 452-002-A-000 *****

1.0 Headline: Disposal of Wastewaters and Decreased Water Requirements are Achieved Through Conservation, Recycling and Process Modification in Dairy Operations

2.0 SIC Code: 2202 Cheese Manufacturing

3.0 Name & Location of Company: General information presented with no mention of specific companies or facilities.

4.0 Clean Technology Category

Technology Principle: This technology involves minimizing water consumption and subsequent wastewater production through onsite conservation and recycling while also increasing productivity.

5.0 Case Study Summary

5.1 Process and Waste Information: This new waste technology is concerned with water, which is a universal solvent in many processes and subsequently becomes an environmental problem. This technology focuses on eliminating the need for new water in a process by recycling water into the process and minimizing consumption. Cheese manufacturing was the example presented. Cheese manufacture produces two wastewater streams: the whey and the water from cleaning the plant. Whey can go to an ultrafiltration plant to produce protein and permeate powder and wastewater can be recycled. Total recycle begins with good preparation including initial treatment of water to remove any contaminants such as hardness, inorganic or organic substances through hyperfiltration, and a complete clean out of the plant to eliminate on-site contaminants (i.e., left-over bacteria).

The process water is conserved by installing better-built pumps, i.e., better glands and bearings independent of the motor, preventing release onto the floors. Discontinuous operation is replaced with continuous operation which serves to increase water economy with minimum storage capacity required. In addition, production increases with less investment. Plants must be set up or run to ensure that total shut-down is not required for clean-up, and a phased clean-up can be effectually conducted with all flush water being reused or directed to ultrafiltration plants which recover almost all internal protein as product.

The final step is to acknowledge that no stream is a waste stream and must be handled in sanitary way. Stream segregation is important as it permits less complicated treatment or regeneration processes. In a dairy plant wastewater streams contain thermophilic and spore-forming microorganisms and recirculation of this water can only be achieved if organism build-up prevention is practiced. Necessary precautions require that water be stored with cleaning agents to prevent the growth of such organisms or be stored with a very low content of BOD and nutrients. BOD and nutrients can be removed through the use of hyperfiltration. Cleaning agents are also necessary. Nitric and phosphoric acids and sodium hydroxide, and some complexing agents can all be recovered (except what has been neutralized), and ultrafiltration of these agents is a good way to remove proteins for animal feeds.

It was mentioned that these strategies have been introduced successfully into a pulp and paper factory in Kai Shan Tun in the Jilin Province in China. This plant recovers lignosulphonate from sulfite liquor using ultrafiltration. The lignosulphonate is used for paper gluing.

5.2 Scale of Operation: Specific plants or facilities were not mentioned however, the example given represented a commercial cheese manufacturing process line.

5.3 State of Development: This technology is fully developed.

5.4 Level of Commercialization: The example given represented a commercial cheese manufacturing run.

5.5 Balances and Substitutions: Water is treated before use and is conserved and regenerated throughout the cheese manufacturing process to effectively reduce the amount of new water required and eliminate wastewaters requiring disposal.

Specific amounts were not given.

6.0 Economics: The investment costs in a dairy operation where wastewaters are not produced are higher than those of a conventional process (due to hyperfiltration plants etc.) however, advantages include: almost all product ends up as valuable product; most cleaning chemicals are recovered; the amount can be reduced to 20-30% of the normal consumption; water consumption is minimized; no money is spent for wastewater treatment.

6.1 Investment Costs: Specific investment costs were not reported, although it was mentioned that investment costs for nonwastewater dairy plants were higher than conventional dairy plants.

6.2 Operational and Maintenance Costs: Specific costs were not mentioned; however, it can be assumed that savings can be realized with the reduction of cleaning agents and required water due to conservation and recycling, as well as, a reduction in wastewater treatment costs. Profit is also realized in the production of permeate powder and proteins from the hyperfiltration plants.

6.3 Payback Time: Payback time was not discussed although the benefits of recycling can be seen immediately.

7.0 Cleaner Production Benefits

Economic benefits are seen in a reduction of cleaning agents and water purchased, the production of proteins and permeate powder, a reduction in wastewater disposal costs, and an increase in productivity due to increased operating hours.

Regulatory compliance is easier with significantly reduced volumes of waste requiring hazardous waste disposal.

8.0 Obstacles, Problems and/or Known Constraints

The buildup of thermophilic and spore forming microorganisms in plant waters is a problem and must be controlled through additives and controlled storage. Water must be treated prior to use to eliminate the introduction of contaminants into plant waters.

9.0 Date of paper preparation was not provided.

10.0 Contacts and Citation

10.1 Type of Source Material: Paper presented at a Non-waste technology symposium held in Finland.

10.2 Citation: Madsen, Erik Rud, "Water and Raw Materials for Non-Waste Technology Processes", Technical Research Center of Finland, Espoo Finland, June 20-23, 1988, (51-62).

10.3 Level of Detail of Source Material: Source material was designed to present general strategies rather than specific technical information.

10.4 Industry/Program Contact and Address: Rud Erik Madsen, A/S De Danske Sukkerfabrikker, Nakskov, Denmark.

10.5 Abstractor and Address: Susan Wojnarowski, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043

11.0 Keywords:

11.1 Waste Type: Wastewater, Rinsewater, Whey

11.2 Process Type/Waste Source: Cheese manufacturing, SIC 2202

11.3 Waste Reduction Technique: Reclamation, Recovery, Rinsewater Reuse, Spill Control, Conservation, Filtration, Process Control.

11.4 Other Keywords: Hyperfiltration Plant, Denmark

Keywords: Cheese Manufacturing, SIC 2202, Reclamation, Recovery, Rinsewater Reuse, Denmark

***** DOCNO: 450-010-A-001 *****

1.0 Headline: Cheese Manufacturer Chooses Source Reduction Over Implementing A Secondary Biological Treatment System To Comply With Effluent Standards

2.0 SIC Code: 2022

3.0 Name and Location of Company

La Fromagerie de la Cooperative Agropur, Fromagerie d'Oka, Oka, Quebec, Canada

4.0 Clean Technology Category: This technology involves a facility-wide reorganization and modification of every step of cheese production.

5.0 Case Study Summary

5.1 Process and Waste Information: The production of cheese at La Fromagerie is divided into 5 stages. All of these stages were scrutinized and ways were found to decrease the amount of pollution at all levels of production.

*Milk Receiving: In order to eliminate the wasting of milk in the storage silos, a squeegee is used to squeeze out the excess. In addition, high-powered water jets reduce the amount of water used to clean the equipment.

*Pasteurization: To eliminate the wasting of milk and to decrease the volume of washing and disinfecting solutions, the company adjusted the dimensions of the stopper and the pasteurizer to allow pasteurization to occur in the tubs on a continual basis.

*Cheese making: To recover minute particles of cheese, cotton filters were used. To recover cheese from the floor, rubber scoops and brooms were used. To recover residues of cheese from the cleansing process, they are scooped up by hand. To reduce the rinsewaters and disinfection solutions in the food conduit from the tables, fixed conduits were replaced with rotary conduits. To recover lactoserum from the first rinsing of the conduits, the stock reservoirs are pumped. To recover milk and the rinses of the food conduits from the tubs, a conductivity meter is used.

*Molding the Cheese: To recover lactoserum, collection pipes are used.

*Disinfection: To eliminate phosphorous, products containing phosphorous were not used.

5.2 Scale of Operation: Not Available

5.3 Stage of Development: This technology is fully implemented and the quantitative figures noted throughout the text are based on actual production.

5.4 Level of Commercialization: This technology is fully commercialized.

5.5 Material/Energy Balances and Substitution

Material Category	Before	After
Purity of effluent	80%	98%
Reduction in Phosphorous Loss	N/A	93%
Loss of Milk	9%	2%

Recovering fine particles of cheese	0	50 kg/day

6.0 Economics*

6.1 Investment Costs: The company had a choice between implementing a secondary biological treatment system or reducing pollutants at the source. By choosing source reduction, the company saved $270,000 as illustrated below.

	Secondary Biological Treatment	Source Reduction
Capital Costs	$350,000	$80,000
Operation Costs	$20,000	$0
Energy Costs	$6,250	$0

6.2 Operational and Maintenance Costs: Since the changes made are at the source and are one-time changes, there are no operation costs.

6.3 Payback Time: Not Available

It is assumed cost data was reported in Canadian dollars

7.0 Cleaner Production Benefits: This process dramatically reduced the amount of pollutants in the effluent and increased production since cheese that would otherwise have been lost is reclaimed and put back into the manufacturing process.

8.0 Obstacles, Problems and/or Known Constraints: Not Available

9.0 Date Case Study Was Performed: These pollution prevention measures were initiated in 1985.

10.0 Contacts and Citation

10.1 Type of Source Material: Report

10.2 Citation: Secteur Agro-Alimentaire, Technologies Propres, Production Fromagere, Gouvernement du Quebec, Ministre de l'Environnement, Gestion et Assainissement des Eaux, Revised June 1988. Source document is in French.

10.3 Level of Detail of the Source Material: More detail is provided about the cheese industry in Quebec and diagrams illustrate how the equipment is used differently before and after the changes.

10.4 Industry/Program Contact and Address: Regional offices, addresses, and phone numbers are given on the back of the report.

10.5 Abstractor Name and Address: Blair M. Raber, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043

11.0 Keywords

11.1 Waste Type: Dairy wastes

11.2 Process Type/Waste Source: Cheese, Agriculture, Food and Kindred Products, and Food Products.

11.3 Waste Reduction Technique: Alternatives Evaluation, Food Processing, Food Preparations, Lactoserum recovery, filtration, material conservation.

11.4 Other Keywords: Canada, Increased Productivity, Increased Efficiency, Process Efficiency.

(*) Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Dairy Wastes, Cheese, Agriculture, Food and Kindred Products, Food Products, Alternatives Evaluation, Food Processing, Food Preparations, Lactoserum Recovery, Filtration, Material Conservation, Canada, Increased Productivity, Increased Efficiency, Process Efficiency

***** DOCNO: 450-013-A-001 *****

1.0 Headline: Poultry Slaughterhouse Decreases Effluent by Using Dry Suction System for Clean-Up

2.0 SIC Code: 2015

3.0 Name and Location of Company

La Cooperative Federee de Quebec,
Saint-Felix-de-Valois, Quebec.

4.0 Clean Technology Category:

This technology involves wastewater reduction by installing a vacuum system to clean-up poultry organs from cutting tables.

5.0 Case Study Summary

5.1 Process and Waste Information: Water is an essential element for poultry slaughterhouses. It is used to clean poultry cages, to scald the poultry so that feathers may be removed, to wash feathers from poultry, to remove organs from cutting tables, to refrigerate poultry, and to wash equipment. The authorities at the municipal water treatment system of Quebec found that the efficiency of their purification machinery was being greatly compromised by the volume and high pollution levels of water from the poultry slaughterhouses. As a result, the water treatment company and La Cooperative Federee decided to treat the slaughterhouses's waters on site. The company elected to decrease the amount of water it was using and, therefore, avoid the $1,500,000 cost of a treatment system. The most obvious way to decrease the volume of water at the facility was to install a vacuum system that sucked organs and other inedible body parts from the visceration tables and collected them in a vat of other non-edible parts. The old system used a lot of water to hose the tables down with disinfectant. As a result of the new suctioning system, the company was able to reduce the pollutants in its effluent by 75%. The company also used the following source reduction techniques to decrease its wastewaters:

*Recovered blood instead of washing it away,

*Segregated process waters from rain waters so that only the volume of process waters needing treatment would be discharged to a pit,

*Installed automatic spray nozzles to concentrate water more directly when washing equipment,

*Installed high pressure cleaning systems to clean more efficiently.

5.2 Scale of Operation: La Cooperative Federee slaughters approximately 23,000 poultry per day. It used 500,000 liters/water/day and discharged 400 kg BOD(5)/day (demande biochimique en oxygen).

5.3 Stage of Development: This technology was fully implemented at the time of this case study.

5.4 Level of Commercialization: This technology was fully available at the time of this case study although the suction system needed to be specifically designed for this application.

5.5 Material/Energy Balances and Substitutions

Transportation of Visceral Organs

Parameters (kg/ton)	Traditional Transportation	Transportation at La Cooperative			
	Transportation by Water	Transport by Water		Suction System	
	without hens*	w/o hens*	with hens*	w/o hens*	with hens*
BOD(5)	15.5	17.1	39.5	8.2	11.0
Suspended Solids	10.9	9.7	25.8	7.8	9.4
Oils and Fats	5.1	3.7	7.0	2.1	2.5

* It is noted in the text that hens pollute more than other poultry due to the eggs located in the viscera.

6.0 Economics*

6.1 Investment Costs: In order to install the equipment for the suction system, the company invested $180,000 compared to the $1,500,000 the company would have had to spend to install a chemical and biological treatment system.

6.2 Operation and Maintenance Costs: With the dry suction system, the company must only spend $4,000/year for disinfection chemicals as opposed to spending $10,000/year on chemical and energy costs for the chemical/biological treatment system.

6.3 Payback time: The payback time of this operation was 7 months.

It is assumed that costs are reported in Canadian dollars.

7.0 Cleaner Production Benefits:

This process reduced the wastewaters of the slaughterhouse by 75%. The use of disinfection chemicals decreased by 75% and oils and fats in the effluent were reduced by 65%.

8.0 Obstacles, Problems and/or Known Constraints

One of the obstacles the company had to overcome was how to implement a suction system using existing pipes and equipment. The company was able to attach the system to existing conduits to transport the organs to an existing storage area for inedible parts.

9.0 Date Case Study Was Performed: This case study was performed in 1986.

10.0 Contacts and Citation

10.1 Type of Source Material: Report

10.2 Citation: Secteur Agro-Alimentaire, Technologies Propres, Abattage de Volailles, Gouvernement de Quebec, Ministre de l'Environnement, Gestion et Assainissement des Eaux, May 1989. Source document is in French.

10.3 Level of Detail of Source Material: More detail is provided about the slaughter industry in general in Quebec. More detail is also provided about the system before the changes and the system after the implementation of the suction system.

10.4 Industry/Program Contact and Address: Regional offices, addresses and phone numbers are given on the back of the report.

10.5 Abstractor Name and Address: Blair M. Raber, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA, 22043.

11.0 Keywords

11.1 Waste Type: Wastewater, Food Wastes, Animal and Marine Fats, Fats and Oils.

11.2 Process Type/Waste Source: Food Processing.

11.3 Waste Reduction Technique: Equipment Modification, Process Modification, Source Reduction, Wastewater Reduction, Jet Sprayers, Vacuum System.

11.4 Other Keywords: Agriculture, Annual Cost Savings, Canada, Environmental Impact Reduction, Food Products.

(*) Disclaimer - Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Wastewater, Food Wastes, Animal and Marine Fats, Fats and Oils, Food Processing, Equipment Modification, Process Modification, Source Reduction, Wastewater Reduction, Jet Sprayers, Vacuum System, Agriculture, Annual Cost Savings, Canada, Environmental Impact Reduction, Food Products

***** Document No. 453-001-A-000 *****

1.0 Headline: Fugitive dust recovered and reused in an iron foundry

2.0 SIC Code: SIC 3322, Malleable Iron Foundries

3.0 Name and Location of Company:

Baxi Partnership
Brownedge Road
Bamber Bridge
Preston PR5 6SN, England

4.0 Clean Technology Category

This technology involves recycling fugitive dust back into the manufacturing process.

5.0 Case Study Summary

5.1 Process and Waste Information: Precision iron founding involves the production of moulds and cores from mixtures of sand and clay. In the traditional process, the factory space is ventilated by extractor fans. If scrubbers are used, the dust forms a sludge which is dumped at high cost.

At this foundry, the dust collected as sludge by water scrubbers is recovered by returning it to the mixer to make new moulds. A special sludge pumping system uses a centrifugal pump with a natural rubber impeller to overcome the problems associated with the abrasive properties of the sludge. The composition of the moulding material is controlled by using a highly effective and flexible electronic control and display system.

5.2 Scale of Operation: The facility has 400 employees on a 15 acre site. Over 25,000 tonnes of cast iron are melted per year using two 4MW electrical furnaces.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: Unknown.

5.5 Material/Energy Balances and Substitutions: The system recovers 1600 te per year of sludge.

6.0 Economics*

6.1 Investment Costs: The capital investment was 19,000 English Pounds.

6.2 Operational and Maintenance Costs: The annual savings are 84,000 English Pounds. (Material savings of 60,000 English Pounds. Reduced disposal charges of 24,000 English Pounds.)

6.3 Payback Time: 3 months.

7.0 Cleaner Production Benefits

The system recovers 99% of the moulding material and sludge generation is reduced by 1,300 m^3/year. Emissions are insignificant. Higher quality products are produced and the working environment is improved.

8.0 Obstacles, Problems and/or Known Constraints

None identified

9.0 Date Case Study Was Performed

Unknown

10.0 Contacts and Citation

10.1 Type of Source Material: Government Publication.

10.2 Citation: Clean Technology, Environmental Protection Technology Scheme, Department of the Environment, 2 Marsham Street, London SW1P 3EB, 1989, p6.

10.3 Level of Detail of the Source Material: Simple diagram of process provided.

10.4 Industry/Program Contact and Address: David Sumner, Project Engineer, Baxi Partnership, Brownedge Road, Bamber Bridge, Preston PR5 6SN, England, telephone (0772) 36201.

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Dust, sand, clay, sludge

11.2 Process type/waste source: Iron foundry, scrubber sludge

11.3 Waste reduction technique: Recovery and reuse, sludge pump

11.4 Other keywords: United Kingdom, SIC 3322

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Dust, Sand, Clay, Sludge, Iron Foundry, Scrubber Sludge, Recovery and Reuse, Sludge Pump, United Kingdom, SIC 3322

***** DOCNO: 400-096-A-321*****

HEADLINE:	Recovery and regeneration of pickling baths reduces wastewater generation by 33% and increases recovery rate of chlorides and ferric oxide.
INDUSTRY/SIC CODE:	Iron and Steel Basic Industries/ISIC 3710
POLLUTION PREVENTION OPTIONS SUMMARY:	Chlorhydric acid pickling baths are regenerated and recycled for pickling of steel plates. The pickling baths go through a roasting oven where the chlorhydric acid is recovered, along with ferric oxide powder which is sold. Residual acid losses are neutralized and settled.
FEEDSTOCKS:	HCl - 2 kg/ton steel, lime - 1 kg, wash water - 0.2 m^3, energy (gas) -0.125 GJ.
WASTES:	Residual, used pickling baths, and washing water
MEDIUM:	Water
COSTS:	
CAPITAL COST:	25,000,000 francs (1979 franc)
OPERATION/MAINTENANCE:	4.90 francs/ton of steel
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Capital investment is increased by 21,200,000 francs, but operating costs are decreased by 5.06 francs/ton of steel. Recovered ferric oxide is sold for 1.10 franc.
FEEDSTOCK REDUCTION:	HCl requirement reduced by 18 kg/ton steel, lime is reduced by 8.5 kg, water by 0.2 m^3.
WASTE PRODUCTION:	Low waste techniques generates 0.2 m^3 of wastewater containing 0.25 chloride ions, compared to 0.3 m^3 water with 1.3 kg chloride ions with conventional technology. Ferric oxide mud is reduced from 7 to 0.6 kg.
IMPACT:	Wastewater generation is reduced by 33%, with a high recovery rate of chlorides and ferric oxide. The technique could be extended to other applications where chlorides are decomposed and recovery of metals is profitable.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Pickling Steel Plates with Chlorhydric Acid, After Hot Rolling: Recovery and Regeneration of Acid Pickling Baths", Monograph ENV/WP.2/5/Add.96.
KEYWORDS:	Steel, Pickling, Recovery, Recycling, Rinsewater, ISIC 3710

*****DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Use of Acid Purification Unit on Concentrated High Temperature Pickling Liquor Reduces Iron Concentration

2.0 SIC Code: ISIC 2105, Pickling Steel

3.0 Name & Location of Company:

Metal Koting
Continuous Colour Coat Ltd.
1430 Martin Grove Road
Rexdale Ont. M9W 4Y1
Canada
Phone (416) 743-7980

4.0 Clean Technology Category

Technology Principle: This technology involves the use of an acid purification unit (APU) consisting of filters and an ion exchanger to reduce iron content of the pickle acid.

5.0 Case Study Summary

5.1 Process and Waste Information: In the original pickling process, no purification of the acidic liquor was undertaken. The liquid was discarded in a continuous "bleeding" process after the "bleed" was neutralized with lime.

The new process involves use of equipment consisting of three basic pieces and one optional piece: an Eco-Tec Acid Purification Unit AP30-24 HT cartridge filter and ion exchanger, a feed pump, an Eco-Tec sand filter and an optional 400 gallon (1100 liter) water supply tank.

The pickle acid is pumped from the reservoir tank through a media filter to remove dirt and oil particles. The acid then passes through a second filter (0.5 μm) to remove very fine particulate and filter media from reaching the resin bed in an ion exchange unit. The following stage contains three steps per cycle: the water displacement stage, the byproduct (iron) removal stage, and the produce (acid) return stage.

The water displacement phase allows the pickle acid into the resin bed, displacing the water from the previous cycle. This water can be reused by sending it to the water supply tank, or sent to drain. This stage lasts approximately one minute.

The byproduct stage allows the pickle acid to continue its flow through the resin bed trapping the sulfate ions and allowing the iron to pass through to the drain. This phase also takes about one minute.

The product return phase stops the flow of acid from the reservoir and starts a counterflow of water from a pressurized source (main water line or water supply tank pump). The water picks up the sulfate ions and returns them to the tank of sulfuric acid. This stage takes about two minutes.

This three phase cycle continues automatically until the dirt build-up in the media filter causes the process to automatically shut down. A back flush procedure is necessary to clean the filter before restarting the system again. Backflushing time is approximately one hour.

Using the new process results in the reduction of the iron content of the acid solution from an initial 7.7% to a steady 2-3% during the latter half of the test period. An 89% decrease in use of sulfuric acid and lime also resulted. No new materials are introduced in the process. Since pickling uniformity is a product quality improvement, product quality is at least as good as before using the APU, but this was not quantified.

5.2 Scale of Operation: Not reported

5.3 Stage of Development: The installation is fully implemented. Data are derived from the last month of testing.

5.4 Level of Commercialization: The installation is commercially available. The vendor seems well equipped and experienced in construction and maintenance of the equipment.

5.5 Material/Energy Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Feedstock Use:		
Sulfuric acid (lbs/year)	629,089	67,558
Lime (tons/year) (Computed)	252	28

6.0 Economics*

6.1 Investment Costs: Investment costs were as follows:

Design and supply of equipment	$84,000.00
Equipment installation	$10,000.00
Start-up, supplies, etc.	$ 2,500.00
Total	$94,000.00

These costs do not include the test program nor the management personnel costs for the project.

6.2 Operational & Maintenance Costs: These costs are estimated at $2,500/year.

6.3 Payback Time: Payback time was calculated as 2.33 years. Annual savings on chemicals were calculated as $43,937. Not included in the calculations are an estimated $8,000 saved annually on sludge hauling.

7.0 Cleaner Production Benefits

Annual savings on chemicals were $25,942 for sulfuric acid and $17,995 for lime, or a total of $43,937. An estimated $8,000 were saved on sludge hauling. The project demonstrated that sulfuric acid used in preparing steel strip for electrogalvanizing could be reclaimed for continuous use.

8.0 Obstacles, Problems and/or Known Constraints

Except for some start-up problems, no other problems seem to have been encountered.

9.0 Date Case Study Was Performed: May 31, 1985 (date of source document)

*

10.0 Contacts and Citation

10.1 Type of Source Material: Report

10.2 Citation:

Acid Purification Unit for Use on Concentrated High Temperature Pickling Liquor (Sulfuric Acid).

10.3 Level of Detail of the Source Material: More detailed cost information is available in the source document.

10.4 Industry/Program Contact and Address:

Mr. M. Schulz
Head Training Secion
Environment Canada
3439 River Road South
Ottawa, Ontario K1 OH3
Canada
Phone (613)991-1954
Fax (613)991-1635

10.5 Abstractor Name and Address: M. Stein, RIVM, Dept. LAE, Anthonie van Leeuwenhoeklaan 1, Postbus 1, Bilthoven, Netherlands. Reformatted: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: Pickle liquor

11.2 Process type/waste source: Steel strip

11.3 Waste reduction technique: Acid purification, ion exchange, filtration, iron reduction, acid reclamation

11.4 Other keywords: Canada

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Pickle Liquor, Steel Strip, Acid Purification, Ion Exchange, Filtration, Iron Reduction, Acid Reclamation, Canada, ISIC 2105

***** Doc # 501-016-A-000 *****

1.0 Headline: High-carbon ferrochrome smelting process cuts electric power consumption in half.

2.0 SIC Code: SIC 3313

3.0 Name and Location of Company: Shunan Denko, Japan

4.0 Clean Technology Category:

This technology involves a process modification whereby an additional process step is added prior to the ore entering the furnace.

5.0 Case Study Summary

5.1 Process and Waste Information: This plant makes high-carbon ferrochrome suitable as an addition agent in the production of stainless steel. Pellets of ore mixed with carbon are hot-charged into a closed-type electric furnace. The main feature of this technique is a pre-reduction step ahead of the furnace. Chrome ore is pelletized along with coke, binder and flux, and roasted in a rotary kiln. By pelletizing the fine, low-grade chrome ore more commonly available around the world, it is possible to use the closed-type electric furnace. This enables a substantial reduction in unit power consumption, and in pollution-abatement costs otherwise spent to control fugitive dust from handling dusty ore in the open.

5.2 Scale of Operation: A 60,000-ton/year plant uses this operation.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions: Energy use after the process modification is 2,000 to 2,100 kWh/ton of ferrochrome.

6.0 Economics

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Compared to the traditional smelting process this process cuts energy consumption by 50% and reduces dust generation by eliminating one of the ore handling steps.

8.0 Obstacles, Problems and/or Known Constraints

None were identified.

9.0 Date Case Study Was Performed

1974

10.0 Contacts and Citation

10.1 Type of Source Material: Book

10.2 Citation: Process Technology and Flowsheets, articles which appeared in Chemical Engineering over the last five years. V. Cavaseno and Staff of Chemical Engineering eds., McGraw-Hill, NY, NY, 1979. High-Carbon Ferrochrome Route Slashes Power Use, Kazuo Ichikawa. Pg. 110.

10.3 Level of Detail of the Source Material: Additional detail of each of the steps and ingredients as well as a process flowsheet are included in the article.

10.4 Industry/Program Contact and Address: Kazuo Ichikawa, Deputy Manager, Administration and planning Dept., Metals and Alloys Div. Showa Denko, K.K.

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Ore dust

11.2 Process type/waste source: Blast furnace, ferrochrome smelting

11.3 Waste reduction technique: Pelletized ore, closed-type electric furnace

11.4 Other keywords: Japan, energy conservation

KEYWORDS: Ore Dust, Blast Furnace, Ferrochrome Smelting, Pelletized Ore, Closed-Type Electric Furnace, Japan, Energy Conservation, SIC 3313

***** DOCNO: 400-012-A-203 *****

INDUSTRY/SIC CODE:	Silicon/Ferrosilicon/ISIC 3720
NAME/CONTACT:	Elkem-Spigerverket a/s, Oslo, Norway
TECHNOLOGY DESCRIPTION:	The company uses a semi-closed furnace with waste heat boiler and filter. Gas and heat recovery are utilized. The semi-closed furnace restricts the amount of excess air and elevates the temperature of the off-gases making energy recovery feasible. The off-gas amount is restricted to 2-5 Nm^3 per kWh of electrical input to furnace. The energy is recovered in a special waste heat boiler, and the cooled off-gas is cleaned in a bag house filter. The size of the bag house filter is proportional to the amount of off-gas drawn off the furnace. The closed furnace has a gas-tight cover, and the gas, as rich CO-gas, is collected without being burned above the charge surface. The gas volume to be cleaned is small compared with the volumes from the open and semi-closed furnaces, theoretically only 2 per cent of the volume from an open furnace. Recovered energy in percent of electrical input to furnace will be in the range of: 1) 65-75 per cent with steam as end product; 2) 20-25 per cent with electrical power as end product.
FEEDSTOCKS:	Not reported
WASTES:	Not reported
MEDIUM:	Gas, energy
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Not reported
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Semi-closed or Closed Silicon/Ferrisilicon Furnaces with Gas Cleaning and Recovery", Monograph ENV/WP.2/5/Add.12).
KEYWORDS:	Ferrosilicon, Silicon, ISIC 3720, Ferroalloys, Reduction Furnace

LEATHER TANNING AND FINISHING

***** DOCNO: DOCUMENT NOT AVAILABLE (404) *****

1.0 Headline: Methane gas production from tannery waste biomethanisation.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Aloy M
CTC
4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
Tel: +33 78695012
Tlx:340497 F
Fax: +33 78612857

4.0 Clean Technology Category

Technology Principle: Solid waste benefits - nitrogen; Energy saving; Other environmental claims/cost of dumping saving. 75% less COD in waste. 62% less volatile and 44% less volume. 515 litres of gas (73% methane) per kg of volatile material, available for tannery boilers.

Used in: Waste treatment Energy usage.
Cleanness: Good - best available to-date. The organic matter transformation gives a lower quantity of waste for disposal. The waste is more friendly with the environment and gas is recovered.

5.0 Case Study Summary

Stage of Development: Trial / Prototype stage 1-10 estimated number of enterprises in year 2000. 1-5m sq ft of leather produced to date. Available: World First developed in: 1985

Results of Application: A mixture of liquid sludge and ground fleshings is sent to a digester with a 20 days retention time. Temperature is maintained at 35 deg C. Gas production is 615 litre of gas with 73% methane per kg of volatile matter sent to the digester. Gas, after washing and sulphide removal, is usable for feeding boilers in tanneries.

6.0 Economics

Investment Costs: Implementation costs: #1000001+

Payback Time: 4.5 years

7.0 Cleaner Production Benefits

Wastes: The elimination levels are: 75% COD; 44% dry material; 62% volatile material. Volume of waste to be disposed of can be reduced by 40%. 515 litres of gas (73% methane) per kg of volatile material, available for tannery boilers.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: High costs in investment. Technical problems of grease during cold periods.

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Aloy M
CTC
France

Regulatory Compliance: Financial support from EEC (Project BM/185/83) and AFME (French Energy Agency).

Citation:

1. Biomethanisation des residus de tannerie: une experience industrielle, Aloy M, Mermet R & Sanejouand J, Industrie du Cuir, 1987, (5), 23-27.

2. Biomethanisation of tannery wastes : an industrial experiment, Aloy M, Mermet R & Sanejouand J, JALCA, 1989, 84, (4), 97-109.

Keywords: Leather, Tanning, Biomethanisation, Process Alternatives, Methane, Energy Reclamation

***** DOCNO: DOCUMENT NOT AVAILABLE (405) *****

1.0 Headline: Processing chrome tanned leather by-products - glue and gelatine - using hydrogen.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Cot J
Inst Tecnologica Quimica y Text
CSIC
Jorge Girona Salgado No 18-26
08034 Barcelona
Spain
Tel:(93) 2040600
Fax:(93) 2045904

4.0 Clean Technology Category

Technology Principle: Solid waste benefits - chromium; Other environmental claims; Better profit of chrome tanned shavings, trimmings, splits, etc. Obtention of glue, gelatin and other high added value products. 95-98% reduction of total solid chrome tanned by-products (originating from mechanical operations such as shaving, splitting, trimmings, etc).

Used in: Waste treatment
Cleanness: Reasonable - better than other processes.
Contributes to reducing the amount of solid chrome tanned by-products of the leather industry. This particular type of waste material is otherwise very difficult to treat by conventional and classical processes, due mainly to the presence of chromium (III) cross-linked to the collagen. This new process is based on the oxidizing effect on chromium (III) to chromium (VI) by the action of hydrogen peroxide in alkaline medium.

5.0 Case Study Summary

Stage of Development: Research & Development stage

Results of Application: This process treats solid chrome tanned by-products in a matter of a few hours; conventional methods cannot process chrome tanned wastes mainly because chromium which strongly stabilizes leather structure remains unaffected by ordinary conditions. Main steps of present procedure are: a) defibration or grinding of the material, b) application of classical detanning process alternated with acid washings (hydrogen peroxide), c) filtration after each acid or alkaline treatment (vacuum incorporated). This process represents substantial savings of chemicals for dechroming treatment and reduces the time considerably. The sequence of oxidation reactions from chromium (III) to (VI) (in alkaline medium) and reductions from chromium (VI) to (III) (in acid medium) permits efficient elimination of chromium in the by-products, thus facilitating the production of glue and gelatine.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: Reduces the amounts of solid chrome waste produced by the leather industry and, at the same time, contributes to obtaining profitable products from them. 95-98% reduction of total solid chrome tanned by-products (originating from mechanical operations such as shaving, splitting, trimmings, etc).

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Undesirable effects on the environment.

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citation

Abstractor and Address:

Cot J
Inst Technologia Quimica y Textil
CSIC
c/o Jorge Girona y Salgado no.18 -26
08034 Barcelona
Spain
Tel: 93 2040600
Fax: 93 2045904

Citation:

1. Cot J & Granell JR, Bol AQEIC, 1978, 29, 191-325 / 325-350.
2. Goschev Iv, Botev Iv & Nodkov P, Leder, 1979, 56-60.
3. Cot J & Granell JR, Bol AQEIC, 1981, 32, 225.
4. Smith & Donovan, JALCA, 1982,77.
5. Cot J & Granell JR, Bol AQEIC, 1982, 33, 31.
6. Cot J & Granell JR, Bol AQEIC, 1983, 34, 1.
7. Cot J, Bol AQEIC, 1984, 35, 39.
8. Cot J, Aramon C, Baucells M, Lacort G & Roura M, JSLTC, 1986, 70, 69-76.

Keywords: Leather, Tanning, Waste Reduction, Chromium, Process Alternatives, Leather By-Products, Hydrogen

***** DOCNO: DOCUMENT NOT AVAILABLE (406) *****

1.0 Headline: Sterilization of salted raw bovine hides

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Rio G del
Carburos Metalicos Division CO2
Pau Claris 95 entlo
08009 Barcelona
Spain
Tel:412 4606
Tlx:8017689

4.0 Clean Technology Category

Technology Principle: Liquid waste benefit - ammonia; Liquid waste benefit - nitrogen; Better working conditions.

Used in: Rawstock.
Cleanness: Reasonable - better than other processes. Eliminates bacteria of salted hides.

5.0 Case Study Summary

Stage of Development: Research & Development

Results of Application: The physico-chemical characteristics of ethylene oxide and precautions for its use and application are described. Practical trials of the sterilization of salted bovine raw hide with a mixture of ethylene oxide and carbonic anhydride were undertaken from which it is concluded that the mixture is effective in the destruction of the bacterial flora of a salted bovine hide.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: Water from soaking less contaminated with bacteria, hides are better quality.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: High costs

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Adzet JM
Escuela Superior de Teneria
Plaza del Rey No 15
08700 Igualada
Barcelona

Spain
Tel:8034558
Fax 8031589

Keywords: Leather, Tanning, Hide Sterilization, Ethylene Oxide, Carbonic Anhydride

***** DOCNO: DOCUMENT NOT AVAILABLE (407) ****

1.0 Headline: Elimination of leather waste by production of ceramic pastes for paving and brickwork.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Barcelo ACO
INESCOP
PO Box 253
Poligono Industrial 'Campo Alto'
03600 Elda
Alicante
Spain
Tel:5395213
Tlx:68269
Fax:5381045

4.0 Clean Technology Category

Technology Principle: Recycled chromium; Solid waste benefits - chromium; Reduction in volume in the solid wastes. The production of a combustible carbon matrix. The production of activated carbons for use in adsorption. The production of combustible chemical products through distillation. Concentration of chromium oxide for storage and subsequent recovery.

Used in: Waste treatment.
Cleanness: Reasonable - better than other processes. It is a controlled process for the elimination of the leather wastes. It transforms the chromium compounds incorporated into the leather during tanning in chromium oxide (III) of great chemical stability. It avoids risks of contamination.

5.0 Case Study Summary

Stage of Development: Trial / Protype

Results of Application: Two ways to eliminate waste from the tanning and footwear industries.

1) Addition of small percentages (1-2%) of shredded leather to ceramic pastes for paving and exterior brickwork. This produced the occurrence of porosity due to the combustion of organic matter, and this process is therefore recommended only when special textures in the materials are required.

2) Under controlled temperature and atmospheric conditions in the inside of the suitable ovens, a carbonised material having acceptable calorific capacity, combustible chemical compounds through distillation, recovery of chromium oxide and production of activated carbons could be obtained from the leather wastes, for industrial purposes such as adsorbents.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Reduction in volume of the solid wastes.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Citation:

1. Barcelo ACO, Tesis doctoral Universidad de Alicante, 1988.

2. Activated carbons from chromium tanned leather waste. In: Pyrolysis and Gasification, Ed. Ferrero GL, Elsevier Pub Ltd, 1989, 439-443.

Keywords: Leather, Tanning, Waste Disposal, Leather By-Products, Incineration, Ceramic Additives, Chemical Reclamation

***** DOCNO: DOCUMENT NOT AVAILABLE (408) *****

1.0 Headline: Drying of leather using a heat pump

2.0 ISIC Code: Not provided

3.0 Name and Location of Company: Not reported

4.0 Clean Technology Category

Technology Principle: Energy saving. The energy saving is approximately 50% compared to another fuel oil heated dryer.

Used in: Finishing.
Cleanness: Good - best available to-date. It saves energy. It helps to decrease the atmospheric pollution because the factory wastes less fuel oil.

5.0 Case Study Summary

Stage of Development: Limited commercial use.

Results of Application: The drying of leather is achieved satisfactorily using a heat-pump. With this method we can choose the temperature and the relative humidity of the air in the dryer so the drying process becomes more rational. Drying at low temperature we have softer leather and leather with better results in physical testing. For each kind of leather we can use its best drying conditions.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Energy Use: Energy saving. The energy saving is approximately 50% compared to another fuel oil heated dryer.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Bigger initial investment than a fuel oil heated dryer.

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Font J
Escuela Superior de Teneria
Pza Rei 15
08700 Igualada (Barcelona)
Spain
Tel: + 8034558
Fax: +803 1589

Industry/Program Contact and Address: Milosa

Citation:

1. Gavend G Rev Tech Ind Cuir 1985 v.77 p.293.
2. Gratacos E et al AQEIC Bol Tech 1987 v.38 p.584.
3. Font J & Salvado J AQEIC Bol Tech 1989 v.40 p.261.

Keywords: Leather, Tanning, Drying, Heat Pump, Energy Savings

***** DOCNO: DOCUMENT NOT AVAILABLE (385) *****

1.0 Headline: Aluminium + titanium complex mineral tanning agent (non chrome) Synektan TAL

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Tate I
ICI Colours and Fine Chemicals
PO Box 42
Hexagon House
Blackley
Manchester M9 30A
UK
Tel 061 721 2562 Txl: 667841 Fax: 061 795 6005

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Less chloride required; Better uptake of chromium; Solid waste benefits - chromium; Other environmental claims - chrome-free solid by-product by pretanning for wet white.

Used in: Tanning, Dyeing
Cleanness: Good - best available to-date.
Synektan TAL can make real reductions in levels of discharged chrome with no current additional environmental problems. Discharges of aluminium (and possibly titanium) may be subject to environmental pressure in the future.

5.0 Case Study Summary

Stage of Development: Widespread use 501+ estimated number of enterprises in year 2000. 1-5m sq ft of leather produced to date.

Level of Commercialization: 2 years in commercial use. Available: Worldwide. First developed in: 1987 (1988).

Results of Application: Non chrome tanning agent, potentially useful in three areas:

1. Pretanning for wet white, to reduce production of chrome tanned solid waste and reduce chrome consumption in the tannery.

2. Total or partial replacement of chrome in main tannage, to reduce chrome offers by aiding chrome uptake and by substituting at least part of the normal chrome offer.

3. Total or partial replacement of chrome in combination tannages or retanning.

6.0 Economics

Investment Costs: Implementation costs: #10001-50000

Payback Time: 5-10 years

7.0 Cleaner Production Benefits

Wastes: Total replacement of chrome by Synektan TAL would satisfy any requirement regarding solid or liquid chrome-bearing waste. If a practical chrome offer, eg 1% Cr_2O_3, is retained (to maintain leather character), chrome discharges in the effluent might be approximately 10 ppm in the mixed wastestream. By optimising conditions, that level can be significantly reduced.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: No undesirable effects on the environment at present - legislation may apply Consent Limits. Post tanning steps have to be modified to take account of Al + Ti in the leather.

9.0 Date Case Study was Performed: Not reported

10.0 Contacts and Citations

Abstractor and Address: Dr. AD Covington, British Leather Confederation

Regulatory Compliance: EC supported Demonstration Project (ACE/88/UK/002/A21) currently being conducted at The British Leather Co Ltd, in collaboration with the British Leather Confederation.

Industry/Program Contact and Address: Ian Tate, ICI Colours and Fine Chemicals

Citation:

1. Tannages based on aluminium III and titanium III complexes by Covington, AD., J Amer Leather Chem Assoc, 1987 82(1)1.

2. Leather tanning process using aluminium III and titanium IV complexes by Covington, AD.

3. Proceedings IULTCS Conference, Philadelphia, USA by Tate IP, 1989.

Product code 36003
Company Information Pack

Keywords: Leather Tanning, Chromium Compounds, Chemical Alternatives, Source Reduction, Aluminum, Titanium

***** DOCNO: DOCUMENT NOT AVAILABLE (386) *****

1.0 Headline: Deliming using carbon dioxide AGA Deliming

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Petersson M
AGA AB
S-181 81 Lidingo
Sweden
Tel: +46 8 7311000
Tlx:19820
Fax: +46 8 7652487

4.0 Clean Technology Category

Technology Principle: Alternative to ammonia; Liquid waste benefits - Bod/Cod Odour reduction; Better working conditions. (Cf 5) No ammonia odour. No lifting of sacks. Automation possible.
Used in: Beamhouse.
Cleanness: Very good - best possible. Ammonium-free process which does NOT increase COD (cf organic acids, etc).

5.0 Case Study Summary

Stage of Development: Limited commercial use 101-500 estimated number of enterprises in year 2000. 5m sq ft+ of leather produced to date.

Level of Commercialization: 2.5 years in commercial use. Available: Europe, N. America, S. America. First developed in: 1987

Results of Application: The process replaces ammonium compounds and organic acids with carbon dioxide as the deliming agent.

6.0 Economics

Investment Costs: #5001-10000

Payback Time: 1-2 years

7.0 Cleaner Production Benefits

Wastes: No ammonium / nitrogen load from the deliming step.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: H_2S formation has to be controlled. Time consumption for thick hides.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Walter R
AGA AB
S-181 81 Lidingo
Sweden
Tel: +46 8 7311000
Tlx:19820
Fax: +46 8 7652487

Industry/Program Contact and Address:

Munz KH
Vesuchsanstalt fur Lederindustrie

Citation:

1. IULTCS 20th Congress, Philadelphia, USA October 15-19, 1989.
2. Leder December 1989, p 251.
3. Leder June 1990, p 103.
4. Ind Cuir, January 1990, p 30.

Keywords: Leather, Tanning, Deliming, BOD/COD Reduction, Chemical Alternatives, Carbon Dioxide

***** DOCNO: DOCUMENT NOT AVAILABLE (387) *****

1.0 Headline: Tanning using vegetable tannins and aluminium sulphate in the same bath.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company: Not reported

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Liquid waste benefit - chromium; Solid waste benefits - chromium; Energy saving; Other environmental claims - chrome-free solid waste. 100% replacement of chrome.

Used in: Tanning.
Cleanness: Reasonable - better than other processes. Comparing with full vegetable tanning organic load in effluent is less. Discharges of aluminium may be subject to environmental pressure in the future.

5.0 Case Study Summary

Stage of Development: Trial / Protype stage

Level of Commercialization: First developed in: 1988

Results of Application: Total replacement of chrome with a combination of aluminium sulphate and vegetable tannins for the manufacturing of upper leather and clothing leather. The above tanning agents are added in the same bath. There is no formation of precipitation.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: Total removal of chrome from the effluent. Reduction of vegetable tannins in effluent compared with effluent from vegetable tanned upper leather.

Feedstocks: Chrome-free solid waste. 100% replacement of chrome.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Discharges of organic material.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Pateropoulou Despina
Hellenic Leather Centre SA
Thisseos 7A
176 76 Kallithea
Athens
Greece
Tel:(01)9025595/6/7

Fax:(01)9025598

Citation:

1. Boziaris E, Tonigold L & Heidemann E: Eine unerwartete Beobachfung bei der Gerbung mit pflanzengerbstoffen Leder 39 (1988) 236-238.

2. Prof Dr E Heidemann. Institut fur Biochemie, Abtly. Eiweiss und Leder, Technische Hochschule Darmstadt.

Keywords: Leather, Tanning, Vegetable Tanning, Aluminum Sulphate, Chemical Alternatives

***** DOCNO: DOCUMENT NOT AVAILABLE (388) *****

1.0 Headline: Fresh hides and skins directly to the beamhouse.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

4.0 Clean Technology Category

Technology Principle: Alternative to chloride; Liquid waste benefit - chloride; Solid waste benefits - chloride; Liquid waste benefits - total solids; Energy saving - 100% less salt in effluent coming from soaking 60% less water-demands for soaking 60% less required time for soaking.

Used in: Beamhouse.
Cleanness: Reasonable - better than other processes. Given that the removal of salt from liquid waste is nearly impossible, the above process is really important when the receiver is not the sea, as it happens usually in Greece. This method is not really a new technology. Some tanneries, simply, exploit the fact that these are located near slaughterhouses.

5.0 Case Study Summary

Stage of Development: -1m sq ft of leather produced to date. Available: World

Results of Application: Raw hides and skins, without any preservatives or biocides, are used in beamhouse. This rawstock needs less amount of water, and less time for soaking.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: Total removal of salt from liquid and solid wastes coming from soaking.

Energy Use: Energy saving - 100% less salt in effluent coming from soaking 60% less water-demands for soaking 60% less required time for soaking

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Technical problems.

9.0 Date Case Study was Performed: Unknown

10. Contacts and Citations

Abstractor and Address:

Pateropoulou Despina
EL.KE.DE. S.A.
Thisseos 7A
Kallithea 176 76
Athens
Greece
Tel:01-9025595/6/7
Fax:(01)9025598

Notes: Information is coming from tanneries which use, from time to time, Fresh raw material.

Keywords: Leather, Tanning, Chloride (Salt), Salt Removal, Source Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE (389) *****

1.0 Headline: Recycling of chromium as tanning agent from the effluents.of the tanning process. Precipitation of chromium by adding magnesium oxide.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Van Vliet M
TNO, Leather & Shoe Research Institute
PO Box 135
5140 AC Waalwijk
Mr van Coothstraat 55
5141 ER Waalwijk
The Netherlands
Tel:0031-4160-33255
Fax:0031-4160-41735

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Recycled chromium; Better uptake of chromium - Chromium free waste-liquors. 99.9% reduction of chromium in waste Cr-liquors.

Used in: Waste treatment.
Cleanness: Very good - best possible. Almost total removal of chromium from the tanning effluents. Discharges of magnesium may be subject to environmental pressure in the future.

5.0 Case Study Summary

Stage of Development: Available: Europe

Results of Application: This technology combines the complete removal of chromium from the factory's effluents, with economic benefits which will be based on the reusual of the recovered chromium.

6.0 Economics

Payback Time: 2.5 to 3 years

7.0 Cleaner Production Benefits

Wastes: The chromium content of the effluents from the tanning process was reduced from 4000 ppm to 2 ppm, which means 99.9% reduction.

Feedstocks: Chromium free waste-liquors. 99.9% reduction of chromium in waste Cr-liquors.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Magnesium in effluents.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Barla M
Hellenic Leather Centre SA
Thisseos 7A
176 76 Kallithea
Greece
Tel:(01)9025595-6-7
Fax:(01)9025598

Industry/Program Contact and Address:

Hellenic Leather Centre SA, Thisseos 7A, 176 76 Kalli
John Germanakos Germanakos SA
Tannery 5 Leof Irinis
Agia Anna
Rentis
GR 182 33
Athens
Greece
Tel:(01)3461550

Keywords: Leather, Tanning, Chromium Recycling, Precipitation, Magnesium Oxide

***** DOCNO: DOCUMENT NOT AVAILABLE (390) *****

1.0 Headline: Partial replacement of chrome by an aluminium complex tanning agent.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

EL.KE.DE. S.A.
Thisseos 7A, Kallithea
176 76 Atherns
Greece
Tel:(01) 9023395/6/7
Fax:(01) 9023398

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Less chloride required; Better uptake of chromium; Solid waste benefits - chromium; Other environmental claims -Chrome-free solid by-product by pretanning for wet white. In pilot plant trials chrome in the spent tan liquor was reduced by approx 90%.

Used in: Tanning.
Cleanness: Good - best available to-date. Pretanning with aluminium complex salts not only simplifies the tanning process but reduces drastically pollution problems resulting from its combination-tanning with reduced quantities of chrome-salts. Only problem remains the future environmental pressure on aluminium discharges.

5.0 Case Study Summary

Stage of Development: Research & Development stage 11-50 estimated number of enterprises in year 2000.

Results of Application: (1) Pretanning for wet white, to reduce chrome presence both in the effluent and in the solid waste. Interesting applications of the wet white solid waste after the removal of aluminium tanning agent. (2) Partical replacement of chrome in main tannage to reduce chrome offers and aiding chrome uptake. Without changing the chrome character of the leather nevertheless improving its physicomechanical properties.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: In pilot plant trials chrome in the spent tan liquor was reduced by approximately 90%.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Undesirable effects - Legislation may apply consent limits. Post-tanning operations have to take into account the hardness of leather resulting from an aluminium pretanning. Corrections in fatliquoring and retannage must be modified.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Citation:

Nikolaos Marnelakis
EL.KE.DE. S.A.
Thisseos 7a
176 76 Kallithea
Athens
Greece

Keywords: Leather, Tanning, Chemical Alternatives, Chromium, Aluminum Complex

***** DOCNO: DOCUMENT NOT AVAILABLE (391) *****

1.0 Headline: Catalytic oxidation of sulphides.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

4.0 Clean Technology Category

Technology Principle: Liquid waste benefit - sulphide; Liquid waste benefits - Bod/Cod. Reduction of sulphides in wastewaters to nearly 100%. Reduction of BOD during catalytic oxidation. Reduction of sulphides to 30-40%.

Used in: Waste treatment.
Cleanness: Very good - best possible.
1-10 estimated number of enterprises in year 2000.
First developed in: 1986 in Greece.

5.0 Case Study Summary

Results of Application: Aeration of beamhouse wastewaters or even the mixed effluents by using $MnSO_4$ as catalyst. The air demand is $2Nm^3/hr/m^3$ of effluents or 2.5 lt/gr S=

The quantity of catalyst is 20 mg/lt Mn^{++} that is coming from commercial $MnSO_4$ with 32% Mn^{++}. The reaction is $2S= +3/2\ O_2\ Mn^{++}\ \ S_2O_3\ S\ +\ SO_3=$

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: S= in raw effluent 400-500 ppm S= in exit 6-10 ppm. Reduction of sulphides in wastewaters to nearly 100%. Reduction of BOD during catalytic oxidation. Reduction of sulphides to 30-40%.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Barla M
Hellenic Leather Center S.A.
Thisseos 7a
176 76 Kallithea
Athens
Greece
Tel:(01) 9025595/6/7
Fax:(01)9025598

Industry/Program Contact and Address:

Pantelaras PJ
c/o DAMIVRET George Vretos
22 Irinis Ave
GR 177 78 TAVROS
Greece

Citation:

1. Bailey DA & Humphreys FE JSLTC 1967 v.51, p.194
2. Guerrec H see LALCA 1964 v.59, p709
3. Thorensen TC JALCA 1976 v.71 p.152
4. Vulliermet B & Aloy M see JSLTC 1976 v.60 p.123
5. Berg N et al JALCA 1967 v.62 p.684
6. Van Vlimmeren PJ JALCA 1972 v.67 p.388^&. Zehender FLeder 1970 v.21 p.95
8. Eye D & Clement D JALCA 1972 v.67 p.256
9. Rawlings DE et al JSLTC 1975 v.59 p.129

Keywords: Leather, Tanning, BOD/COD Reduction, Chromium, Catalytic Oxidation, Sulphide Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE (392) *****

1.0 Headline: Fatliquoring using glue stock

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

4.0 Clean Technology Category

Technology Principle: Liquid waste benefits - grease; Solid waste benefits - grease. All fat from fleshings can be re-used. Less fatliquors have to be bought from chemical companies.

Used in: Dyeing & Fatliquoring.
Cleanness: Good - best available to-date.

5.0 Case Study Summary

Stage of Development: Research & Development (Experimental stage) 11-50 estimated number of enterprises in year 2000. Available: World

Results of Application: A process for the utilization of gluestock fat. The fat is transesterifized together with rapeseed oil using an immobilized lipese as catalyst. This transesterification lowers the melting point of the fat which makes it more suitable for fatliquoring of leather. It has been shown possible to replace up to 80% of a commercial fatliquor with this fat without any negative effect on the leather. The reaction time for the transesterification is between 4-8 hours.

6.0 Economics

Investment Costs: #1-5000

7.0 Cleaner Production Benefits

Wastes: The fat fraction from the fleshings can be reused for the fatliquoring.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: High costs

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Rydin S
Danish Technological Institute
Denmark

Industry/Program Contact and Address:

Rydin S
Danish Technological Institute

Citation:

1. Fatliquoring of leather using enzyme treated gluestock fat by Rydin S. Internal Report 1988.

2. Biological conversion of low grade fats by Rydin S. Licentiate Thesis, 1989.

Datasheet exists on product - but not for this application.

Keywords: Leather, Tanning, Fat Liquoring, Gluestock Fat Transesterification, Fat Recycling

***** DOCNO: DOCUMENT NOT AVAILABLE (393) *****

1.0 Headline: Incineration of chrome shavings.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

4.0 Clean Technology Category

Technology Principle: Recycled chromium

Used in: Waste treatment
Cleanness: Very good - best possible

5.0 Case Study Summary

Stage of Development: Trial / Protype stage. Available: World

Results of Application: The technique allows the combustion of chrome shavings to take place without any emission of chromium and ensures that the chromium in the ash will keep the original trivalent form and not be oxidized to hexavalent chromium. The chromium can then be extracted from the ash, 40% of which is chromium (Cr_2O_3). The incineration takes place under low oxygen - low temperature conditions.

6.0 Economics

Investment Costs: Implementation costs: #1000001+

7.0 Cleaner Production Benefits

Wastes: The chrome shavings can be re-used.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: High costs. Sensitive to changes in raw material. Needs large amount of chrome shavings.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Rydin S
Danish Technological Institute
Denmark

Industry/Program Contact and Address:

Frendrup W
Danish Technological Institute

Citation:

1. Combustion of chrome shavings, Danish Technological Institute, Report 1987

Keywords: Leather, Tanning, Chromium Recycling, Incineration

***** DOCNO: DOCUMENT NOT AVAILABLE (394) *****

1.0 Headline: Chilling using ice.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Schroeder P
Hude-Centralen
Sindalsvej 8
DK-8240 Risskov
Denmark
Tel: +45 86212100
Tlx:68150

4.0 Clean Technology Category

Technology Principle: Less salt in effluent.

Used in: Rawstock
Cleanness: Reasonable - better than other processes
Technical problems in uniform chilling of the hides. If the temperature rises in any process stage because of technical problems the quality will be lower.

5.0 Case Study Summary

Stage of Development: Limited commercial use

Level of Commercialization: 2-3 years in commercial use. Available: World

Results of Application: The hides are iced directly at slaughterhouses immediately after slaughter (using 5 kg ice per hide). The ice is produced by installed ice making machines. After icing, the hides are sent overnight to Hude-centralens warehouse for grading and salting. The warehouse is refrigerated to 8 deg C in order to minimise bacterial action and preserve quality. According to Hude-centralen the shelf life of chilled unsalted hides is two weeks.

6.0 Economics

Investment Costs: Implementation costs: #1-5000

7.0 Cleaner Production Benefits

Wastes: No salt used for short-term conservation. However, at Hude-centralen most of the hides are salted before transportation to tanneries.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Technical problems in uniform chilling of the hides. If the temperature rises in any process stage because of technical problems the quality will be lower.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Rydin S Danish Technological Institute
Denmark

Industry/Program Contact and Address:

Rydin S, Danish Technological Institute

Citation:

1. Iced hides are better, Schroeder P, Leather, 1990, 192, 34-37.

2. Technical literature, Hude-centralen, Denmark.

Keywords: Leather, Tanning, Hide Preservation, Process Alternatives, Ice Chilling, Salt Use Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE (395) *****

1.0 Headline: Deliming using sodium bicarbonate and hydrochloric acid.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Heidemann E.
Technische Hochschule Darmstadt/Department of Protein and Leather
Petersenstrasse 22
D-6100 Darmstadt
West Germany
Tel:0615/16 2175

4.0 Clean Technology Category

Technology Principle: Alternative to ammonia; Liquid waste benefit - ammonia; Liquid waste benefits - BOD/COD; Other environmental claims/deliming with CO_2. Ammonia might be reduced by 75%.

Used in: Beamhouse
Cleanness: Not so good
The cleanness of the process is good but there is a loading of sodium chloride or sodium sulphate in the effluent.

5.0 Case Study Summary

Stage of Development: Trial / Protype stage. Available: World. First developed in: 1987

Results of Application: Rapid and safe deliming process with hydrochloric acid (and other strong acids) in the presence of sodium hydrogen carbonate avoiding a pH value below 6 and without using ammonium salts.

6.0 Economics

Investment Costs: Implementation costs: #5001-10000

7.0 Cleaner Production Benefits

Wastes: Replacement of ammonia salts by sodium hydrogencarbonate and hydrochloric acid in the deliming process would reduce the effluent loading of inorganic ammonia. The reduction would be 75% ammonia. This would not satisfy the requirements. In this case the bating products must not contain ammonia salts and also no ammonia products may be used in the other processes.

8.0 Obstacles, Problems and/or Known Contraints

Problems Encountered: Undesirable effects on the environment from formation of sodium chloride or sodium sulphate. Technical problems in that an automatic adding system for the acid is required.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Pauckner W
Westdeutsche Gerberschule Reutlingen
PO Box 29 44
Erwin-Seiz-Strasse 9
D-7410 Reutlingen, West Germany

Industry/Program Contact and Address:

Heideman E
Technische Hochschule Darmstadt
Dept Protein & Leather
Petersenstrasse 22
D-6100 Darmstadt
West Germany

Citation:

1. Hein A, Herrera P and Heidemann E, Leder, 1988, 39, (8), 141-145.

Keywords: Leather, Tanning, Deliming, Ammonia, Sodium Hydrogencarbonate

***** DOCNO: DOCUMENT NOT AVAILABLE (396) *****

1.0 Headline: Dyeing of leather with liquid 1:2 metal complex dyestuffs Levaderm dyes

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Traubel H
Bayer AG
ATEA-Leder
Bayerwerk
D-5090 Leverkusen
West Germany
Tel:0214 3071180
Tlx:85103-257

4.0 Clean Technology Category

Technology Principle: Liquid waste benefits - BOD/COD; It is possible to use these dyestuffs in drum, spraying and roller coating. They can be used in water and organic solvents (alcohol). They have no salts as do powder dyes and give good properties.

Used in: Dyeing & Fatliquoring
Cleanness: Reasonable - better than other processes
By using these dyestuffs, the exhaustion of the float is good. By spraying or roller coating, there are no effluents. The COD is similar.

5.0 Case Study Summary

Stage of Development: Widespread use 501+ estimated number of enterprises in year 2000. 5m sq ft+ of leather produced to date.

Level of Commercialization: 8-10 years in commercial use. Available: World

Results of Application: A new universally applicable range of liquid dyestuffs is described. The liquid dyestuffs are distinguished by good solubility in alcohols and water and by their strong bond to the leather fibers. They have only a very slight tendency to migrate by heat, solvents, water or perspiration. Good lightfastness owing to their metal complex character and high build up in the drum dyeing of different kinds of leather round off the advantage of the range.

6.0 Economics: Not reported

7.0 Cleaner Technology Benefits

By using 1:2 metal complex dyestuffs in the drum: The linking to the fiber is better, resulting in a reduction of COD in the effluent of the dyeing process. In addition, the salt content of the effluent is reduced owing to the liquid formation of the dyes.

8.0 Obstacles, Problems and/or Known Contraints

Problems Encountered: Undesirable effects on the environment due to addition of a small quantity of metals to the effluent. Several azo dyes (with carcinogenic amino components) are subject of discussions concerning the health risks.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Pauckner W
Westdeutsche Gerberschule Reutlingen
PO 29 44, Erwin-Seiz-Str 9
D-7410 Reutlingen
West Germany
Tel: 07121/40056
Tlx: 729 868
Fax: 07121/4 54 93

Industry/Program Contact and Address:

Traubel H
Bayer AG
ATEA Leder
Bayerwerk
D-5090 Leverkusen
Tel: 0214/3071180
Tlx: 85103-257

Citation:

1. Westphal J, Proceedings VGCT Conference, Maastrickt, 1983.
2. Universal use of liquid metal complex dyestuffs, Westphal J, Leder, 1983, 34, 148-151/Leder Haute Markt, 1983, 29, 8-10.
3. Newer practical experiences with liquid dyestuffs in drum dyeing, Muller W and Westphal J, Leder Haute Markt, 1985, 37, 38-40 /Bayer Information for the Leather Industry, 1985.

Company information pack.

Keywords: Leather, Tanning, Leather Dyes, Metal Complex Dyestuffs, BOD/COD Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE (397) *****

1.0 Headline: Titanium salt as a pretanning agent.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Bagni W
Bitossi Dianella SpA
Via Pietramarina 18
I-50053 Sovigliane
Vinci
Firence
Italy
Fax: +571 50 98 87

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Less chloride required; Better uptake of chromium; Liquid waste benefit - chromium; Solid waste benefits - chromium; Other environmental claims/chrome-free solid by-products by pretanning for wet white. No chrome in solid wastes. Chrome can be reduced in the retanning.

Used in: Tanning
Cleanness: Good - best available to-date
Pretannage with titanium salts reduces the discharge of chrome in the effluent. The resulting chrome-free shavings are more suitable for versatile utilisations.

5.0 Case Study Summary

Stage of Development: Limited commercial use

Level of Commercialization: 2 years in commercial use. Available: Europe. First developed in: 1986

Results of Application: Non-chrome tanning agent useful in pretannage. All kinds of leathers were made by using 4-10% of ammonium titanyl sulphate. The received wet white can be stored for a long time without biocides. The solid wastes, eg, shavings, cuts, can be used for the production of animal feed, fertiliser and gelatine. The wet white can be retanned with chrome, vegetable and synthetic tanning agents for clothing leather, shoe upper leather, leather for leather goods and sole leather.

6.0 Economics: Not reported

7.0 Cleaner Production Benefits

Wastes: Total replacement of chrome is given in the pretanning effluents and the quantity of chrome in the retanning process can be reduced. The uptake of chrome is also better.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Undesirable effects on the environment from ammonia in the effluent. Very low pH required at the beginning of the pretannage.

9.0 Date Case Study was Performed: Unknown

10.0 Contacts and Citations

Abstractor and Address:

Germann H-P
Westdeutsche Gerberschule Reutlingen
PO 29 44, Erwin-Seiz-Str 9
D-7410 Reutlingen
West Germany
Tel: 07121/40056
Tlx: 729 868 Fax: 07121/454 93

Citation:

1. Pauckner W, Proceedings 20th IULTCS Congress, Philadelphia, 1989.

Company information pack.

Keywords: Leather, Tanning, Chromium, Chemical Alternatives, Titanium Salt, Ammonium Titanyl Sulphate

***** DOCNO: DOCUMENT NOT AVAILABLE (398) *****

1.0 Headline: Unhairing with enzymes and chrome tanning using the injection method (penetrator).

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Petersen A
J Krause GmbH
Post Box 50 09 68
Planckstrabe 13-15
D-2000
Hamburg 50

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Less chloride required; Recycled chromium; Better uptake of chromium; Liquid waste benefit - chromium; Liquid waste benefits - BOD/COD; Better working conditions. Less COD in effluent, saving of chrome-discharge from residual tanning liquors, saving chemicals and water.

Used in: Beamhouse Tanning
Cleanness: Good - best available to-date

5.0 Case Study Summary

Stage of Development: Trial / Protype & Limited commercial use 11-50 estimated number of enterprises in year 2000.

Level of Commercialization: 1 year in commercial use. Available: Europe, N. America, Australia & NZ & Asia. First developed in: 1980.

Results of Application: The new process technology uses pressure to inject the chemicals from the flesh- or grain-side into the hides and skins. Basing on a direct recycling of the process liquors, the new method saves chemicals and water and reduces the effluent loading. The technology reduces the problem of diffusion drastically, thereby accelerating the desired process and achieving a more homogenous distribution of the chemicals inside the hides. The hides remain in the orientated position throughout the whole process, improving the possibilities of rationalization of through-feed processing.

6.0 Economics

Investment Costs: Implementation costs: #1000001+

7.0 Cleaner Production Benefits

Wastes: COD is reduced by unhairing with enzymes and saving the hair and wool of hides and skins. The direct and continuous recirculation of the chrome liquor in the penetrator system eliminates an effluent loading in the tanning process.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: High costs initial outlay for the machine.

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Germann HP
Westdeutsche Gerberschule Reutlingen
Post Box 29 44
Erwin-Seiz-Str 9
D-7410
Reutlingen
Tel:07121/4 00 56-58 Tlx:729 868 Fax:07121/4 54 93

Industry/Program Contact and Address:

Petersen A
See above

Citation:

1. Unhairing and tannage with the penetrator by Petersen A & Germann HP Leder 1989 40 (9) 187-191.

2. Pauckner W. Proceedings JULICS Conference Venice 1983.

3. Pauckner W. Proceedings B Lederkongress Budapest 1986.

4. Pauckner W. Proceedings Symposia Freiburg 1989.

Information pack of the machine factory

Keywords: Leather, Tanning, Chromium Recycling, Source Reduction, Chemical Injection, Unhairing, Alternative Process, BOD/COD

***** DOCNO: DOCUMENT NOT AVAILABLE (399) *****

1.0 Headline: Pretannage of hides using aluminium sulphate for the production of wet white.

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Heidemann E
TU Darmstadt / Dept Protein & Leather
Petersenstrabe 22
D-6100 Darmstadt
Tel:06151/16 2175

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Less chloride required; Better uptake of chromium; Liquid waste benefit - chromium; Solid waste benefits - chromium; Energy saving; Chrome free solid by-products by pretanning for wet white. Chrome in spent tan liquor might be reduced by 90-95%.

Used in: Tanning
Cleanness: Good - best available to-date
The pretannage with aluminium salt can make real reductions of discharged chrome with no current additional environmental problems. Discharges of aluminium may be subject to environmental pressure in the future.

5.0 Case Study Summary

Stage of Development: Limited commercial use 11-50 estimated number of enterprises in year 2000. 1m sq ft of leather produced to date

Level of Commercialization: 4 years in commercial use. Available: World. First developed: 1984

Results of Application: Aluminium sulphate alone or aluminium salts in combination with a polymer tanning agent are used for the preservation of pelts to yield wet white. The wet white is stable to shaving and its retanning with chrome salts results in a leather, that is stable to boiling. Using aluminium sulphate alone 8-10%, in combination with the polymer 1-2% of the aluminium salt are required respectively. In the first case it is necessary to wash out the aluminium salt with a pickle solution before the retannage with chrome or other tanning agents. In the second case the obtained wet white may be retanned immediately.

6.0 Economics

Investment Costs: Implementation costs: #5001-10000

Payback Time: 5 years

7.0 Cleaner Production Benefits

Wastes: The quantity of chrome for the retannage is smaller and a better uptake of the chrome salt is achieved. The effluent loading of chrome is reduced as compared to a normal chrome tanning and the wet white shavings are chrome-free. Chrome in spent tan liquor might be reduced by 90-95%.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Undesirable effects on the environment - aluminium in effluent. It is not possible to get the same softness of the leather as with a chrome tannage. The wet white cannot be stored for a long time because of mold.

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Pauckner W
Westdeutsche Gerberschule Reutlingen
Post Box 29 44
Erwin-Seiz-Str 9
D-7410 Reutlingen
Tel:07121/4 00 56
Tlx:729 868
Fax:07121/4 54 93

Industry/Program Contact and Address:

Heidemann E
TU Darmstadt/Dept Protein & Leather
Petersenstrasse 22
D-6100 Darmstadt
West Germany
Tel: 06151/16 2175

Citation:

1. Compensation of chrome by other tanning agents by Zissel A et al Leder 1980 31(2)17-24

2. Tanning with aluminia salts by Bay B et al LMH 1985(14)28

3. Production of wet white by Heidemann E et al Leder 1982 v.33 p.131-136, 1985 v.36 p170-175, 1986 v.37 p.221-224, 1987 v.38 p.71-75

4. Heidemann E & Balstros B Leder 1984 v.35 p.186-189 Lutan V (BASF), TI/P 3042 d

Company information pack

Keywords: Leather, Tanning, Pretannage, Aluminum Sulphate, Chromium Alternatives, Wet White

***** DOCNO: DOCUMENT NOT AVAILABLE (400) *****

1.0 Headline: Recycling of lime sulphide effluent using ultrafiltration

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Aloy M
CTC (Centre Technique Cuir Chaussure Maroquinerie)
4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
Tel:(33)78 69 50 12
Tlx:340 497 F
Fax:(33)78 61 28 57

4.0 Clean Technology Category

Technology Principle: Liquid waste benefit - ammonia; Recycled sulphide; Liquid waste benefits - BOD/COD; Liquid waste benefits - suspended solids; Odor reduction 90% residual sulphide recycled. 50-60% ammonia recovered as solid waste.

Used in: Beamhouse
Cleanness: Good - best available to-date
Using ultrafiltration can make very good sulphide recovery without damaging of hides and skins and giving the possibility to recover some proteins.

5.0 Case Study Summary

Stage of Development: Limited commercial use 11-50 estimated number of enterprises in year 2000. 5m sq ft+ of leather produced to date

Level of Commercialization: 10 years in commercial use. Available: World. First developed in: 1980

Results of Application: Recycling of lime sulphide effluent after ultrafiltration treatment giving two parts:

1. An ultrafiltrate (90% of the volume) containing sulphide, a little lime and a low quantity of organics.

2. A concentrate (10% of the volume) with the insoluble lime, and large quantities of organics (proteins). The ultrafiltrate can be reused for a new lime sulphide process.

6.0 Economics

Investment Costs: Implementation costs #50001-100000

Payback Time: 18 months

7.0 Cleaner Production Benefits

Wastes: COD elimination in concentrate 50 to 60%. Total nitrogen 50 to 60%. Sulphide 90% in ultrafiltrate. Odor

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: High costs and clogging of membranes with calcium hydroxide

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Aloy M
CTC (Centre Technique Cuir Chaussure Maroquin
4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
Tel:(33)78 69 50 12
Tlx:340 497
Fax:(33)78 61 28 57

Industry/Program Contact and Address:

Aloy M
CTC (Centre Technique Cuir Chaussure Maroqui
Donikian Mr
Gordon Choisy (reptile tannery)
5 rue de la Grande-Haie
77130 Montereau
France
Tel:(33)1 64 32 13 50
Tlx:211 362
Fax:(33)1 47 00 70 48

Gand Mr
Tacham (reptile tannery)
25 rue Louis Chatin
42400 Saint Chamond
France
Tel:(33)77 22 12 73

Citation:

1. Tannery and pollution by Aloy M et al CTC 1976 p.307
2. Essais en station pilote d'ultrafiltration de bains residuaires de l' industrie du cuir by Vulliermet B et al Technicuir 1976 v.6 p.94-99
3. Separation des proteines des proteines des dechets de peaux brutes par technique membrane by Dubois M et al Technicuir 1978 v.4 p.53-63

Rhone-Poulenc Membrane Division
24 Quai Paul Doumer
92408 Courbevoie Cedex
France
Tel:(33)1 47 68 08 01

Keywords: Leather, Tanning, Lime Sulphide, Recycling, BOD/COD, Ultrafiltration, Ammonia

***** DOCNO: DOCUMENT NOT AVAILABLE (401) *****

1.0 Headline: Stabilization of hides and skins BSH (Blanc Stabilise Humide), BSS (Blanc Stabilise Se

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Gavend G
CTC (Centre Technique Cuir Chaussure Maroquinerie
4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
Tel:(33)78 69 50 12
Tlx:340 497
Fax:(33)78 61 28 57

4.0 Clean Technology Category

Technology Principle: Alternative to chromium; Less chloride required; Better uptake of chromium; Solid waste benefits - chromium; Alternative to solvents; Less solvents required; Liquid waste benefit - solvents; Liquid waste benefits - BOD/COD; Odor reduction; Better working conditions; Chrome free by-product. 10-15% better uptake chrome in tanning process. No solvent for sheep skin degreasing.

Used in: Beamhouse, Tanning & Other
Cleanness: Good - best available to-date
BSH process can make important reduction in chrome wastes (solid and liquid). Better valorization is possible in comparison with chrome solid waste (shavings). BSS process gives the possibility of solvent-free, or "freon"-free degreasing. BSH and BSS improve the sorting of hides and skins.

5.0 Case Study Summary

Stage of Development: Widespread use 51-100 estimated number of enterprises in year 2000 5m sq ft+ of leather produced to date

Level of Commercialization: 3 years in commercial use. Available: Europe, N. America, Australia & NZ & Asia. First developed in: 1986

Results of Application: Stage of preparation of hides and skins which presents: - potential diversification of the pickle without the acidity - stability of the wet blue without the problem of chrome use. It is a non-chrome process using the low tanning effect of complexed aluminum salts.

6.0 Economics: Not reported

7.0 Cleaner Technology Benefits

Wastes: Utilization of chrome tanning on BSH increases the fixation of about 10-15% of Cr_2O_3. Splitting and shaving of BSH give the possibility of considerable reduction of chrome solid wastes in tanneries. Degreasing of BSS is possible with water only and some surfactants. Chrome free by-product. 10-15% better uptake chrome in tanning process. No solvent for sheep skin degreasing.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Undesirable effects on the environment - possibly in the future (Aluminium)

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

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4 rue Hermann Frenkel
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Tel:(33)78 69 50 12
Tlx:340 497 Fax:(33)78 61 28 57

Industry/Program Contact and Address:

Balas A
Tanneries Grosjean
88160 Le Thillot
France
Tel:(33)29 25 00 07
Tlx:960 193
Fax:(33)29 25 81 29

Citation:

1. Bleu ou Blanc by Balas A. Industrie du Cuir 1988 (8802) p.27-29.
2. Elimination of salt pollution : Coupling of cooling of hides and wet white technology by Vulliermet B & Gavend G. JSLTC 1988 72 2 p.68-72.
3. Nouvelle matiere premiere pour l'industrie du cuir, le BSS - Aspects fondamentaux by Haran R & Gervais-Lugan M. Industrie du Cuir 1989 (8901) p.28-32

Regulatory Compliance: CTC Patent n deg 87-02035 du 11/oc/1987

Keywords: Leather, Tanning, Chromium, Chemical Alternatives, Stabilization, COD/BOD

***** DOCNO: DOCUMENT NOT AVAILABLE (402) *****

1.0 Headline: Chilling using cold air (bovine hides)

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

Gavend G
Centre Technique Cuir Chaussure Maroguinerie
4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
Tel: +33 78695012
Tlx:340497
Fax: +33 78612857

4.0 Clean Technology Category

Technology Principle: Alternative to chloride; Liquid waste benefit - chloride; Solid waste benefits - chloride; Alternative to biocide; Liquid waste benefit - biocide; Liquid waste benefits - total solids; Odor reduction; Better working conditions; About 50% less chloride in effluents.

Used in: Rawstock
Cleanness: Good - best available to-date
Hides are free of salt or other chemicals and the possibility of valorization of by-products is better. It is possible to have a specific enzymatic process at the beamhouse stage (sulphide free unhairing systems on chilled hides).

5.0 Case Study Summary

Stage of Development: Limited commercial use 11-50 estimated number of enterprises in year 2000. 1-5m sq ft of leather produced to date

Level of Commercialization: 5 years in commercial use. Available: Europe, N. America, Australia & NZ. First developed in: 1988

Results of Application: Preservation of fresh hides using cold air system with the possibility of antiseptic additives (level 2 degrees C to +2 degrees C). Optimization of manipulation of fresh and chilled hides, with diminution of labor costs. Adaptation and simplification of beamhouse process.

6.0 Economics

Investment Costs: Implementation costs: #10001-50000

Payback Time: 2 years

7.0 Cleaner Technology Benefits

Wastes: Suppression of salt in waste of curing units (liquid and solid). Important diminution of salt pollution in tanneries (about 50 to 60%).

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Technical problems

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Gavend G
CTC
France
Haefele C
4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
Tel: +33 78695012
Tlx:340497
Fax: +33 78612857

Citation:

1. Elimination of salt pollution: coupling of cooling of hides and wet white technology, Vulliermet B & Gavend G, JSLTC, 1988, 72, (2), 68-72.

2. The OCS chiller, Mattson G & Tomoser T, Leather Manufacturer, 1988, 4, 24-26

Keywords: Leather, Tanning, Process Alternatives, Hide Chilling, Waste Reduction, Chloride (Salt)

***** DOCNO: DOCUMENT NOT AVAILABLE (403) *****

1.0 Headline: Finishing leather process ICC (Instant Colour Concept)

2.0 ISIC Code: Not provided

3.0 Name and Location of Company:

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4 rue Hermann Frenkel
69367 Lyon Cedex 07
France
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Tlx:340497
Fax: +33 78612857

4.0 Clean Technology Category

Technology Principle: Alternative to solvents; Liquid waste benefit - solvents; Liquid waste benefits - BOD/COD; Odor reduction; Energy saving; Better working conditions; Other environmental claims/air pollution decrease. Non-solvent finishing. Nearly 100% use of finishing materials.

Used in: Finishing Energy usage
Cleanness: Good - best available to-date
Utilization of ICC process allows the best utilization of chemicals (no waste). It is a solvent free process.

5.0 Case Study Summary

Stage of Development: Limited commercial use 51-100 estimated number of enterprises in year 2000. -1m sq ft of leather produced to date

Level of Commercialization: 2.5 years in commercial use. Available: Europe, N. America, Australia & NZ, S. America. First developed in: 1987

Results of Application: Process of finishing of leather using UV reticulation of specific chemicals (UV curable polymers). This process is specially adapted for finishing of leather precuts for shoe manufacturing.

6.0 Economics

Investment Costs: Implementation costs: #50001-100000

Payback Time: 2 years

7.0 Cleaner Technology Benefits

Wastes: Total suppression of solvent emissions in the air. All the chemicals disposed on the leather are transformed in a finishing film after UV curing. Air pollution decrease. Non-solvent finishing. Nearly 100% use of finishing materials.

8.0 Obstacles, Problems and/or Known Constraints

Problems Encountered: Technical problems. Choice of finishes.

9.0 Date Case Study was Performed: 1990

10.0 Contacts and Citations

Abstractor and Address:

Gavend G
CTC
France

Industry/Program Contact and Address:

Vitteau B
CTC

Citation:

1. The challenge of ICC (Instant Colour Concept). Zero stock level and zero delay, by Vulliermet B, Vitteau B & Gavend G, Proc IULTCS Conf, Philadelphia, 1989, L-14.

2. Le challenge d'ICC - Zero stock, zero delai, by Vitteau B, Gavend G & Vulliermet B, Industrie du Cuir, 1988, 8807, 81-83.

CTC Patent No 87 09163, January 23, 1987.

Keywords: Leather, Tanning, Leather Finishing, Alternative Chemicals, Solvent, Ultraviolet (UV) Curable Polymers, Air Emissions

***** Document No. 453-001-A-000 *****

1.0 Headline: New tanning process reduces chromium use and waste in the leather tanning industry

2.0 SIC Code: Leather Tanning and Finishing/3111

3.0 Name and Location of Company:

British Leather Company
Tranmere Tannery
Birkenhead L41 9BS, England

4.0 Clean Technology Category: The tanning process was modified by using a two-stage process and metal combinations to allow a smaller amount of chromium to be used.

5.0 Case Study Summary

5.1 Process and Waste Information: The level of trivalent chromium normally used as a tanning agent for high quality leather is between 4-5 percent by weight. With even the most efficient processing some 30% of the chrome offered to the hide is left in the tanning liquor.

The new technology employs a two stage tanning process. The first stage uses the ICI 'TAL' process: the liquor is based on titanium, aluminum and magnesium. In the second stage, a chromium tan is used with 9 percent chromium instead of the normal 17 percent chromium. This results in a leather with a chromium content of about 3 percent but with characteristics comparable to traditional leather.

5.2 Scale of Operation: The company employs over 300 people at two tanneries and processes about 6,000 hides per week.

5.3 Stage of Development: The technology is fully operational.

5.4 Level of Commercialization: The technology is commercially available.

5.5 Material/Energy Balances and Substitutions: The technology reduces the chromium content of the spent liquor from 1,200 to 350 ppm and the level in the final effluent to 10 ppm.

6.0 Economics*

6.1 Investment Costs: Considerable research was carried out to identify the optimum tanning properties of the various combinations of metals used in the first stage of the process. No new capital equipment or investment is needed and the technology can be used with the existing plant.

6.2 Operational and Maintenance Costs: The company saved 160,000 English Pounds that it would have cost to install the wastewater treatment equipment required to achieve the same chromium effluent concentration achieved by the process change. A modest savings in tanning reagent costs is reported.

6.3 Payback Time: No information provided.

7.0 Cleaner Production Benefits

The main incentive to develop the new technology was an anticipated tightening of future wastewater discharge standards. The chromium level in the discharge is substantially reduced by this technology.

8.0 Obstacles, Problems and/or Known Constraints

None reported

9.0 Date Case Study Was Performed

Unknown

10.0 Contacts and Citation

10.1 Type of Source Material: Government Publication.

10.2 Citation: Clean Technology, Environmental Protection Technology Scheme, Department of the Environment, 2 Marsham Street, London SW1P 3EB, 1989, p4.

10.3 Level of Detail of the Source Material: Simple diagram of process provided.

10.4 Industry/Program Contact and Address: Arthur Jones, Production Director, The British Leather Co. Ltd, Tranmere Tannery, Birkenhead L41 9BS, England, Telephone (051) 647-6252.

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Chromium wastes, spent tanning liquor

11.2 Process type/waste source: Tanning

11.3 Waste reduction technique: Process modification, source reduction, raw material substitution

11.4 Other keywords: United Kingdom, SIC 3111

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Chromium Wastes, Spent Tanning Liquor, Tanning, Process Modification, Source Reduction, Raw Material Substitution, United Kingdom, SIC 3111

***** DOCNO: 400-054-A-241 *****

INDUSTRY/SIC CODE:	Manufacture of Leather/SIC 3111
NAME/CONTACT:	Institute for Leather and Shoe Research/tonNO; Ministry of Public Health and Environmental Protection of the Netherlands
TECHNOLOGY DESCRIPTION:	The company removes trivalent chromium from the effluent and re-uses it in the tanning process. The mean concentration of chromium (III) in the effluent is 5 kg/m^3. This effluent is treated with MgO, producing a fast-settling and compact precipitate, $Cr(OH)_3$. The chromium (III) concentration in the effluent is thus reduced to 2 g/m^3 (a reduction of more than 99 percent). The $Cr(OH)_3$ is then dissolved in sulfuric acid for re-use in the tanning process.
FEEDSTOCKS:	Tanning process effluents containing chromium (III), sodium sulfate, sodium chloride, and organic salts.
Wastes:	Effluent containing 1 g/m^3 trivalent chromium, 40 kg sludge/ton of hide material generated on sand filters.
MEDIUM:	Aqueous
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	The advantages of the technology include a less pollution effluent and a 40 percent saving in the chromium required for tanning.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recovery and Re-Use of Trivalent Chromium in the Leather Tanning Industry", Monograph ENV/WP.2/5/Add.54.
KEYWORDS:	Leather Tanning, Chromium, Precipitation, SIC 3111

METAL PRODUCTS MANUFACTURING

***** DOCNO: 400-032-A-221 *****

INDUSTRY/SIC CODE:	Manufacturing of Metal Products, Machines and Material/ISIC 3819
NAME/CONTACT:	Ministere de l'Environnement et due Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The facility is involved with priming and lacquering aluminum foil. In the low pollution technique, the solvent vapors emitted during the hot air drying of the lacquer are recovered with activated carbon. The activated carbon, in a second operation, is steam cleaned. The solvent vapor and water vapor mix is sent into a distilling column after condensation. After condensation, the solvents obtained are recycled to the workroom where the lacquer is prepared. In the standard process, the solvent vapors from the drying of the lacquer are discharged directly into the atmosphere without treatment. This is the first industrial application of the recovery of ketonic solvent vapors, generally considered as a difficult procedure. As the technical results were positive as far as the reduction of pollution is concerned and the economic results should be satisfactory given the expected increase in the prices of petroleum based solvents, the use of this process should be extended to activities employing the same types of products.
FEEDSTOCKS:	Solvent vapors
WASTES:	The waste produced is made up of ketonic and ethylic solvent vapors.
MEDIUM:	Air
COST:	(1978 Francs)
CAPITAL COST:	F 3.85 million
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Virgin solvent requirements reduced by a factor of three.
WASTE PRODUCTION:	With the low pollution technique, 30 kg of solvent vapors are released into the atmosphere per ton of solvent used. With the standard technique, the quantity of the waste released is 700 kg.
IMPACT:	The amount of new solvents required is reduced by three due to recycling. Energy needs are increased by 13.5 GJ per ton of solvent used in order to produce the vapor necessary for cleaning the activated carbon and the distillation of the recovered solution.

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recovery and Recycling of Solvents from Vapors Originating from Priming and Painting of Aluminum Foils", Monograph ENV/WP.2/5/Add.32.

KEYWORDS: Solvent, Air Drying, ISIC 3819, Activated Carbon, Distillation

***** DOCNO: 400-071-A-308*****

HEADLINE:	Spinning rings hardened on a fluidized bed dry process eliminates waste production.
INDUSTRY/SIC CODE:	Manufacture of Metal Products, Machinery and Equipment/ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	This audit of manufacturer of spinning rings, used in the textile industry, suggests that by replacing the conventional cyanurated salts bath followed by rapid oil cooling hardening process with a dry process on a fluidized bed there is almost no waste generated. Baskets containing parts to be hardened are dipped into a fluidized bath of nitrogen and corundum particles at temperature between 840 and 860 degrees C. Baskets are then dipped into another fluidized bath at 50 degrees C. Corundum left on processed parts is recovered and recycled.
FEEDSTOCKS:	0.4 kg of corundum, 25 m^3 of nitrogen and 0.63 GJ of electricity per 1000 spinning rings.
WASTES:	Negligible amount of dust
MEDIUM:	Fluidized bath of nitrogen and corundum particles
COST:	(Annual production of 300,000 spinning rings)
CAPITAL COST:	FF 185,000 (1979 figures)
OPERATION/MAINTENANCE:	60% of the O&M costs for the standard technology (excluding treatment plant operating costs).
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 125,000 (1979 figures, including the capital cost for the treatment plant).
FEEDSTOCK REDUCTION:	Corundum left on processed parts is recovered and recycled.
WASTE PRODUCTION:	The polluting wastes generated by the standard technology: used cyanurated salts, oil fumes, and rinse water at a pH of 12.5 (3.5 m^3 per 1,000 rings, containing 75 Equitox) are completely eliminated.
IMPACT:	This technology is more flexible in its application than the standard technology.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Hardening of Spinning Rings by a Dry Process on a Fluidized Bed", Monograph ENV/WP.2/5/Add.71.
KEYWORDS:	Textiles, Metal Hardening, ISIC 38, Fluidized Bed, Corundum, Recovery, Recycling

***** DOCNO: 400-072-A-309*****

HEADLINE:	Ultrafiltration of spent cutting fluids allows reuse of oil and reduces disposal volume of spent oils.
INDUSTRY/SIC CODE:	Manufacture of Metal Products, Machinery and Equipment/ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	Ultrafiltration may be used to reduce the volume of spent cutting fluids generated from cold machining. The spent cutting fluids are first processed through a magnetic filter and a paper filter before ultrafiltration. The latter process ensures filtration at the molecular level because molecules of pollutants are generally larger than those of active products. The filtrate is then submitted to a quality test. If highly contaminated, the filtrate is incinerated. If not, it is recycled. The standard process does not include ultrafiltration.
FEEDSTOCKS:	Spent cutting fluids
WASTES:	Filtration solids, filtrate (if highly contaminated)
MEDIUM:	Spent fluids
COST:	
CAPITAL COST:	FF 200,000 (1976 figures)
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 142,700 per year (1980 figures)
FEEDSTOCK REDUCTION:	476 m^3 of cutting fluids with the low-waste technology (versus 993 m^3)
WASTE PRODUCTION:	Eliminates disposal of 24 m^3 of cutting fluid.
IMPACT:	The volume of filtrate to be incinerated is reduced.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Cold Machining with Recycling of Cutting Fluids after Ultrafiltration", Monograph ENV/WP.2/5/Add.72
KEYWORDS:	Machining, ISIC 38, Ultrafiltration, Recycling, Cutting Oil

***** DOCNO: 400-097-A-322*****

HEADLINE:	Regeneration and copper recovery of sulfuric acid pickling baths is accomplished by recycling the rinse water back to the copper pickling process instead of detoxication.
INDUSTRY/ISIC CODE:	Non-ferrous Metal Basic Industries/ISIC 3720
POLLUTION PREVENTION OPTIONS SUMMARY:	Regeneration and copper recovery of sulfuric acid pickling baths is accomplished in a continuous electrolysis process. Part of the rinsing water is recycled to the copper pickling process, and the remaining part is detoxicated. Current technology requires detoxication of the chemical baths and all of the rinsewaters.
FEEDSTOCKS:	Electrical energy - 3.2 MJ, Sulfuric acid
WASTES:	Rinse water containing 40 g of copper and 50 g of free acid per ton of copper
MEDIUM:	Water
COSTS:	
CAPITAL COST:	140,000 francs (1977 franc) for pickling 12,000 tons of copper
OPERATION/MAINTENANCE:	Additional operating expenses are considerable lower than revenues from selling the copper, and savings in sulfuric acid and running cleaner operations
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Revenues from sales of 200 g of copper/ton processed
FEEDSTOCK REDUCTION:	Reduction in sulfuric acid requirements
WASTE PRODUCTION:	Rinse water is reduced in volume, copper content is reduced by 210 g, and free acid is reduced by 450 g
IMPACT:	This recycling technology significantly limits the volume of wastes requiring detoxication while recovering sulfuric acid feed, and copper for resale.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Pickling of Copper Parts: Electrolysis of Used Pickling Baths", Monograph ENV/WP.2/5/Add.97.
KEYWORDS:	Nonferrous Metal, Pickling, Recycling, Electrolysis, ISIC 3720

***** DOCNO: 400-008-A-199 *****

INDUSTRY/SIC CODE:	Hardening and Zinc-Coating of High-Strength Bolts, Chains and Wire Components/ISIC 3710
NAME/CONTACT:	Oy Navire Ab, SF-21600 Parainen, Finland Mr. Pentti Sippola
TECHNOLOGY DESCRIPTION:	The Zinquench process is a continuous hardening and zinc-coating process. In the Zinquench process the main stages are (1) austenitizing at normal hardening temperature (approx. 900° C), (2) quenching in zinc bath where the hot-dip coating simultaneously takes place at 400° C, (3) centrifuging and finally (4) water cooling.
FEEDSTOCKS:	
WASTES:	Not reported
MEDIUM:	Not reported
COST:	
CAPITAL COST:	$900,000
OPERATION/MAINTENANCE:	$115/g
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	$95/g
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	The process saves energy. Only about 40 per cent of the energy for conventional technology is needed (60 per cent energy savings). These savings result from the tempering furnace not being used in the process and the zinc bath not requiring a constant heat supply.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Continuous Hardening and Zinc-Coating (Zinquench)", Monograph Env/WP.2/5/Add.8
KEYWORDS:	Metal Hardening, Zinc Galvanization, Metal Treating, Zincquench, ISIC 3710.

***** DOCNO: 400-036-A-225 *****

INDUSTRY/SIC CODE:	Manufacturing of Metal Objects, Machines and Material/ISIC 3819
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	In the low pollution technique, the brass parts to be treated are first placed in a vibration apparatus with abrasive glass marbles and slightly acid additive. After rinsing, the parts are placed in a second apparatus for etching with steel balls and basic additive, then they are dried.
FEEDSTOCKS:	Brass parts
WASTES:	The wastes produced by the low pollution process are made of used baths of acid reagents, which are sent for detoxification. The rinse water is mixed with the baths of basic reagents. The mixture is then stored for pH control, filtered to eliminate heavy particles, and sent back into the circuit.
MEDIUM:	Water, Air
COST:	(1979 Francs)
CAPITAL COST:	F 265,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	The low pollution technique eliminates the need to detoxify nitric acid baths, perform soda neutralization of nitric vapor, and treat rinse waters
IMPACT:	Not reported
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Descaling of Metal Objects by means of Vibration/Abrasion", Monograph ENV/WP.2/5/Add.36.
KEYWORDS:	Process Change, Abrasive Cleaning, ISIC 3819

***** DOCNO: 450-003-A-358*****

HEADLINE:	Moyer Diebal replaced liquid paint system with powder coating process, eliminated paint sludge, and reduced energy consumption.
INDUSTRY/SIC CODE:	Machinery/ISIC 38
NAME/CONTACT:	Moyer Diebel Jordon, Ontario G. Evans
POLLUTION PREVENTION OPTIONS SUMMARY:	An automated powder coating process is used in a small paint line in the manufacture of vending machines. It was found that the powder coating sticks better and requires less cleaning. As a result, the company was able to reduce its 4-stage prewash system to 3 stages. An efficient overspray system allows for 95-99% of the 5,000 lbs of powder used each month to be used for coating. Thus, the company does not accumulate paint sludge wastes.
FEEDSTOCKS:	Powder coating
WASTES:	Waste feed materials, rinsewater
MEDIUM:	Powder, sludge
COST:	
CAPITAL COST:	$280,000
OPERATION/MAINTENANCE:	15% lower than a liquid paint line.
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	Reduced paint requirements due to improved efficiency, 35% less energy required.
WASTE PRODUCTION:	Reduction in prewash stages reduces wastewaters, efficient powder use eliminates paint sludge.
IMPACT:	A more efficient, dry powder paint line allows for reduced raw material requirements and reduced waste generation.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects", Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 58.
KEYWORDS:	Paint, Coating, ISIC 38

MINING

***** Doc # 501-016-A-000 *****

1.0 Headline: Thin layer process of copper and uranium ore-leaching cuts water use by up to 75% and reduces dust generation.

2.0 SIC Code: SIC 1021, SIC 1094, Copper ores/Uranium-radium-vanadium

3.0 Name and Location of Company:

Sociedad Minera Pudahuel, Ltda.
Santiago, Chile.

4.0 Clean Technology Category

This technology involves using thin-layer (TL) leaching to process ores using less water, thereby reducing tailings volume.

5.0 Case Study Summary

5.1 Process and Waste Information: The Thin Layer (TL) process involves spreading the crushed ore in layers 3 ft. thick or less for leaching. After treatment with concentrated sulfuric acid, which liberates the copper or uranium, the crushed ore is allowed to cure for a day. It is then spread over shallow beds for leaching. The shallowness of the beds permit uniform contact between the leach liquor and the ore by minimizing compacting and channeling. In agitation leaching, the conventional copper and uranium process, tailings are typically mixed with about 50 wt. % of water for disposal. In the TL process, water use may be as little as one-fourth the amount needed for agitation leaching.

5.2 Scale of Operation: The operation was expected to handle 2,600 metric tons/day of copper ore.

5.3 Stage of Development: Ore has been processed in bench tests and at an 8-ton/day uranium ore demonstration plant in Moab, Utah. Full scale implementation was scheduled for late 1979.

5.4 Level of Commercialization: The technology is commercially available.

5.5 Material/Energy Balances and Substitutions: This technology uses 25 percent less water than the conventional leaching method.

6.0 Economics*

6.1 Investment Costs: The investment is $30 million ($1,875 per annual ton of copper produced based on 355 production days/year) for the leach, solvent-extraction and electrowinning sections. Figures are in US dollars and based on 1978 prices. There is a 50% cost savings compared to an agitation leach facility. The comparison only includes the mill section.

6.2 Operational and Maintenance Costs: A 5% to 15% reduction in operating costs are expected compared to agitation extraction. A 40 to 60% smaller solvent-extraction plant is required because the metal concentration in the leach liquor can be controlled to a higher concentration than in agitation leaching. Tailing disposal costs are lower because tailings take up only 25% of the volume compared to tailings from agitation leaching methods.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Economic benefits from reduced water use are expected. The tailings have about one-fourth those generated using the conventional process. Less fugitive dust is generated because the TL process only requires ore to be crushed to 3/8 inch size versus <65 mesh for cooper and <28 mesh for uranium so there are fewer fines, minimizing windblown dust.

8.0 Obstacles, Problems and/or Known Constraints

None were identified.

9.0 Date Case Study Was Performed

April 1978

10.0 Contacts and Citation

10.1 Type of Source Material: Book.

10.2 Citation: Process Technology and Flowsheets, articles which appeared in Chemical Engineering over the last five years. V. Cavaseno and Staff of Chemical Engineering, McGraw-Hill, NY, NY, 1979. Cu/U ore-leaching route cuts pollution, trims costs, Gerald Parkinson. Pg. 108.

10.3 Level of Detail of the Source Material: Detailed process information and flow sheet provided.

10.4 Industry/Program Contact and Address: Holms & Naver, Inc., 999 Town and country Rd., Orange, CA 92668.

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: mine tailings, slurry

11.2 Process type/waste source: Metal mining, cooper ores, uranium ores

11.3 Waste reduction technique: process redesign, volume reduction thin-layer (TL) process

11.4 Other keywords: volume reduction, SIC 1021, SIC 1094

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Mine Tailings, Slurry, Metal Mining, Copper Ores, Uranium Ores, Process Redesign, Volume Reduction Thin-Layer (TL) Process, Volume Reduction, SIC 1021, SIC 1094

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NONFERROUS METALS

***** DOCNO: 400-069-A-306*****

HEADLINE:	Copper pickling operation uses alcohol instead of acid and eliminates acid dumps and rinsewater discharges.
INDUSTRY/SIC CODE:	Metallurgical Industry/ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	A pickling of copper wire process which utilizes alcohol produces no pollutant discharge. The wire rod, hot and slightly oxidized, leaves the mill and enters a pickling chamber fed with alcohol which reduces copper oxides present in metal form. In the standard technology the pickling process is achieved with a similar installation, but acid is used to dissolve the oxides and the metal. It is then necessary to rinse with water.
FEEDSTOCKS:	Alcohol
WASTES:	None
MEDIUM:	Liquid
COSTS:	
CAPITAL COST:	FF 300,000
OPERATION/MAINTENANCE:	FF 8.55 per ton of pickled wire
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	With the low-waste technology pickling one ton of wire requires 4 liters of alcohol solution, versus 2 kg of H_2SO_4 at 66 degrees. With the standard technology. Furthermore, the standard technology requires 750 liters of rinse water and 0.75 kg of effluent-neutralizing products.
WASTE PRODUCTION:	There is no polluting discharge with the low-waste technology. The standard technology generates 750 liters of waste per ton of pickled wire, consisting of: 20 g of suspended matter, 15 g of oxidizable matter, and toxicity = 0.3E. The neutralization process produces 2 kg of sludge per ton of pickled wire.
IMPACT:	The new process can be applied only to continuous casting and drawing units. Alcohol pickling is only feasible when surface oxidation is light and when the copper is at a temperature sufficiently high for the chemical reaction to occur.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Pickling of Copper Wire with Alcohol.", Monograph ENV/WP.2/5/Add.69.
KEYWORDS:	Metallurgical Industry, ISIC 3800, Pickling, Alcohol, Copper

***** DOCNO: 400-068-A-305*****

HEADLINE:	Mechanical descaling of wire-rod coils eliminates hot acid bath discharges and provides a more reliable and safer descaling process.
INDUSTRY/SIC CODE:	Metallurgical Industry/ISIC 38
POLLUTION PREVENTION OPTIONS SUMMARY:	The standard technology dips wire-rod coils in a hot acid bath, rinsed and then treated with lime in order to neutralize any trace of acid. In the new process, wire-rod is descaled by roller-binding. It then goes through a sanding chamber where it is sand blasted. The surface quality thus achieved permits wire-drawing. The low-waste dry and wet processes require 0.5 GJ per ton of descaled wire-rod versus 2.35 GJ in the standard technology.
FEEDSTOCKS:	Water
WASTES:	Scale from the metal descaling operation
MEDIUM:	Solid
COST:	
CAPITAL COST:	FF 500,000 (1979 figures)
OPERATION/MAINTENANCE:	FF 22.9 per ton (1979 figures)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 26.6 per ton descaled.
FEEDSTOCK REDUCTION:	3.99 m^3 of water per ton of descaled wire-rod.
WASTE PRODUCTION:	5 kg of scale
IMPACT:	Greater safety and reliability due to the absence of hot acid.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Mechanical Descaling of Wire Rods by a Dry or Wet Process", Monograph ENV/WP.2/5/Add.68.
KEYWORDS:	Metal Finishing, Wire, Descaling, ISIC 38

***** DOCNO: 400-098-A-260 *****

INDUSTRY/SIC CODE:	Non-ferrous Metals/ISIC 3720
TECHNOLOGY DESCRIPTION:	This process transforms blende into zinc oxide by roasting with fabrication of H_2SO_4 through catalysis of roasting gases and integrated treatment of tail gases. The blende is roasted to obtain zinc oxide. The resulting gases are sent, in succession, to a scrubbing unit, a catalysis unit and then to a concentration column. Tail gases are treated and recycled. The resulting sulphite mud is mixed with wastes from the gas scrubber, neutralized, and settled.
FEEDSTOCKS:	Blende
WASTES:	Tail gases, sludge
MEDIUM:	Gaseous
COST:	(Francs 1980)
CAPITAL COST:	1,800,000
OPERATION/MAINTENANCE:	2 Francs per ton ZnO
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	2 Francs per ton ZnO
FEEDSTOCK REDUCTION:	The low pollution technique leads to the production of 1.037 tons of H2SO4 for one ton of ZnO.
WASTE PRODUCTION:	The production of one ton of ZnO gives rise to the rejection of 3 kg (against 22 kg for conventional technology) of SO_2 into the atmosphere.
IMPACT:	The low pollution technique permits improving catalysis efficiency through recycling of SO_2 and thus transformation efficiencies to be obtained that are comparable with that of the double catalysis process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Transforming Blends into Zinc Oxide by Roasting With Fabrication of H2SO4 Through Catalysis of Roasting Gases and Integrated Treatment of Tail Gases", Monograph ENV/WP.2/5/Add98.
KEYWORDS:	Acid Catalysis, ISIC 3720, Tail Gases, Blende

***** DOCNO: 400-095-A-320*****

HEADLINE:	Brass turnings are recycled and heat recovered from recycling process reduce energy requirements.
INDUSTRY/SIC CODE:	Nonferrous Metal Basic Industries/ISIC 3720
POLLUTION PREVENTION OPTIONS SUMMARY:	Brass turnings are compressed and transformed into briquettes to reduce the free area and to reject part of the oil contained in the turnings. Remaining oil is removed by drying in an oven. Briquettes are then sent to a melting furnace. Fumes are filtered and heat is recovered. With the standard techniques, briquettes are sent directly to the melting furnace and resulting fumes are not processed.
FEEDSTOCKS:	Per one ton of briquettes, 1.06 tons of turnings are required, 980 MJ of electricity, 315 MJ of butane.
WASTES:	16,500 m^3 of fumes are rejected containing 0.5 kg of unburnt residues
MEDIUM:	Gaseous
COSTS:	
CAPITAL COST:	5,200,000 francs
OPERATION/MAINTENANCE:	650,000 francs/year (minus revenues of 780,000 francs)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	700,000 francs in additional sales of brass, 80,000 francs from energy recovery (operating costs of low waste technology are 650,000 compared to 200,000 francs/year for conventional technology, investment is 5,200,000 compared to 2,000,000).
FEEDSTOCK REDUCTION:	Reduction of 0.03 tons of turnings, increased usage of energy consisting of 635 MJ electricity and 315 MJ butane.
WASTE PRODUCTION:	16,500 m^3 of fumes are rejected (compared to 3,700 m^3 with conventional technology) containing 0.5 kg unburnt residues (compared to 11 kg).
IMPACT:	Significant reduction in concentration of unburnt residues in fume emissions. Working conditions are also improved.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Melting of Brass Turnings in and Electric Furnace with Previous De-oiling of Turnings and Heat Recovery", Monograph ENV/WP.2/5/Add.95.
KEYWORDS:	Nonferrous Metal, Energy Recovery, Gas Filtration, Brass Turnings, ISIC 3720

***** DOCNO: 400-114-A-327*****

HEADLINE:	QSL Process, developed to smelt lead sulphide concentrates and sulphate secondaries, reduces fuel requirements by 60% and waste gases by 80%.
INDUSTRY/SIC CODE:	Non-ferrous Metal Basic Industries/ISIC 3720
POLLUTION PREVENTION OPTIONS SUMMARY:	The QSL Process has been developed to smelt lead sulphide concentrates as well as sulphate and mixed oxide-sulphate secondaries such as flue dusts, battery paste or lead-silver residues. As in conventional lead smelting, the gangue minerals contained in the raw materials are separated from the molten metal in the form of a fluid siliceous slag. Instead of two separate steps of sintering and blasting in a furnace, the QSL Process is a one-step process of continuous smelting of the charge, with the resulting pellets directly fed to the oxidation and reduction zones of the reactor. Sulphur dioxide gas emissions of about 15 to 25% by volume are utilized in the manufacture of sulfuric acid. Any sulphur contained in reduction coal or fuel is recovered, and the precipitated flue dust is directly recycled to the mixing section.
FEEDSTOCKS:	Lead concentrate, fuel (coal), oxygen, nitrogen, fluxes, electrical energy
WASTES:	Air exhaust, dust, discarded slag
MEDIUM:	Gaseous, solid
COST:	
CAPITAL COST:	DM 90-110 million
OPERATION/MAINTENANCE:	235 DM/ton lead bullion
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	30 million DM in capital cost, 149 DM/ton lead bullion in operating costs
FEEDSTOCK REDUCTION:	60% reduction in fuel consumption, recycling of precipitated flue dust
WASTE PRODUCTION:	Waste gases are reduced from 20,000 to 25,000 m^3/ton of lead (20 mg dust/m^3), to 4,000 to 5,000 m^3/ton of lead (10 to 20 mg dust/m^3). Sulphur dioxide gas can be used in sulfuric acid production, instead of emitting to the air.
IMPACT:	The QSL Process is a continuous one-step process with low investment and operating costs compared to the conventional technology. Energy recovery reduces the fuel requirements by 60%, and sulphur contained in the raw materials is recovered. The volume of waste gases emitted to the environment is reduced by 80%, and the SO_2 emissions are eliminated.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Continuously Operating Direct Lead Smelting Process (QSL)", Monograph ENV/WP.2/5/Add.114.
KEYWORDS:	Nonferrous Metal, Lead, Smelting, QSL Process, Energy Recovery, Reduction Furnace, Gas Collection, ISIC 3720

***** DOCNO: 400-009-A-200 *****

INDUSTRY/SIC CODE:	Ferrochrome Production and Raw Materials/ISIC 3710
NAME/CONTACT:	Outokumpu Oy, SF-02200 Espoo 20, Finland Mr. Bengt Norrman
TECHNOLOGY DESCRIPTION:	Outokumpu Oy has developed a ferrochrome process, where chrome ore fines and ores with a low chrome content can be used as raw material to produce ferrochrome. Special attention has been paid to the environmental aspects, when developing this process, and total energy consumption is low. Ore fines or concentrate are first ground in a wet grinding mill with grinding media to the fineness required for pelletizing. Sludge from grinding is filtered before pelletizing, which is performed by a pelletizing disc. The sintering of pellets takes place in the vertical shaft furnace at the temperature of approximately 400° C. Its burners are designed to use electric furnace CO-gases and coal mixed with the pellets. The sintering pellets together with coke and slag forming materials are dosed into the preheating furnace, where carbon monoxide from the arc furnace is used as fuel. Preheated feed mixture is fed through the feeding ring continuously into the totally closed electric smelting furnace. Waste gas from the furnace is cleaned before use as a fuel in the sintering and preheating furnaces. Molten ferrochrome is granulated or cast into molds which are crushed after cooling.
FEEDSTOCKS:	Furnace CO-gas is used in the sintering furnace of pellets and in preheating the smelting charge.
WASTES:	From different stages of the process, dust recovered from waste gas purifications is brought back to the process through pelletizing.
MEDIUM:	Not reported
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Energy savings, use of lower grade ores and raw materials and reduced slag and gas generation.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Outokumpu Ferrochrome Process", Monograph ENV/WP.2/5/Add.9.
KEYWORDS:	Ferrochrome, ISIC 3710, Energy Recovery

NONMETALLIC MINERAL PRODUCTS

***** DOCNO: 400-031-A-220 *****

INDUSTRY/SIC CODE:	Manufacturing of non-metallic mineral products with the exception of petroleum and coal derivatives/ISIC 3699
NAME/CONTACT:	Ministere de l'Environment et due Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard de General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company manufactures asbestos-cement panels and pipes and recycles the water used in the process. The asbestos and the cement are mixed in water. The resulting mixture is placed on a cloth rolling at high speed, is drained and forms a thin layer that serves as a base for the panels and pipes. The water drained off in both processes is decanted twice. The residue from the first decanting is recycled; that from the second is also recycled in the low pollution process, while it is discharged in the standard process.
FEEDSTOCKS:	Wastewater from asbestos-cement panels.
WASTES:	Pollution is mainly due to water that is discharged.
MEDIUM:	Water
COST:	(1980 Francs)
CAPITAL COST:	F 5,500,000
OPERATION/MAINTENANCE:	F 2.6/ton asbestos-cement
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Residue discharged reduced by 57%, nearly eliminates wastewater production.
IMPACT:	Reduces volume of disposed residue, and reduces wastewater discharge.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recycling of Water from Manufacturing of Asbestos/Cement Panels and Pipes", Monograph ENV/WP.2/5/Add.31.
KEYWORDS:	Cement, Asbestos, ISIC 3699, Wastewater, Recycling

***** DOCNO: 400-001-A-192 *****

INDUSTRY/SIC CODE:	Manufacture of Non-Metallic Molded Mineral Products Unclassified Elsewhere/ISIC 3699
NAME/CONTACT:	Mineral Products, Ave. du Bois 31, 4920 Embourg, Belgium. National Institute of Extractive Industries (UNIEX), rue du Chera Zoo, 400 Liege, Belgium
TECHNOLOGY DESCRIPTION:	This company crushes quarry waste or glass for recycling, produces pulp by mixing polyester resin with the charge, and places the pulp in ambient temperature molds. After vibration, the shaped elements are taken out of the mold. Material and energy requirements per ton of product manufactured include: 1) 850 kg of mineral charges, 2) 130 kg of polyester resin, 3) 20 kg of various materials, 4) 3 GJ of energy. The resulting waste is nil and is comprised of any dust and styrene emanations.
FEEDSTOCKS:	Quarry waste and recycling glass
WASTES:	None
MEDIUM:	Solid
COST:	
CAPITAL COST:	$ 1,666,667
OPERATION/MAINTENANCE:	$ 432,000
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Waste dumped in the environment is reduced to none.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Use of Quarry Wastes or Waste Glass", Monograph ENV/WP.2/5/Add.1.
KEYWORDS:	Waste Glass, Quarry Waste, ISIC 3699, Molded Products

***** Document No. 453-001-A-000 *****

1.0 Headline: Cement kiln NOx and SOx emissions reduced by improved process control

2.0 SIC Code: SIC 3241, Cement, Hydraulic

3.0 Name and Location of Company:

Blue Circle Industries pic, Hope Works facility

4.0 Clean Technology Category

The technology was improved process control using a computer expert-system to run the cement kiln at its optimum operating conditions to reduced SOx and NOx emissions and conserve energy.

5.0 Case Study Summary

5.1 Process and Waste Information: Blue Circle Industries manufactures Portland cement by blending fuel, limestone, and clay to produce a clinker and then grinding with gypsum. The process must be operated within a certain temperature range to generate a usable product, avoid coal wastage, and minimize air pollution.

The LINKman expert-system continuously monitors all the appropriate process variables such as the flue gas temperature, oxygen, NOx level and the power used to turn the two cement kilns. It then adjusts the coal, air and feed rates on the basis of a model of the plant's behavior derived from operational experience. This allows the plant to run much closer to its optimum conditions than is possible under manual control. One significant novel feature of the instrumentation is the measurement of the NOx level in the flue gas which gives valuable information on the temperature in the firing zone.

5.2 Scale of Operation: No information provided.

5.3 Stage of Development: The technology is fully operational.

5.4 Level of Commercialization: The technology is commercially available.

5.5 Material/Energy Balances and Substitutions: The NOx level of around 500 ppm is typically reduced to 200 ppm.

6.0 Economics*

All economic data is based on 1987 prices. It is assumed that the economic figures are based on purchase and operation of two cement kilns.

6.1 Investment Costs: 203,000 English Pounds.

6.2 Operational and Maintenance Costs: Annual savings in coal is 500,000 English Pounds and annual savings in grinding clinker is 430,000 English Pounds.

6.3 Payback Time: Payback time is 3 months.

7.0 Cleaner Production Benefits

NOx and SOx emissions are reduced. The wastage of coal at high temperatures is avoided. Higher quality clinker is produced. The clinker requires less energy to grind. The lining of the kilns has a longer life. Economic savings in energy costs are realized.

8.0 Obstacles, Problems and/or Known Constraints

None identified.

9.0 Date Case Study Was Performed: 1987

10.0 Contacts and Citation

10.1 Type of Source Material: Government publication.

10.2 Citation: Clean Technology, Environmental Protection Technology Scheme, Department of the Environment, 2 Marsham Street, London SW1P 3EB, 1989, p23.

10.3 Level of Detail of the Source Material: A simplified process flow diagram is provided. Equipment suppliers and contact are provided.

10.4 Industry/Program Contact and Address: Mr. W. Henerson, Chief Electrical and Process Control Engineer, Blue Circle Industries pic, Technical Services Centre, 305 London Road, Greenhithe, Kent DA99JQ, England, telephone (0322) 843011.

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Cement kiln emissions, nitric oxides, sulfur oxides, NOx, SOx

11.2 Process type/waste source: Portland cement manufacture

11.3 Waste reduction technique: Process efficiency, expert system, continuous monitoring

11.4 Other keywords: expert system, United Kingdom, Portland cement, SIC 3241

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Cement Kiln Emissions, Nitric Oxides, Sulfur Oxides, NOx, SOx, Portland Cement Manufacture, Process Efficiency, Expert System, Continuous Monitoring, United Kingdom, Portland Cement, SIC 3241

PETROLEUM REFINING

***** DOCNO: 400-046-A-235 *****

INDUSTRY/SIC CODE:	Petroleum Refining/ISIC 3530
NAME/CONTACT:	The USSR State Committee for Science and Technology
TECHNOLOGY DESCRIPTION:	The process of hydrodesulfurization is developed so that it can be used after the de-asphalting of the residue with light gasoline. Heavy residual products of sulfur and high sulfur crude petroleum is de-asphalted with light gasoline (virgin gasoline) in standard extraction columns at a temperature of 140-190° C and a dilution ratio of 3.5:1 to 5:1. The content of ash in the de-asphalted oil compared with the feed stock will be 2-4 times less and its coking tendency about 1.5-2 times less. In addition, 2-7 percent of the feed is in the form of a new product - petroleum asphaltite - containing 60-80 percent asphaltenes, 10-20 percent of resin and 10-20 percent of oil. The asphaltite is easily powdered and does not agglomerate in storage. The product can be used for thermo/hydroisolation of heat tubes, and in combination with vacuum residue it can be used to briquette coal fines and to produce bitumens of different grades.
FEEDSTOCKS:	Not reported
WASTES:	Flue gases from process furnaces.
MEDIUM:	Not reported
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Not reported
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Preconditioning of Petroleum Residues for Subsequent Catalytic Processing and Manufacture of New Material: Petroleum Asphaltite", Monograph ENV/WP.2/5/Add.46.
KEYWORDS:	Petroleum, Asphaltite, ISIC 3530

***** DOCNO: 400-045-A-234 *****

INDUSTRY/SIC CODE:	Petroleum Refining/ISIC 3530
NAME/CONTACT:	The USSR State Committee for Science and Technology.
TECHNOLOGY DESCRIPTION:	Sulfide-containing condensates are treated by means of distillation. Distillation of sulfide-containing condensates makes it possible to produce hydrogen sulfide and ammonia as products. The distillation unit allows the production of 95-97 per cent gaseous ammonia and 98 percent hydrogen sulfide. The effluent from the distillation unit contains 50-100 mg/1 of hydrogen sulphide and around 500 mg/1 of ammonia. This wastewater is either used in the pre-treatment unit or discharged into the sewer.
FEEDSTOCKS:	Sulfide-containing condensates
WASTES:	None
MEDIUM:	Aqueous
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Non-waste process gives commercial products of hydrogen sulfide and ammonia.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Utilization of Process Condensate Resulting from Petroleum Refining", Monograph ENV/WP.2/5/Add.45.
KEYWORDS:	Petroleum Refining, Condensates, Distillation, ISIC 3530

PLASTICS PROCESSING

***** DOCNO: 400-002-A-193 *****

INDUSTRY/SIC CODE:	Recovery of Mixed Waste Plastics, Manufacture of Plastic Items - Unclassified Elsewhere/ISIC 3560
NAME/CONTACT:	Fabrique Nationale de Herstal, Industrial Equipment and Service Division, B 4400 Herstal (Liege), Belgium
TECHNOLOGY DESCRIPTION:	This company performs plastification of mixed plastics into granules for use in traditional extrusion or injection molding. After collection of industrial plastic waste or after an automatic unit extracts plastic from household garbage, this process reduces mixed plastic waste to reusable plastic granules. The process proposed by F.N. Herstal S.A. at present covers the industrial recycling of mixed polymer fractions. The process is concerned primarily with urban plastic waste from household garbage. However, it is also concerned with industrial plastic waste which has not as yet been evaluated. The essential feature of the F.N.-CRIF homogenization process is the short time in the molten state, coupled with intense mixing on a plastification disc. This process is available on a turnkey basis.
FEEDSTOCKS:	Mixed plastic waste primarily from urban household garbage.
WASTES:	None.
MEDIUM:	Plastic
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Reduces the disposed waste to none.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recovery of Mixed Plastic Waste Products," Monograph ENV/WP.2/5/Add.2.
KEYWORDS:	Plastic, Mixed Plastic Waste Recovery, ISIC 3560, F.N.-CRIF Process

**** DOCNO: 400-038-A-227 *****

INDUSTRY/SIC CODE:	Chemical industry and manufacturing of chemical products, petroleum and coal derivatives and plastic and rubber products/ISIC 3560
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	Pickling of ABS plastic matter in a sulfochromic solution with restoration and recycling of the solution. The pickling operation itself is identical to the standard technique except that a basket containing the plastic parts is dipped into a bath of concentrated sulfuric acid and chromic acid that ensures descaling. When the $Cr3^{+}$ ion concentration reaches 50 g/l, in the low pollution process, the bath is restored by electrodialysis and recycled in order to maintain the $Cr3^{+}$ concentration at between 20 g and 30 g/l. The restoration of the bath allows a reduction of sulfuric acid consumption from 12.5 kg/100 m^2 descaled to 3.3 kg and the consumption of chromic acid from 13 kg/100 m^2 descaled to 3.5 kg.
FEEDSTOCKS:	ABS plastic, sulfochromic solution
WASTES:	Sulfochromic baths sent for detoxification
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	F 100,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DIRECT COST:	F 76,000
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	No information is available concerning the wastes produced by the detoxification station. The baths sent for detoxification equal 9.5 l/100 m^2 for the low pollution technique against 35 l in the standard process.
IMPACT:	Since the number of times the baths are sent to the detoxification center is reduced by four, the risks of accidental pollution are reduced by as much.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Surface Treatment of Plastic Materials in a Sulfochromic Solution with Regeneration and Recycling of the Solution", Monograph ENV/WP.2/5/Add.38.
KEYWORDS:	Pickle Liquor, ISIC 3560

PRINTING

***** Document No. 453-001-A-000 *****

1.0 Headline: Water-based screen printing inks replace solvent-based ink.

2.0 SIC Code: 2700, Screen printing

3.0 Name and Location of Company:

Sericol Group Ltd.
Westwood Road
Broadstairs
Kent CT10 2PA, England

4.0 Clean Technology Category

This technology involves development of water-based screen printing ink to replace solvent-based ink.

5.0 Case Study Summary

5.1 Process and Waste Information: Use of solvent-based inks results in fumes which are undesirable to the work and outdoor environments. Heat generated during the drying process also contributes to bad working conditions and to energy wastage.

Sericol developed a water-based ink whose performance is at least as good as the existing solvent-based inks. Although water-based inks can be used with conventional dryers their full potential is realized when radio-frequency (RF) dryers are employed. Using the microwave principle only the wet, i.e., printed, areas are heated.

5.2 Scale of Operation: The company has a staff of over 500.

5.3 Stage of Development: The technology is fully operational.

5.4 Level of Commercialization: Water-based inks are commercially available.

5.5 Material/Energy Balances and Substitutions: Not reported

6.0 Economics

Not reported

7.0 Cleaner Production Benefits

Advantages include elimination of solvent use and atmospheric emissions. If radio frequency drying is used, energy is saved and a higher drying speed can be obtained.

8.0 Obstacles, Problems and/or Known Constraints

None identified.

9.0 Date Case Study Was Performed

Unknown

10.0 Contacts and Citation

10.1 Type of Source Material: Government Publication.

10.2 Citation: Clean Technology, Environmental Protection Technology Scheme, Department of the Environment, 2 Marsham Street, London SW1P 3EB, 1989, p14.

10.3 Level of Detail of the Source Material: No additional detail is provided.

10.4 Industry/Program Contact and Address: David Seddon, Technical Director, Sericol Group Ltd., Westwood Road, Broadstairs, Kent CT10 2PA, England, Telephone (0843) 67071

10.5 Abstractor Name and Address: John Houlahan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Solvent-based ink

11.2 Process type/waste source: Solvent emissions, printing ink

11.3 Waste reduction technique: Raw material substitution, radio frequency (RF) dryers

11.4 Other keywords: United Kingdom, air emissions, energy conservation, SIC 2700

Keywords: Solvent-Based Ink, Solvent Emissions, Printing Ink, Raw Material Substitution, Radio Frequency (RF) Dryers, United Kingdom, Air Emissions, Energy Conservation, SIC 2700

***** DOCNO: 400-109-A-324*****

HEADLINE:	Recycling of printing ink to be reused by newspapers as black printing ink reduces waste disposal to treatment plant by seven tons.
INDUSTRY/SIC CODE:	Newspaper Production/ISIC 3420
POLLUTION PREVENTION OPTIONS SUMMARY:	Discarded printing ink is collected, purified, and reused as black printing ink. Waste ink produced from the printing process and from color changes is collected in an accumulation vessel and is passed through four filters, the last of which removes particles down to 25 microns. The purified ink is then mixed with new printing ink for reuse in newspaper production.
FEEDSTOCKS:	Waste ink with moisture content below 5% and other impurities such as oil and organic solvents below 2%, 0.05 kWh energy consumption per ton paper
WASTES:	Low volume of synthetic filters and objects from coarse filter
MEDIUM:	Solid
COST:	
CAPITAL COST:	37,000 Danish kroner (1980)
OPERATION/MAINTENANCE:	1.23 Danish kroner per ton of paper
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	3.0 Dk/ton of paper for destruction of discarded ink 21.5 Dk/ton savings for reusing the ink
FEEDSTOCK REDUCTION:	7 tons of discarded printing ink is treated per year
WASTE PRODUCTION:	7 tons of discarded ink requiring disposal in national treatment plant
IMPACT:	Seven tons of waste no longer require waste disposal in a treatment plant. With a net savings of 24.5 Dk per ton of paper, and about 185,000 tons of paper used per year in Denmark, the possible savings are 4 - 5 million Dk. Annual costs of printing ink are 50 to 60 million Dk (1980).
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Re-use of Printing Ink for Newspaper Production," Monograph ENV/WP.2/5/Add.109
KEYWORDS:	Ink, Printing, Recycling, Filtration, ISIC 3420

PULP AND PAPER

***** DOCNO: 400-044-A-233 *****

INDUSTRY/SIC CODE:	Pulp and Paper Industry/ISIC 3411
NAME/CONTACT:	The USSR State Committee for Science and Technology
TECHNOLOGY DESCRIPTION:	Wet barking in drums is substituted with dry wood barking which virtually eliminates the generation of wastewater. Instead of adding water to the barking drum, the dry bark stripping process uses steam to intensify the bark stripping, producing only solid wood waste. The wet bark stripping process supplies hot and cold water to the barking drums to intensify the process. This process produces a water-borne waste and solid waste.
FEEDSTOCKS:	Wood material for the manufacture of pulp and paper products (pulpwood)
WASTES:	Solid waste, wood
MEDIUM:	Not reported
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Dry barking provides significant cost savings not only because of the exclusion of the treatment of wet bark and bark containing wastewater but also because of the higher energy content of the dry bark. Bark-fired boilers can provide up to 20 per cent of a facility's steam requirements. The combined method results in a substantial reduction of water requirements compared to conventional wet barking.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Technological Process of Dry Bark-Stripping of Wood in Barking Drums," Monograph ENV/WP.2/5/Add.44.
KEYWORDS:	Pulp and Paper, ISIC 3411

***** DOCNO: 400-006-A-197 *****

INDUSTRY/SIC CODE:	Pulp and Paper Industry; Mechanical Pulping by Stone Grinding/ISIC 3411
NAME/CONTACT:	Oy Tampella Ab, SF-33100 Tampere 10, Finland. 26 March 1979/Mr. Matti Aario, Product Engineering Manager of Stock Preparation Department
TECHNOLOGY DESCRIPTION:	The company changed the construction of the conventional hydraulic stone grinder so that the processed wood is ground in a gas tight space under pressure. Pressurized grinding has been implemented as a batch process. The experiments were carried out with a production scale T 1512 grinder, by altering the machine to perform under pressure. As a result of the trial runs, mechanical pulp of a new type was obtained, the strengths of which - especially the tearing resistance - were considerably better than those of the stone-ground wood, corresponding to the strength figures of thermomechanical pulp. Furthermore, it became evident that the energy consumption needed by the process was lower than of the presently known processes for manufacturing of mechanical pulp. The feeding of wood into the grinder was done manually through a gate that can be lifted by a crane so that during the feeding the pressure is released from the grinder.
FEEDSTOCKS:	Not reported
WASTES:	Not reported
MEDIUM:	Not reported
COST:	At the present development stage of the process investment requirements are not available.
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Improved paper properties and reduced energy consumption.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Pressurized Stone Grinding for Mechanical Pulp Production," Monograph ENV/WP.2/5/Add.6.
KEYWORDS:	Pulp and Paper, ISIC 3411, Mechanical Stone Grinding

***** DOCNO: 400-005-A-196 *****

INDUSTRY/SIC CODE:	Manufacture of Pulp, Paper and Paper Board; Bleached Kraft Process/SIC 2611
NAME/CONTACT:	U.S. Environmental Protection Agency
TECHNOLOGY DESCRIPTION:	The company runs a 725 ton/day ERCO Envirotech (Rapson-Reeve) closed-cycle technology for bleached kraft pulp mills. Chlorine dioxide replaced 70 percent of the chlorine normally used in the first-stage chlorination. This stage is followed by conventional caustic extraction, chlorine dioxide regeneration. Countercurrent washing is employed by the bleach plant, and bleach plant effluent is re-used in pulp mill in countercurrent brown-stock washers. Sodium chloride recovered from white liquor by evaporation and filtration, and is used in chlorine dioxide generator. Saltcake (sodium sulphate) in chlorine dioxide generator (can be dried and sold). Salt (sodium chloride) from salt removal process can be re-used in the generation of bleaching chemical such as (ClO_2), ($NaOH$-Cl_2) and ($NaClO_3$).
FEEDSTOCKS:	Wood, $NaClO_3$, Cl_2, H_2, SO_2, NaOH, Lime
WASTES:	Aqueous Na_2SO_4 and solid sodium sulfate
MEDIUM:	Low-level contaminated water
COST:	(1975 Dollars)
CAPITAL COST:	4.5 million
OPERATION/MAINTENANCE:	1.0 million
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	2.2 million/year
FEEDSTOCK REDUCTION:	Fresh process water requirement reduced from 104 m^3/ton to about 15m^3/ton.
WASTE PRODUCTION:	Total flow of 117 m^3/ton
IMPACT:	Reduced wastewater and wastewater contamination in bleached kraft process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Closed Cycle Technology for Bleached Kraft Pulp Mills," Monograph ENV/WP.2/5/Add.5).
KEYWORDS:	Bleached Kraft Pulp, Paper, Wastewater, SIC 2611

***** DOCNO: 450-003-A-363*****

HEADLINE:	Northwood Pulp and Paper modernizes bleaching system and particulate removal system and reduces bleaching effluent and particulate emissions.
INDUSTRY/SIC CODE:	Paper and Allied Products/SIC 26
NAME/CONTACT:	Northwood & Paper, Ltd. Prince George, British Columbia
POLLUTION PREVENTION OPTIONS SUMMARY:	A 680 ton/day bleached sulfite pulp mill, installed equipment supplied by Kamyr to reduce the volume of effluent. Four separate bleaching stages occur in a single tower. Bleaching chemicals are displaced through the mat of pulp as it moves upwards. A Munters particulate removal unit was installed to reduce particulate emissions from the smelt dissolving stack. The unit comprises a number of multiangular components arranged in parallel for form modules that act as mist eliminators through impaction. The particulates in the gas stream are wetted and captured and the collected water droplets are directed back down the stack.
FEEDSTOCKS:	Emissions
WASTES:	Bleaching effluent
MEDIUM:	Air
COST:	
CAPITAL COST:	Munters unit - $40,000 compared to the Venturi unit - $230,000.
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Dollar values not reported.
FEEDSTOCK REDUCTION:	No energy requirements for the Munters unit, compared to $15,000/year for Venturi scrubber, with 90% the removal efficiency.
WASTE PRODUCTION:	Bleaching effluent reduced to 15 m^3/ton of pulp, particulate emissions reduced to 0.2 kg/ton.
IMPACT:	Waste management was improved at this pulp mill with the dynamic bleaching process which reduces effluent, and with the Munters particulate removal unit which reduces emissions.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 65.
KEYWORDS:	Pulp and Paper, Bleached Kraft Pulp, Scrubber Effluent, Process Change, SIC 26

IRON AND STEEL

***** DOCNO: 450-003-A-364*****

HEADLINE:	Abitibi-Price utilizes sulfonated chemi-mechanical pulp (SCMP) plant to reduce sulfite effluent.
INDUSTRY/SIC CODE:	Paper and Allied Products/SIC 26
NAME/CONTACT:	Abitibi-Price, Inc. Fort Williams Division Thunder Bay, Ontario
POLLUTION PREVENTION OPTIONS SUMMARY:	A batch sulfite pulp operation was replaced by a continuous sulfonated chemi-mechanical pulp (SCMP) plant to reduce sulfite effluent. A scrubber system was installed that contains an alkaline liquid suspension of powdered activated carbon which trickles downwards through packing, ensuring gas/liquid contact. Hydrogen sulfide is absorbed by the alkaline solution and then reacts with caustic and oxygen to produce sodium thiosulfate. Sulfur dioxide is recovered in the form of sodium sulfate, and the scrubbing liquor is recycled to the scrubber. The gas is then washed and heat is recovered through direct contact with water.
FEEDSTOCKS:	Wood chips, sodium sulfate
WASTES:	Sulfide wastes, emissions
MEDIUM:	Water, air
COST:	
CAPITAL COST:	SCMP plant - $30 million.
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	36
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Dollar values not reported.
FEEDSTOCK REDUCTION:	Reduced energy consumption.
WASTE PRODUCTION:	Scrubber removes 96.4% of the hydrogen sulfide and all the sulfur dioxide. Particulate emissions reduced from a range of 200-500 $\mu g/m^3$ to 126 $\mu g/m^3$.
IMPACT:	The new SCMP process complies with Ontario provincial controls on the amount of effluent entering Lake Superior. Plant yield has been increased from 70% to 90%, and particulate emissions have been reduced by 37-75%.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 66.
KEYWORDS:	Pulp and Paper, Hydrogen Sulfide, Scrubber Effluent, Process Change, Heat Recovery, SIC 26

***** DOCNO: 400-080-A-312*****

HEADLINE: Modifications to the paper manufacturing process reduces wastewater discharge.

INDUSTRY/SIC CODE: Manufacture of Paper and Paper Products/ISIC 34

POLLUTION PREVENTION OPTIONS SUMMARY: Modification of a paper manufacturing process resulted in a reduction of process wastewater discharged. Pulp is produced by chemical digesting wood chips with caustic soda and reduction in a disk refiner. The liquors are concentrated and processed with lime to recover the caustic soda. Fibers extracted from the resultant sludge can be commercialized. The pulp is then bleached and the water is settled, and the sludge is incinerated in a lime kiln. Paper is made from pulp with lime carbonate as a filler. The sludge generated here is also incinerated. Part of the process water is recycled for paper making and bleaching, while the remainder is discharged. In the conventional process, the sludge is not incinerated; kaolin is used instead of lime carbonate; a greater quantity of wastewater is discharged.

FEEDSTOCKS: Water, lime carbonate, pulp

WASTES: Wastewater, sludge

MEDIUM: Aqueous

COST:
CAPITAL COST: FF 10,100,000 (1979 figures)
OPERATION/MAINTENANCE: FF 2,100,000 per year (1979 figures)
MONTHS TO RECOVER: Not reported

SAVINGS:
DISPOSAL & FEEDSTOCK: FF 1,900,000 in capital cost
FF 1,000,000 per year in O&M costs

FEEDSTOCK REDUCTION: For papermaking, pulp consumption is 0.8 ton, water consumption 25 m^3 and lime carbonate consumption 175 kg per ton of paper. In the standard technology water and pulp requirements are identical and the mineral filler is made up of 175 kg of kaolin. For pulp making, the water discharge is identical with both technologies: flow rate of 250 m^3/ton of paper; suspended mater 6 kg; biochemical oxygen demand 5 kg; chemical oxygen demand 95 kg.

WASTE PRODUCTION: For papermaking: 15 m^3 of wastewater for each ton of paper; 3.5 kg suspended matter; biochemical oxygen demand 0.5 kg; chemical oxygen demand 3 kg (versus, respectively, 25 m^3; 15 kg, 2 kg and 4 kg). 180 kg per ton of paper (22 percent of dry matter) in the standard technology is no longer discharged.

IMPACT: Since the sludge generated from this pulp/paper manufacture is incinerated, all problems associated with land disposal: possible leaching into surface and ground water, odors, methane production, etc., are eliminated. Also, this low-waste technology generates a smaller volume of wastewater.

CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Integrated Manufacture of Pulp and Lime Carbonate Paper with Effluent Recycling and Sludge Burning," Monograph ENV/WP.2/5/Add.80
KEYWORDS:	Paper, Pulp, Incineration, Solid Waste, Sludge, Wastewater, ISIC 34

***** DOCNO: 400-088-A-317*****

HEADLINE:	Closed water loop in kraft pulping process reduces quantity of reagents and water used and discharged by the bleaching process.
INDUSTRY/SIC CODE:	Manufacture of Pulp, Paper and Paperboard/ISIC 3411
POLLUTION PREVENTION OPTIONS SUMMARY:	This case study presents a modification to the bleaching stage of pulp manufacturing. Bleached kraft pulp is manufactured by cooking, washing, and bleaching wood chips. Modification of the standard bleaching process by preceding the chlorine, caustic soda, and chlorine dioxide bleaching with oxygen bleaching will reduce the quantities of reagents and water used in the conventional bleaching process. Washing water resulting from oxygen bleaching may be used for washing the pulp after cooking. This process reduces the coloration of wastes.
FEEDSTOCKS:	Material requirements for low-pollution manufacturing one ton of pulp: 4 tons of wood, 50m^3 of water, 25 kg of caustic soda, 45 kg of chlorine, 10 kg of chlorine dioxide, 30 kg of oxygen, 8.78 GJ of primary energy.
WASTES:	Polluting wastes consist of bleaching effluents.
MEDIUM:	Aqueous
COST:	
CAPITAL COST:	FF 24,000,000 (1973 figures) for an annual production of 170,000 tons of pulp
OPERATION/MAINTENANCE:	FF 13.3 per ton of pulp (1973 figures)
MONTHS TO RECOVER:	
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 9.1 per ton of pulp in raw chemicals cost and water consumption
FEEDSTOCK REDUCTION:	The following reductions in feedstocks have been reported per ton of pulp manufactured: 50 m^3 of water, 10 kg of caustic soda, 55 kg of chlorine, 5 kg of chlorine dioxide.
WASTE PRODUCTION:	Polluting wastes by the bleaching process consist of the bleaching effluents. Switching from the standard to the low pollution technique permits reducing by half the rate of coloration of wastes.
IMPACT:	Additional variable expenses of energy and manpower (F 13.3 per ton) are partly offset by savings in chemicals and water (F 9.1).
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Paper/board Making with Closed Water Systems," Monograph ENV/WP.2/5/Add.88
KEYWORDS:	Paper, Pulp, Bleaching, Kraft Paper, ISIC 3411

***** DOCNO: 450-003-A-361*****

HEADLINE:	Eddy Forest modernizes plant, improves pulp quality and reduces discharges.
INDUSTRY/SIC CODE:	Paper and Allied Products/SIC 26
NAME/CONTACT:	Eddy Forest Products, Ltd. Espanola, Ontario
POLLUTION PREVENTION OPTIONS SUMMARY:	This pulp mill pioneered commercial oxygen bleaching of softwood kraft pulp in 1977 by using the Modo-cil-oxygen/alkali bleaching process and reducing chlorine consumption by over 50%. A modernization project has increased capacity of the chip handling, digester, bleach plant, recovery boiler and evaporator. A new black-liquor evaporation system, which can produce black liquor up to 75% solids, and a new low-odor recovery boiler have been installed. Foul condensates from the digester and evaporator are steamstripped to remove sulfur gases and methanol, which are incinerated. A new bleaching line consists of two 3-stage lines which are each preceded by an oxygen and hot chlorination stage. Effluent is recycled through the system.
FEEDSTOCKS:	Wood chips, chlorine, fuel
WASTES:	Emissions, methanol, BOD wastes
MEDIUM:	Air, liquid, solids
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Dollar values not reported.
FEEDSTOCK REDUCTION:	Oxygen bleaching has reduced chlorine consumption by over 50% and bleaching costs by 10-15%.
WASTE PRODUCTION:	Oxygen bleaching has reduced effluent BOD by 50%. A new secondary water-treatment system has decreased BOD levels by 80-95%. The recovery boiler system has reduced emissions by 88% for particulates, and 99% for sulfur gases.
IMPACT:	Plant Modifications have enabled the company to meet government water pollution regulations, have increased bleaching capacity to 1000 tons/day, and have improved product quality.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 63.
KEYWORDS:	Pulp and Paper, Bleached Kraft Pulp, Sulfur, Chlorine, Recycling, Process Change, SIC 26

***** DOCNO: 400-110-A-325*****

HEADLINE:	Application of the black liquor disilication technology increases efficiency and eliminates environmental pollution of alkaline non-wood plant fibre pulping.
INDUSTRY/SIC CODE:	Manufacture of Pulp, Paper and Paperboard/ISIC 3411
POLLUTION PREVENTION OPTIONS SUMMARY:	Removal of silica from spent liquors of alkaline non-wood plant fibre pulping. When using non-wood annual plant as raw material for pulping a considerable amount of silica (SiO_2) is carried into the process, which prohibits recycling of the quick lime to the causticizing process. The desilication of the black liquor requires steam boiler flue gas as the only reagent. Precipitated matter is separated from the liquor by means of conventional mechanical systems (centrifuging, sedimentation, etc.)
FEEDSTOCKS:	Steam boiler flue gas, black liquor containing dissolved silica
WASTES:	Precipitated silica, clarified black liquor recovered in the process.
MEDIUM:	Solid, liquid
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	Low waste technology allows for recycling of quicklime
WASTE PRODUCTION:	Current technology generates 250-300 kg $CaCO_3$ solids as lime mud per ton of dissolved black liquor solids. Low waste technology produces 15-125 kg SiO_2 solids per ton.
IMPACT:	Many pulp mills processing straw species with extremely high silica content are still running without any chemical recovery system due to silica problems. They are draining their spent liquor into the effluent system and are forced to cover their demand on pulping chemicals by purchases from the market. Application of the black liquor desilication technology would allow them to operate with a chemical recovery system, increasing their efficiency and eliminating environmental pollution.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Desilication of Spent Liquors Derived from Aldaline Pulping of Non-wood Fibres," Monograph ENV/WP.2/5/Add.110.
KEYWORDS:	Pulp, Paper, Recycling, Solid Waste Recovery, Silica, ISIC 3411

***** DOCNO: 452-003-A-001 *****

1.0 Headline: Advanced Pulp Bleaching Technology and Mill Design Reduce Adsorbable Organic Halogen (AOX) Levels

2.0 SIC Code: 2611

3.0 Name & Location of Company

Wisaforest, Jakobstad
Pietarsaari, Finland

4.0 Clean Technology Category: The technology involves advanced pulp bleaching technology using oxygen bleaching, washing, and screening to reduce AOX levels.

5.0 Case Study Summary

5.1 Process and Waste Information: The company produces bleached and unbleached pulp, mostly from hardwood, with some eucalyptus from South America. The clean technology involves use of the Sunds Defibrator pulp technology in the bleaching, washer, and screening plant. The five-stage bleaching plant has a D/D-OE-D-E-D sequence. The oxygen bleaching technology and effluent controls reduce AOX levels below regulatory levels.

5.2 Scale of Operation: The facility produces 540,000 tpy of bleached and unbleached pulp.

5.3 Stage of Development: The technology is fully developed.

5.4 Level of Commercialization: The facility uses the Sunds Defibrator pulp technology.

5.5 Material/Energy Balances and Substitutions: No information provided.

6.0 Economics*

6.1 Investment Costs: No information provided.

6.2 Operational & Maintenance Costs: No information provided.

6.3 Payback Time: No information provided.

7.0 Cleaner Production Benefits: AOX levels are reduced below regulatory levels.

8.0 Obstacles, Problems, and/or Known Constraints: No information provided.

9.0 Date Case Study Was Performed: Information not provided.

10.0 Contacts and Citation

10.1 Type of Source Material: Journal article

10.2 Citation: Pride, D. Old pulps for new. Paper, 6 November, 1990. p. 28.

10.3 Level of Detail of the Source Material: A brief description of the companies other subsidiaries is provided. docu

10.4 Industry/Program Contact and Address: The technology is produced by Sunds Defibrator. Martin Granhold of Wisaforest is the facility contact.

10.5 Abstractor Name and Address: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: AOX effluents

11.2 Process type/waste source: Pulp mills, bleaching

11.3 Waste reduction technique: Oxygen bleaching, effluent controls

11.4 Other keywords: Finland

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Bleaching, Process Modification, Pulp Mills

***** DOCNO: 452-003-A-001 *****

1.0 Headline: Chlorine and Sulphur-free Pulp Process Planned for Pilot Plant Project

2.0 SIC Code: 2611

3.0 Name & Location of Company

Finland

4.0 Clean Technology Category: The technology involves a cooking process for hard and soft woods using peroxyformic acid and a bleaching process using alkaline peroxide to produce a chlorine and sulphur-free pulp.

5.0 Case Study Summary

5.1 Process and Waste Information: Sulphate cooking and bleaching of pulp have traditionally been used in pulping mills. An alternative technology, the Milox process, involves cooking the wood using a three-stage process. The first stage involves acid cooking at 80 degrees C in the presence of small amounts of peroxide. The second stage involves refluxing with formic acid at 100 degrees C. The final stage consists of cooking at 80 degrees C with peroxyformic acid. The peroxyformic acid selectively delignifies wood and the lignin can be recovered from the spent liquor. The cooking is accelerated using this process and peroxide consumption is minimized. The resulting pulp from the cooking process can be bleached with alkaline hydrogen peroxide to a brightness over 90% for birch and pine. Kraft pulps reach a brightness of 86% and can be treated with oxygen, ozone, and peroxide to achieve 90% brightness.

The new technology converts both birch and pine into pulps with well separated fibers in yields of 40-50%, depending on the Kappa number. Experiments have also been conducted with Eucalyptus Globulus. Little chemical damage to the cellulose occurs, as indicated by the high viscosity of the pulp. The strength characteristics of pine peroxyacid pulps are inferior to those of pine sulphate pulps. The potential effluents from the process have not yet been characterized but the recovery system in the pilot plant may provide some information. However, no chlorinated organic compounds should be present.

5.2 Scale of Operation: The pilot project's first phase will consist of a unit with a capacity of about 100 kg.

5.3 Stage of Development: Experimental studies have been conducted. The first phase of the pilot plant project is scheduled for fall, 1991. If successful, formic acid recovery and recycling systems will be added in 1992.

5.4 Level of Commercialization: A full-scale mill could be planned after five years, if results of the pilot plant are positive.

5.5 Material/Energy Balances and Substitutions: No quantitative data were provided concerning raw materials usage or waste generation.

6.0 Economics*

6.1 Investment Costs: The cost of the first phase will be about 10M (FM). If the second phase is added, consisting of the recovery and recycling systems, the cost will be another 10M.

6.2 Operational & Maintenance Costs: No information provided.

6.3 Payback Time: No information provided.

7.0 Cleaner Production Benefits: The new technology will produce a chlorine and sulphur-free pulp. No chlorinated organic compounds will be present in the effluent. Peroxide use is minimized and lignin can be recovered from the spent liquor although a use for it has not been found.

8.0 Obstacles, Problems, and/or Known Constraints: Strength characteristics of pine peroxyacid pulps are inferior to those of pine sulphate pulps.

9.0 Date Case Study Was Performed: Information not provided.

10.0 Contacts and Citation

10.1 Type of Source Material: Journal article

10.2 Citation: Pride, D. Old pulps for new. Paper, 6 November 1990. p. 26.

10.3 Level of Detail of the Source Material: The article briefly discusses another pilot plant involved in chlorine-free high whiteness pulping.

10.4 Industry/Program Contact and Address: The technology was developed by Professor Jorma Sundquist at the Finnish Pulp and Paper Research Institute.

10.5 Abstractor Name and Address: Barbara M. Scharman, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords

11.1 Waste type: Chlorinated organics

11.2 Process type/waste source: Pulp mills

11.3 Waste reduction technique: Process modification, material substitution, material conservation, Milox process

11.4 Other keywords: Chlorine reduction, sulphur reduction, Finland

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations and other factors.

Keywords: Chlorinated Organics, Process Modification, Pulp Mills

***** DOCNO: 401-006-A-000 *****

1.0 **Headline: Reduction of Multimedia Wastes in Finnish Pulp and Paper Factories**

2.0 **SIC Code: 26 Paper and Allied Products, 2611 Pulp Mills, 2621 Paper Mills.**

3.0 **Name & Location of Company: 53 mill sites located throughout Finland. Mill sites include: Kemi, Oulu, Kajaani, Jamsankoski and Jamsa, Varkaus, Aanekoski, Tampere area. Southern lake Saimaa and the River Kymijoki. Examples of mill sites established since 1950 include Kemijarvi in the north, Uimaharju in the east, Kaskinen in the west and Kirkniemi in the south of Finland.**

4.0 **Clean Technology Category: This case study provides an overview of waste reduction in Finland's pulp and paper industry involving environmental legislative action, administration, improved processes and equipment and recycling.**

5.0 Case Study Summary

5.1 Process and Waste Information: The Finnish pulp and paper industry has seen a trend of replacement of sulfite pulping processes with mechanical and sulfate pulping processes. This trend coupled with the development of loads and pollution control measures as well as increased administration and legislation has brought about a promotion of both industrial development and environmental achievement in the form of multimedia waste reduction.

The development of effluent loads and pollution control measures have lead to decreases in wastewater discharge quality and volume in Finland for the following reasons: 1. Considerable structural change in the industry with a shift from sulfite mills to sulfate and mechanical pulp mills; 2. Improved process internal measures which have lowered chemical losses; including the improvement of control systems, reduction of water consumption by closing some water circulation systems; and the improvement of production processes and equipments (i.e., dry debarking, increasing the recovery rate of spent liquor, stripping of condensates, changes in pulp cooling systems and changes in bleaching and chemical ad conditions).

Malodorous gases from chemical pulp mills are a problem in Finland. The structural development of the pulp industry has promoted air pollution control, because sophisticated chemical circulation systems in sulfate mills have eliminated emissions of sulfur compound. It is expected that as facilities are modernized total emissions of malodorous sulfur compounds by the pulp industry will be reduced to 3000-7000 tons per year (Sulfur dioxide emissions in the 1970's totalled about 600,000 tons per year.).

The total quantity of wastes accumulated in Finland each year attributed to the pulp and paper industry is approximately 70-80 million tons. (10 million tons are wood wastes and 815 000 tons paper and cardboard). Only 35-40% of paper and cardboard are recovered in Finland due to limited capacity of the paper industry to receive paper from households due to export orientation and competition on quality. The degree to which wastes are used in the future will depend on the development of raw material and energy prices. The standard of waste management will depend on the state of development of utilization technology and methods.

5.2 Scale of Operation: Approximately 53 mills in Finland are subject to and participate in the combined efforts of the government to reduce wastes and emissions from pulp and paper manufacture.

5.3 State of Development: In Finland environmental legislation and administration has not developed in parallel. There is a differentiation of the control mechanisms in administration and in environmental protection in legislation. Finland must make an effort to harmonize the licensing and notification system.

5.4 Level of Commercialization: All of the strategies discussed have originated in or have been implemented in the pulp and paper facilities in Finland.

5.5 Balances and Substitutions: The industry has trended towards the replacement of sulfite pulping processes to mechanical or sulfate pulping processes. This trend coupled with tighter discharge limits and control mechanisms have resulted in a reduction of pollution. In wastewaters the suspended solids and biological oxygen demand have decreased in the years 1980-1984 23% and 15% respectively. However, the load of nutrients has increased with the increase in production. Air emissions of sulfur dioxide totalled about 600 000 tons per year in the 1970's. It is expected that modernized total emissions of the pulp and paper industry will be reduced to 3000-7000 tons a year depending on the effectiveness of air pollution control. The installation of a new deinking facility is expected to increase the capacity of Finland to recover paper and cardboard thereby reducing the amount of solid wastes generated in Finland (about 300 000 tons per year).

6.0 Economics:

6.1 Investment Costs: Although costs were not specifically discussed, there was indication that sulfite mills have been converted to mechanical or sulfate pulping mills for reasons of profit. It was also stated that the recovery of energy and raw materials brought about by Finland's program is economically beneficial.

6.2 Operational and Maintenance Costs: Costs were not discussed. However, it was mentioned that an industrial plant with sound production costs is also sound from the point of view of environmental protection. This suggests that the saving of environment, energy, and raw material has become a factor that promotes industrial development in Finland.

6.3 Payback Time: Environmental benefits are recognized immediately. Individual facilities and specific costs and paybacks were not discussed.

7.0 Cleaner Production Benefits

The new sulfate and mechanical pulping processes are more profitable than the older sulfite pulping processes and also produce lowered air emissions and improved wastewater quality.

8.0 Obstacles, Problems and/or Known Constraints

Finland has not harmonized licensing and notification systems. This has resulted in a differentiation of the control mechanisms in administration and in environmental protection in legislation.

9.0 Date case study was performed: This case study was developed from proceedings of the Finland/UNEP International Seminar on Sound Environmental Management in the Pulp and Paper Industry in Helsinki held May 14-17, 1986.

10.0 Contacts and Citation

10.1 Type of Source Material: Proceedings of the 1986 Finland/UNEP International Seminar on Sound Environmental Management in the Pulp and Paper Industry.

10.2 Citation: Ruonala, Seppo, "Environmental Mangement in the Finnish Pulp and Paper Industry." Sound Environmental management in the Pulp and Paper Industry, Seminar Papers and Documents (May 14-17 1986): 65-75.

10.3 Level of Detail of Source Material: More detailed information on water discharge loads are available. This document is an overview of improvements in Finland's pulp and paper industry and does not provide facility specific data.

10.4 Industry/Program Contact and Address: Mr. Seppo Ruonala, National Board of Waters, Finland.

10.5 Abstractor and Address: Susan Wojnarowski, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, VA 22043.

11.0 Keywords:

11.1 Waste Type: Sulfur dioxide emissions, Sulfide wastes, Wastewater, Wood fiber, Organic sludges, Liquors.

11.2 Process Type/Waste Source: Pulping operations, paper manufacture, SIC code 2611, Pulp Mills, and SIC code 2621, Paper Mills.

11.3 Waste Reduction Technique: Process redesign, air pollution control, equipment modification, chemical use review, wastewater reduction, waste segregation.

11.4 Other Keywords: Finland.

Keywords: Equipment Modification, Process Redesign, Pulp and Paper Mills, Sulfur Dioxide Emissions, Wastewater

***** DOCNO: 400-089-A-256*****

INDUSTRY/SIC CODE:	Manufacture of Pulp, Paper and Paper-board/ISIC 3411
TECHNOLOGY DESCRIPTION:	Paper-board making with closed water systems. Water consumption in a hypothetical mill practicing no recycling of water would be 200 - 300 m^3/ton paper produced. Conventional processes recycle a portion of their process waters, but also introduce freshwater in some process areas. A closed system blends in freshwater only as a make-up or in order to dilute some component which might otherwise restrict recycling.
FEEDSTOCKS:	Primary pulps and/or secondary fibers, process additives, product quality additives (clay, chalk), water, 30 GJ energy for each ton of paper generated
WASTES:	Steam, no liquid or solid effluent discharge
MEDIUM:	Water vapor
COST:	
CAPITAL COST:	$457,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	7.5 months excluding additional operating costs
SAVINGS:	
DISPOSAL & FEEDSTOCK:	10 British Pounds/ton primarily in waste treatment
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Wastewater production is eliminated. The amount of solid residuals generated is decreased from 6% (64 kg/ton) to 1 percent of waste production.
IMPACT:	Recycling of process waters and recovery of additional 5% of suspended solids is the benefit offered by this technology. Practical problems, including product quality, were incurred during closing-up of the water system and are therefore a significant deterrent to a mill considering implementation.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Paper/board Making With Closed Water Systems," Monograph ENV/WP.2/5/Add89.
KEYWORDS:	Pulp, Paper, Wastewater Recovery, Recycling, ISIC 3411

***** DOCNO: 400-028-A-217 *****

INDUSTRY/SIC CODE:	Manufacturing of Paper and Paper Products/ISIC 3411
NAME/CONTACT:	Ministere de l'Environment et du Cadre de Vie Direction de la Prevention des Pollutions 14 Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company manufactures paper with the recovery and valorization of manufacturing effluents. The manufacturing effluents are separated, two distinct ways. There is a physical chemistry treatment and a coagulation-flotation with the introduction of pressurized water and poly-electrolyte. The recovered raw materials are in part immediately re-integrated into the paper production process, the rest being held for later use or sale. Purified effluents are discharged into the river by way of a sewer.
FEEDSTOCKS:	Wastewater
WASTES:	The manufacturing water is purified before being discharged into the river. Pollution results solely from cooling water. There are 3 kg of suspended and oxidizable matter per ton of paper manufactured, against 18.1 kg in the standard treatment technique.
MEDIUM:	Water
COST:	(1980 Francs)
CAPITAL COST:	F 800,000
OPERATION/MAINTENANCE:	F 1.8/ton paper produced
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	Reduces requirements for virgin chemicals.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Water Closure System in Paper Mills," Monograph ENV/WP.2/5/Add 28.
KEYWORDS:	Paper, ISIC 3411, Closed-Loop Wastewater

***** DOCNO: 450-003-A-362*****

HEADLINE:	Kruger Inc. recovers whitewater at their newsprint mill and reduces wastewater discharge and energy costs.
INDUSTRY/SIC CODE:	Paper and Allied Products/SIC 2621
NAME/CONTACT:	Kruger, Inc. Bromptonville, Quebec
POLLUTION PREVENTION OPTIONS SUMMARY:	A series of modest modifications to a newsprint mill have achieved recovery of significant amounts of lean and clear wastewaters that had been discharging to the sewer. Lean whitewater from the company's three paper machine presses are collected by gravity flow in a reservoir beneath the machines. It is then pumped through a Sweco filter, where 90% is used for dilution of stock and 10% is sent to the clarifier. Clear whitewater is now used instead of heated freshwater on the paper machine showers.
FEEDSTOCKS:	Whitewater from newsprint mill
WASTES:	Wastewater
MEDIUM:	Water
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	$580,000/year
FEEDSTOCK REDUCTION:	1.8 tons/day fiber recovered, which represents $80,000/year. Recovered lean whitewater led to $500,000/year savings.
WASTE PRODUCTION:	Discharges to sewer significantly reduced.
IMPACT:	Efforts to recycle wastewaters, previously discharged to the sewer, have greatly reduced the volume of waste generated, and allow for recycling of fiber feed material.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 64.
KEYWORDS:	Paper and Pulp, Filtration, Wastewater, Recycling, Recovery, SIC 2621

**** DOCNO: 400-091-A-258*****

INDUSTRY/SIC CODE:	Pulp Paper and Paper Board/ISIC 3411
TECHNOLOGY DESCRIPTION:	The ZIMPRO process for disposal of wastewater treatment sludge in the paper and board industry recovers the filler clay by wet air oxidation of the sludge. The sludge is mixed with biological sludge and continuously oxidized by compressed air at 250-350 degrees centigrade and 120-150 bar. After the reaction, the filler clay (kaolin) is separated and cleaned for reuse in paper production.
FEEDSTOCKS:	Sludge from treatment plant, electrical energy, fuel oil, flocculant, water
WASTES:	Wastewater from the settling tanks containing small amounts of acetic acid and other organics are added to the biological water treatment plant. The filler clay which is re-used in the paper production.
MEDIUM:	Water
COST:	(For Oxidizing 16.5 ton/dry sludge in 1977)
CAPITAL COST:	750,000 Swiss francs
OPERATION/MAINTENANCE:	560,000 fr/year
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	430,000 fr/year operating savings over incineration, 110,000 increase over lagooning
FEEDSTOCK:	Not reported
WASTE PRODUCTION:	400,000 fr/year savings due to kaolin recovery
IMPACT:	The recovered filler clay can be re-used in paper production, paying for the operating cost of the plant. The disposal of the sludge via incineration or lagooning is eliminated.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Filler Clay Recovery by Wet Air Oxidation of Sludge (Zimpro Process)," Monograph ENV/WP.2/5/Add91.
KEYWORDS:	Pulp, Paper, Waste Recovery, ISIC 3411, Wet Air Oxidation, ZIMPRO, Kaolin Clay

***** DOCNO: 400-075-A-249*****

INDUSTRY/SIC CODE:	Manufacture of Food, Beverages and Tobacco/ISIC 31 Manufacture of Paper and Paper Products/ISIC 34
TECHNOLOGY DESCRIPTION:	The CSM-Biothane U.A.S.B. process for anaerobic wastewater treatment treats organic wastewater generated during processing of food and paper related materials. This new technology consists of a digester where settling occurs under anaerobic conditions. Methane gas is produced as a by-product and can be used as energy for input to the production process.
FEEDSTOCKS:	Organic wastewater, sludge
WASTES:	Anaerobic wastewater sludge consisting of 2 to 20% carbon compounds, all nitrogen as ammonia
MEDIUM:	Organic wastewater sludge
COST:	
CAPITAL COST:	125,000 to 250,000 Dutch guilders
OPERATION/MAINTENANCE:	0 to 500 Dutch guilders (20% of investment costs)
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	375,000 to 1,250,000 Dutch guilders
FEEDSTOCK REDUCTION:	25 to 50% reduction in need for additional nutrients (P and N)
WASTE PRODUCTION:	Reduces production of surplus sludge by 80 to 90%
IMPACT:	The CSM-Biothane process for anaerobic wastewater treatment reduces the quantity of sludge generated by 80% to 90%, and also produces methane gas which can be used as a substitute for energy in a production process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "CSM-Biothane U.A.S.B. Process for Anaerobic Waste Water Treatment," Monograph ENV/WP.2/5/Add75.
KEYWORDS:	Food Processing, Paper, Energy Recovery, Sludge, Wastewater Treatment, ISIC 31, ISIC 34

***** DOCNO: 450-003-A-365*****

HEADLINE:	Tembec converts coal fired boiler to use waste sulfite liquor as fuel substitute.
INDUSTRY/SIC CODE:	Paper and Allied Products/SIC 26
NAME/CONTACT:	Tembec, Inc. Temiscaming, Quebec
POLLUTION PREVENTION OPTIONS SUMMARY:	A coal-fired boiler at a pulp mill was converted to use waste sulfite liquor. The liquor from the batch digesters is taken to a blow-pit, and then drawn off to a storage tank. Vapor compression evaporators increase the concentration to 49-50% solids, and the liquor is ready for use in the boiler.
FEEDSTOCKS:	Waste sulfite liquor
WASTES:	Emissions
MEDIUM:	Air
COST:	
CAPITAL COST:	$32 million
OPERATION/MAINTENANCE:	Less than costs of coal-firing boiler
MONTHS TO RECOVER:	38
SAVINGS:	
DISPOSAL & FEEDSTOCK:	$10 million/year.
FEEDSTOCK REDUCTION:	Reduced costs for fuel.
WASTE PRODUCTION:	Improved quality of emissions.
IMPACT:	Conversion of a coal-fired furnace to one that burns plant waste reduces fuel costs by eliminating coal purchases, and reduces hazardous emissions that are emitted from coal furnaces.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 67.
KEYWORDS:	Pulp and Paper, SIC 26

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Heat recovery in a synthetic textile industry.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Harihar Polyfibers, GRASIM, Karnataka, India.

4.0 Clean Technology Category

Technology Principle: This technology involves a heat recovery system which incorporated cyclone separators for eliminating liquor carry-over in vent vapors.

5.0 Case Study Summary

5.1 Process and Waste Information: This plant is a dissolving-grade pulp plant where the pulp is produced by employing a pre-hydrolysis sulphate process using mixed tropical hard wood by a two-stage cooking process. The first stage is called pre-hydrolysis, where in the pentosal, contents of wood are dissolved in water at high temperatures and acidic conditions. After the cooking is completed, the digester is vented and the liquor content is drained out. A considerable amount of heat was being wasted to the atmosphere by way of vent vapors and hot poly-hydrolysate (PH) liquor.

To avoid this heat wastage a properly designed heat recovery system was introduced, incorporating suitable cyclone separators for eliminating liquor carry-over in vent vapors. The vent vapors are passed through two-stage cyclone separators and condensed in a shell and tube condenser using mill water. The water is heated from 40 Degrees C to 85 Degrees C. The poly-hydrolysate (PH) liquor from the draining operation is also flashed in a cyclone and the flash vapors are condensed, thus recovering maximum possible heat without allowing the liquor to form resinous deposit.

5.2 Scale of Operation: Not reported

5.3 State of Development: The clean technology is fully implemented.

5.4 Level of Commercialization: The clean technology is fully commercialized.

5.5 Balances and Substitutions: Use of live steam was reduced by about 48 T/day.

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

The heat recovery is in the form of hot water which is used in the bleach plant, and has resulted in reduction in use of live steam of about 48 ton/day. This is equivalent to about Rs. 62/ton pulp and savings of Rs. 3.9 million/year.

8.0 Obstacles, Problems and/or Known Constraints

The liquor has a typical characteristic of forming resinoces deposits but this problem was rectified.

9.0 Date case study was performed: Not reported

10.0 Contacts and Citation

10.1 Types of Source Material: Unpublished

10.2 Citation: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers (GRASIM), Karnataka, India.

10.3 Level of Detail of Source Material: Additional information is available in the source document.

10.4 Industry/Program Contact and Address: Mr. Shailendra Jain, Harihar Polyfibers (GRASIM), Karnataka, India.

10.5 Abstractor and Address: UNEP Workgroup, Paris. Reformatted: Lynn L. Curry, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Thermal waste

11.2 Process Type/Waste Source: Pulp, sulphate process, textile industry, SIC 2299

11.3 Waste Reduction Technique: Heat recovery, cyclone separators

11.4 Other Keywords: India

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Thermal Waste, Pulp, Sulphate Process, Textile Industry, SIC 2299, Heat Recovery, Cyclone Separators, India

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Reduction in the oil consumption in the synthetic fiber industry.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Harihar Polyfibers, GRASIM, Karnataka, India.

4.0 Clean Technology Category:

Technology Principle: This technology involves equipment modification to reduce oil consumption and hot air temperature.

5.0 Case Study Summary

5.1 Process and Waste Information: In the finishing steps of manufacture of dissolving grade pulp, at Harihar Polyfiber, the pulp is dewatered, flash dried, baled and packed. The mechanical dewatering was done to about 38% of dry content then the pulp was dried further to 70% of dry content using hot air at 300 Degrees C, generated by burning fuel oil.

In order to reduce the oil consumption and temperature of the hot air, two dewatering booster presses were installed in series after the existing dewatering presses running in parallel. This improved the dryness of pulp to +50% and the temperature of the hot air could be brought down to 200 Degrees C.

5.2 Scale of Operation: Not reported

5.3 State of Development: The clean technology is fully implemented.

5.4 Level of Commercialization: The clean technology is fully commercialized.

5.5 Balances and Substitutions: Improvement in dryness content of pulp by 50% and temperature of hot air is reduced from 300 Degrees C to 200 Degrees C.

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Economic benefits were a savings of Rs. 3.5 million/year by reducing fuel oil consumption by about 14 kg/tonne of pulp. Furthermore, an improvement in pulp quality resulted by avoiding the "burnouts" due to higher temperatures of hot air.

Environmental benefits include reduction in fuel oil consumption.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date case study was performed: Not reported

10.0 **Contacts and Citation**

10.1 Types of Source Material: Unpublished

10.2 Citation: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers (GRASIM), Karnataka, India.

10.3 Level of Detail of Source Material: Additional information is available in the source document.

10.4 Industry/Program Contact and Address: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers (GRASIM), Karnataka, India.

10.5 Abstractor and Address: UNEP Workgroup, Paris. Reformatted: Lynn L. Curry, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 **Keywords**

11.1 Waste Type: Not reported.

11.2 Process Type/Waste Source: Textile industry, SIC 2299

11.3 Waste Reduction Technique: Energy conservation

11.4 Other Keywords: India

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Textile Industry, SIC 2299, Energy Conservation, India

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Improved washing equipment for pollution load reduction in a synthetic fiber mill.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Harihar Polyfibers, GRASIM, Karnataka, India

4.0 Clean Technology Category

Technology Principle: Process/equipment modifications to reduce energy and chemical consumption.

5.0 Case Study Summary

5.1 Process and Waste Information: Use of a three-stage counter-current brown stock pressure washer at a pulp mill resulted in high alkali loss with the brown pulp stock, carry-over of liquid impurities with the pulp, and high chlorine consumption in the bleach stage. This contributed to the effluent load by way of discharge of chlorinated organic compounds, color, COD, etc. The spent liquor recovered from the washing plant was dilute, requiring more steam for evaporation. The introduction of a fourth-stage pressure wash in series with the previous three resulted in reduction in steam requirements and in chemical requirements, and in alleviation of problems caused by alkali loss and carry-over of lignin compound along with the pulp.

5.2 Scale of Operation: Not reported

5.3 State of Development: Technology is fully implemented

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Waste Generation:		
Color	N/A	40% reduction
Chlorinated organic compounds	N/A	14% reduction
COD	N/A	22% reduction
Feedstock Use:		
Chlorine	N/A	6.5 kg/ton reduction
Alkali	N/A	3.0 kg/ton reduction
Water Use:	N/A	N/A
Energy Use:		
Steam	N/A	0.2 ton/ton reduction

6.0 Economics

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Reduction in steam requirements for evaporators, resulting in savings of Rs. 3.0 million/year. Reduction in chemical requirements resulted in savings of Rs. 0.8 milliom/year for chlorine and Rs. 19 million/year for make-up alkali.

8.0 Obstacles, Problems and/or Known Constraints

Not reported.

9.0 Date case study was performed: Not reported

10.0 Contacts and Citation

10.1 Type of Source Material: Unpublished material

10.2 Citation: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers (GRASIM), Karnataka, India

10.3 Level of Detail of Source Material: Additional information is available in source document.

10.4 Industry/Program Contact and Address: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers (GRASIM), Karnataka, India

10.5 Abstractor and Address: UNEP Workgroup, Paris. Reformatted: Isaac Diwan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater

11.2 Process Type/Waste Source: Synthetic fiber mill

11.3 Waste Reduction Technique: Equipment modification

Keywords: Textiles, Wastewater, SIC 2299, Synthetic Fiber Mill, Equipment Modification

TEXTILE

***** DOCNO: 450-003-A-378*****

HEADLINE:	Recycling spent nylon hosiery dyebaths reduce disposal costs and purchases of raw material
INDUSTRY/SIC CODE:	Rubber and Plastics/ISIC 15, ISIC 16
NAME/CONTACT:	Dominion Textiles, Inc. Valleyfield, Quebec
POLLUTION PREVENTION OPTIONS SUMMARY:	A pilot operation was established to recycle spent nylon hosiery dyebaths containing disperse dyes and chemical auxiliaries (scouring, levelling and wetting agents). The dyebaths are pumped from the rotary drum dying machine to a holding tank for analysis and reconstitution with dyestuff. An average of 30 batches can be dyed before discharge.
FEEDSTOCKS:	Dyes, chemical auxiliaries
WASTES:	Spent dyes and chemicals
MEDIUM:	Liquid
COST:	
CAPITAL COST:	$28,441 for conversion and analytical equipment (1980)
OPERATION/MAINTENANCE:	Wet processing costs decreased by $0.044/kg
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	$12,240/year
FEEDSTOCK REDUCTION:	19% reduction in dye consumption, 35% in auxiliaries and 57% in energy.
WASTE PRODUCTION:	Spent dyes and chemicals no longer require disposal.
IMPACT:	Contaminated dyes and chemicals are being recycled, reducing the volumes disposed, in addition to raw material and disposal costs.
CITATION:	"Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 91.
KEYWORDS:	Textiles, Dye, Recycling, Recovery, Nylon, ISIC 15, ISIC 16

***** DOCNO: 400-121-A *****

1.0 Headline: Zinc recovery in the rayon industry in Netherlands.

2.0 SIC Code: 22, Textile Mill Products

3.0 Name and Location of Company: Enka B.V., Velperweg, Kleefsewaard at Arnheim, Netherlands

4.0 Clean Technology Category: This case study addresses recovery of zinc

5.0 Case Study Summary:

5.1 Process and Waste Information: The main production steps in the rayon industry are (1) the reaction of cellulose with sodium hydroxide, followed by pressing and grinding; (2) the reaction of sodium-cellulose with carbon disulfide; (3) the creation of a solution of reaction product in water, called viscose; (4) the spinning of viscose by injection through a spinning head into a spinning bath, where the viscose is transformed into cellulose yarn by coagulation; and (5) finishing of rayon tire cord by washing, lubrication, and drying.

During the spinning process, zinc sulphate is used to slow down the formation of the yarn. This is necessary in order to obtain the desired strength and elongation of the yarn. The wastewater from the spinning process contains mainly sulfuric acid, sodium sulphate, and zinc salts. This wastewater is treated in the biological wastewater treatment plant. Removal of $zinc^{++}$ is effected by precipitating it to form inert zinc sulfides. The biological sludge containing this zinc sulfide is dumped on the land. For the wastewater, the discharge draft standard for zinc in some areas of the Netherlands is 20 kg/day. The maximum allowable amount of zinc in any given sample of wastewater effluent is 3 mg/liter. Over a 24-hour period the maximum allowable zinc content in the wastewater effluent is 2 mg/liter.

The low-waste technology concerns the recovery and recycling of zinc from the acid effluent of the rayon spinning process. The $zinc^{++}$ containing acid effluent is treated with a mixture of D.E.H.P.A. (10%) and solvesso 150 (90%). The ratio of acid effluent to organic solvent is generally less than one. Treatment occurs in a tank fitted with agitators. The dispersed water and organic solvent is transported to a separation tank in order to obtain separation between water and the organic phase. The extraction process is carried out in three steps with counter-flow of the effluent and the organic solvent. The reaction product of $zinc^{++}$ and D.E.H.P.A. dissolves in the organic phase. This organic phase has to be stripped in order to recover the $zinc^{++}$.

In order to obtain high efficiency of $zinc^{++}$ removal, the pH of the water phase must be controlled by addition of sodium hydroxide. During the first extraction step the pH is greater than 2.8 and afterwards it is greater than 3.0. The $zinc^{++}$ removal efficiency is generally more than 98%. The zinc-free water phase is neutralized and charged together with 10 times the amount of caustic wastewater in the wastewater treatment plant. The effluent from the wastewater treatment plant is dumped together with three times the amount of other wastewater into open water.

To recover the $zinc^{++}$ from the organic extraction solvent, the solvent is stripped with a water-based solution of sulfuric acid (20%) and a flocculent. This is, however, a one-step process. During stripping, the $zinc^{++}$ is re-worked as zinc sulphate. It dissolves in the waster phase. This solution is used again in the spinning process. The addition of a flocculent is essential in order to obtain high efficiency of $zinc^{++}$ recovery and to prevent large losses or organic solvent. This flocculent neutralizes the cation-active substances. The $zinc^{++}$ recovery efficiency is about 100%.

5.2 Scale of Operation: The plant maximum capacity for treatment is 40 cubic meters of effluent per hour.

5.3 Stage of Development: The technology is fully implemented.

5.4 Level of Commercialization: Unknown

5.5 Material/Energy Balances and Substitutions: Figures based on tone of rayon tire cord production in the effluent discharge.

6.0 Economics*

6.1 Investments Costs: While the total investment for the conventional process is 2,000,000 F1, the investment for the low-waste technology is 5,600,000 F1. The cost of rayon tire cord per year increases from 70 F1 for the conventional method to 85 F1 for the low-waste technology. Zinc recovery results in savings of 225,000 F1 per year.

6.2 Operational & Maintenance Costs: Unknown

6.3 Payback Time: Unknown

7.0 Cleaner Production Benefits: Because the zinc removal efficiency is high, there are economic benefits as well as regulatory benefits.

8.0 Obstacles, Problems, and/or Known Constraints: Not available.

9.0 Date Case Study Was Performed: 1982

10.0 Contacts and Citation

10.1 Type of Source Material: United Nations document.

10.2 Citation: United Nations Economic and Social Council, Economic Commission for Europe, Compendium on Low- or Non-Waste Technology, Monograph ENV/WP.2/5/Add.121, May 1985.

10.3 Level of Detail of Source Material: Unknown

10.4 Industry/Program Contact and Address: Unknown

10.5 Abstractor Name and Address: The information in this case study was derived from abstracts provided by the United Nations Environment Program (Paris). This abstract was prepared directly from the abstract without access to the document cited. Mary L. Wolfe, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Wastewater

11.2 Process Type/Waste Source: Textile Mill Products, SIC 22

11.3 Waste Reduction Technique: Wastewater reduction, reuse, recovery

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Textile Mill Products, SIC 22, Wastewater Reduction, Reuse, Recovery

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Closed loop recycle systems for textile effluents.

2.0 SIC Code: 2231, Wool Broadwoven Fabric Mills

3.0 Name & Location of Company: Referred to as "Textile Mills and Pilot Plants" located at University of Natal, Durban, South Africa

4.0 Clean Technology Category

Recycling, reuse and reclamation: This technology involves the inclusion of treatment/recycle systems for water and chemical recovery and reuse in textile wet processing operations.

5.0 Case Study Summary

5.1 Process and Waste Information: Individual textile wet processing operations of wool scouring, desizing and wool/synthetic fiber dyeing result in a large quantity of effluent containing water and chemicals.

The development of closed loop recycling systems attached to the above mentioned processing operations is described in this case study. Water and chemical recovery and reuse are discussed. Several techniques are discussed as well as results of detailed effluent survey techniques to determine the effluent treatment approach.

Ultrafiltration has been found to be an effective treatment process for recycling wool scouring and desizing effluents, producing permeates suitable for process reuse with 95% grease rejection.

The results from studies suggest that practical water reuse can only be obtained by an undestinquishable method referred to as "desuiting" the wool prior to detergent scouring and by the incorporation of an efficient grease step for the scouring effluent.

Ultrafiltration was also found economically attractive for recovery of sizes in cotton textile mills.

The ion exchange and flocculation treatment systems for the wool/synthetic fiber dyehouse effluent result in a reusable effluent containing the buffer chemicals and recovers the surfactants.

5.2 Scale of Operation: Not reported

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions:

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Economic benefits are expected over the conventional end-of-pipe treatment approach, but no specifics were provided.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study Was Performed: 1979

10.0 Contacts and Citation

10.1 Type of Source Material: Journal

10.2 Citation: G. R. Groves, C.A. Buckley and R.H. Turnbill. Close Loop Recycle Systems for Textile Effluents. Journal of Water Pollution Control Federation. Vol. 51, No. 3, March 1979.

10.3 Level of Detail of the Source material: Not reported

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wet textile mill effluent

11.2 Process Type/Waste Source: Textile mill products, SIC 2231, wool broadwoven fabric mills, desizing chemicals, wastewater

11.3 Waste Reduction Technique: Effluent recovery, close loop systems, ultrafiltration process

11.4 Other Keywords: Wastewater reduction

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wet Textile Mill Effluent, Textile Mill Products, SIC 2231, Wool Broadwoven Fabric Mills, Desizing Chemicals, Wastewater, Effluent Recovery, Closed-Loop Systems, Ultrafiltration Process, Wastewater Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Reuse of water in a woollen mill.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Shanghai Second Woollen Mills, Shanghai, China

4.0 Clean Technology Category

This technology involves the recycling and reuse of wastewater.

5.0 Case Study Summary

5.1 Process and Waste Information: Coloured wastewater effluents from two workshops at a woollen mill were treated using dissolved air flotation and biological towers. Decolorization was achieved by coagulation and adsorption with activated carbon. After biological treatment and decolorization, the wastewater was diluted with 20% tap water. This water was used to prepare dyeing liquors. A neutral dye and a mordant dye were selected. The dyeing recipe was adjusted to account for the effect of hexavalent chromium ion present in low concentrations in the reuse water.

5.2 Scale of Operation: Not reported

5.3 State of Development: Pilot stage field experiments were performed

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Feedstock Use:		
$Al_2(SO_4)_3$	120 ?/day	156 ?/day
Activated Carbon	--	300 ?/day
Water Use:	1450 m^3/day	300 m^3/day
Energy Use:		
Electricity	420?/day	650?/day

? - Units not provided

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Operational use of activated carbon reported to cost 12 Yuan/day (1974). An increase in energy use resulted in a net cost increase of 23 Yuan/day. Wastewater treatment costs increased by 46 Yuan/day. Costs of $Al_2(SO_4)_3$ increased by 13 Yuan/day.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Economic benefits were calculated to be 90 Yuan/day (1974) and resulted from the decreased use of tap water.

Use of the technology minimizes discharges of coloured wastewater

8.0 Obstacles, Problems and/or Known Constraints

Economic feasibility of the technology depends on the availability of activated carbon, and the lack of costs associated with carbon regeneration in this case.

9.0 Date case study was performed: 1974 and 1976

10.0 Contacts and Citation

10.1 Type of Source Material: Conference Proceedings

10.2 Citation: A Study on Reuse of Water in a Woollen Mill. Hu Hiajue et al. Purdue Universty Conference on Industrial Waste Treatment

10.3 Level of Detail of Source Material: Additional information is available in the source material

10.4 Industry/Program Contact and Address: Not provided

10.5 Abstractor and Address: Reformatted: Isaac Diwan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Coloured wastewater

11.2 Process Type/Waste Source:

11.3 Waste Reduction Technique: Wastewater reuse

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Coloured Wastewater, Wastewater Reuse, Textiles

***** DOCNO: 400-027-A-216 *****

1.0 Headline: Application of counter-current rinsing and washing in woollen industry.

2.0 SIC Code: 2299, Textile Goods, NEC, ISIC 3211 Textile, Clothing and Leather Industries

3.0 Name & Location of Company: Textile Industry in France

4.0 Clean Technology Category

This technology involves recycling, reuse and reclamation of wool wash water.

5.0 Case Study Summary

5.1 Process and Waste Information: Fleece (raw wool) contains about 40% impurities by weight which must be removed with the conventional technology. Fleece is beaten and then washed and rinsed in water. Centrifugation of wash water permits recovery of suint and recycling of part of the wash water to the washing baths. Mud and heavy grease separated by centrifuge are discharged to a holding pond.

A number of modifications and new operations are introduced. These include the reuse of rinse water rather than its discharge to public sewers. Effluent from the first washing bath is centrifuged to recover suint and to recycle part of the washing water. Bottom residual water loaded with mud and heavy grease is subjected to further treatments consisting of a multiple effect evaporation to concentrate the grease. Water condensate is reused in rinsing and washing. Grease concentrate is vacuum dried to produce a combustible residue (oil distillate and bitumen) for the evaporation boiler. Liquid wastes are completely eliminated with the low waste technology.

No additional pollution control measures are required with the Low Wastage Technology, except for the treatment of fumes from the boiler with a bag-filter.

5.2 Scale of Operation: Annual production capacity is 18,500 tonnes of wool per year (285 days of operation per year).

5.3 State of Development: This technology is fully implemented

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Waste Generation:		
SO_2 emissions	N/A	1.5 kg/tonne wool
Water Use:	7.5 m^3/tonne	2 m^3/tonne
Energy Use:	0.6 GJ/tonne	5.2 GJ/tonne

6.0 Economics*

6.1 Investment Costs: 15,000,000 French Francs (1981) compared to 32,500,000 FF for conventional technology if a conventional effluent treatment is constructed

6.2 Operational and Maintenance Costs: F 195/m wool washed

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Economic benefits are achieved while regulations are met. Aqueous wastes disappear completely with the low pollution technique. Both techniques bring about atmospheric pollution of 0.5 kg of dust per ton. The low pollution technique allows the reduction of the SO_2 discharged from 2 kg to 1.5 kg per ton.

8.0 Obstacles, Problems and/or Known Constraints

Not reported.

9.0 Date case study was performed: 1981

10.0 Contacts and Citation

10.1 Type of Source Material: Organizational Report, "Counter-current Rinsing and Washing Including Recycling of Rinsewater and Treatment of Washing Water from Wool Washing."

10.2 Citation: United Nations Economic and Social Council, Compendium on Low and Non-waste Technology, ENV/WP.2/5/Add.27 Economic Commission for Europe, July, 1981.

10.3 Level of Detail of Source Material: Additional information available in the source.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: Reformatted: Isaac Diwan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater

11.2 Process Type/Waste Source: Wool (fleece) wash water

11.3 Waste Reduction Technique: Reuse, recycle

11.4 Other Keywords: Grease, vacuum dried, evaporation

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Textiles, Wastewater, Wool, Counter-Current Rinsing, SIC 2299, ISIC 3211

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Conversion of willow dust into biogas at cotton textile processing mill.

2.0 SIC Code: 2211, Cotton Fabric Mill

3.0 Name & Location of Company: Apollo Textile Mills, Bombay,India.

4.0 Clean Technology Category

Technology Principle: The technology involves the conversion of willow dust into biogas and organic fertilizer.

5.0 Case Study Summary

5.1 Process and Waste Information: Textile mills generate considerable quantities of solid waste materials during different stages of operation. Willow dust is a waste generated from a willow machine. In India, 30,000 to 33,000 tonnes of this material is generated every year. To convert this willow dust into biogas, a pilot plant was installed at Apollo Textile Mills in Bombay with assistance from the Cotton Textile Research Laboratory (CTRL). This plant has a 12.5 ton/month capacity. 350 m^3 of biogas was produced per 2 tons of willow dust for a retention period of 90 days.

The mill's average production of willow dust is 12.5 tons/month. The consumption of liquid propane gas by the laboratory alone has been reduced by 65 kg since the installation of this converter.

The scientists at the CTRL have further developed a process which needs less water, and double the quantity of material can be accommodated in the same unit. Improvements have been made so that the calorific value of biogas is increased. Also, the organic substance that is a by-product of fermentation can serve as a good fertilizer.

5.2 Scale of Operation: Average monthly production of willow dust is 12.5 tons.

5.3 State of Development: The clean technology is fully implemented.

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions: Not reported

6.0 Economics:* It is assumed that the abbreviation "Rs." stands for "rupees." It is also assumed that the word "lakhs" means "100,000 rupees."

6.1 Investment Costs: The investment cost of the project was 3.4 lakhs (lakh = 100,000 Rs.).

6.2 Operational and Maintenance Costs: Operating costs, including water and collection of willow dust and alkali, are about 18,000 Rs.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Benefits including biogas and organic fertilizer generation are as follows:

Biogas	12,000 m^3/year	63,412 Rs.
Fertilizer	24 tons/year	2.400 Rs.

Economic benefits will also include reduction in gas expenditures and waste disposal costs.

8.0 Obstacles, Problems and/or Known Constraints

No information provided.

9.0 Date the Case Study was Performed: 1985.

10.0 Contacts and Citation

10.1 Type of Source Material: Organizational report

10.2 Citation: "Production of Biogas from Willow Dust: A Solid Cellulosic Waste from Textile Mills." Cotton Technological Research Laboratory (CTRL). Adenwala Road, Matunga, Bombay - 400 019, India.

10.3 Level of Detail of Source Material: Additional information is available from this source.

10.4 Industry/Program Contact and Address: Industry contact not provided.

10.5 Abstractor and Address: UNEP Work Group, Paris. Reformatted by: Marilu Hastings, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Dust

11.2 Process Type/Waste Source: Cotton textile processing, SIC 2211

11.3 Waste Reduction Technique: Conversion of willow dust into biogas and organic fertilizer

11.4 Other Keywords: Material segregation, reuse

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Dust, Cotton Textile Processing, SIC 2211, Conversion of Willow Dust into Biogas and Organic Fertilizer, Material Segregation, Reuse

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Poly vinyl alcohol recycling in the process of "Sizing" cotton fibers in the textile industry.

2.0 SIC Code: 2211, Cotton Broadwoven Fabric Mills

3.0 Name & Location of Company: Referred to as "Textile Industry," located in South Africa.

4.0 Clean Technology Category

Recycling, reuse and reclamation: This technology involves the use of a closed-loop recycling including a ultra-filtration membrane process to capture poly vinyl alcohol (PVA).

5.0 Case Study Summary

5.1 Process and Waste Information: Poly vinyl alcohol (PVA), polyacrylates (PAA) and starch are used in the textile industry for "sizing" cotton fibers; a process where applied chemicals confer strength to the fiber and protect it during the weaving process. The PVA, PAA and starch are removed from the cloth after weaving by washing it in hot water in a "desizing" operation resulting in an aqueous effluent containing these chemicals.

A ultra-filtration process to reduce the amount of PVA and starch in the effluent followed by a closed-loop recycling operation was tested for 16 months in a pilot plant. The ultra-filtration membrane used in this process recovered PVA successfully. Starch is enzymatically solubilized prior to desizing and, therefore, can not be recovered. The film forming characteristics of the PAA during testing were impaired by the formation of a calcium-polyacrylate complex.

5.2 Scale of Operation: Not reported

5.3 State of Development: The process was tested for 16 months in a pilot plant.

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions:

6.0 Economics*

6.1 Investment Costs: The capital cost for the ultra-filtration plant is $600,000.

6.2 Operational and Maintenance Costs: Operating costs for ultra-filtration plant was $61,000.

6.3 Payback Time: The payback period is 15 months.

7.0 Cleaner Production Benefits

Economic benefits were calculated in terms of raw material savings based on 4DE 6 meters/year cloth production:

a) PVA sizing - $ 420,000/year
b) Enzymes - $ 100,000/year
c) Steam - $ 20,000/year

This resulted in a net savings of $ 485,000/year from reduced waste generation (900 tons/year) and raw material purchasing needs.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study Was Performed: 1982

10.0 Contacts and Citation

10.1 Type of Source Material: Journal

10.2 Citation: Buckley, C.A. 1982. The Performance of an Ultrafiltration Recycling of Textile Desizing Effluents. Water Science and Technology 14:705-713.

10.3 Level of Detail of the Source material: Additional information is available from this source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Textile mills, poly vinyl alcohol (PVA), polyacrylates (PAA), starch, wastewater, desizing effluent

11.2 Process Type/Waste Source: Textile mill products, SIC 2211, cotton broadwoven fabric mills, desizing effluent

11.3 Waste Reduction Technique: Effluent recovery, PVA (poly vinyl alcohol) recovery, ultra-filtration process

11.4 Other Keywords: Wastewater reduction, South Africa

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Textile Mills, Poly Vinyl Alcohol (PVA), Polyacrylates (PAA), Starch, Wastewater, Desizing Effluent, Textile Mill Products, SIC 2211, Cotton Broadwoven Fabric Mills, Effluent Recovery, PVA (Poly Vinyl Alcohol) Recovery, Ultrafiltration Process, Wastewater Reduction, South Africa

***** DOCNO: 400-026-A-215 *****

INDUSTRY/SIC CODE:	Textile, Clothing and Leather Industries/ISIC 3211
NAME/CONTACT:	Ministere de l'Environment et due Cadre de Vie Direction de la Prevention des Pollutions 14 Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	The company performs mercerizing followed by rinsing in running water and allowing recycle of the soda after concentration. The actual mercerizing operation is identical except that the mercerizer used is more automated: the cotton is immersed in a soda bath containing a wetting agent. The rinsing, instead of taking place in three baths of water (hot then cold) that are discharged after use, takes place in a stream of running water. The rinse water is progressively filled with soda until it is concentrated enough to profitably employ an evaporator to further concentrate it. The concentrated soda is then recycled for mercerizing, along with the wetting agent it contains.
FEEDSTOCKS:	Not reported
WASTES:	Pollution consists of residual soda; for each ton of thread, 100 kg of soda remaining for the low pollution technique, versus 360 kg, in 13 m^3 as opposed to 80 m^3.
MEDIUM:	Water
COST:	(1977 Francs)
CAPITAL COST:	F 1,100,000
OPERATION/MAINTENANCE:	F 1,320/ton thread mercerized
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Reduction of the rate of waste discharge by 67 m^3 per ton of thread mercerized.
IMPACT:	Reduces the amount of wastewater produced.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Counter-current Rinsing and Recycling of Soda in Rinsewater from Mercerizing," Monograph ENV/WP.2/5/Add.26.
KEYWORDS:	Textiles, ISIC 3211, Mercerizing, Counter-Current Rinsing, Rinse Procedures

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Efficient recovery and reuse of caustic soda from mercerizing washwaters.

2.0 SIC Code: 2299, Textile Good Manufacturers

3.0 Name & Location of Company: Bombay Textile Research Association (BTRA) Member Mill, Bombay, India

4.0 Clean Technology Category

Technology Principle: This technology involved the efficient recovery and reuse of caustic soda from mercerizing wastewater.

5.0 Case Study Summary

5.1 Process and Waste Information: A plant floor study examined mercerizing machines and a caustic soda recovery plant in a textile mill. It was observed that only 75% of the caustic soda from washwaters was collected, compared to the normal 85%. Also, the caustic soda recovery plant only recovered 81% of the soda, as opposed to the normal 90%.

The probable causes of the low collection and recovery rates were inefficient washing in the mercerized material, poor squeeze and high quantities of caustic left on the fabric, overflowing/leakage of dilute caustic soda solutions from the washing tank, and seepage from the underground storage tanks. The probable causes of poor recovery were the improper filtration of caustic soda solution prior to recovery, poor heat transfer coefficient in the recovery plant due to scaling of the metallic tubes of the heat exchanger, lower vacuum obtained by the barometric condenser, and the inefficient removal of non-condensate gases from the evaporation body. Necessary corrective steps were taken yielding significant cost savings.

5.2 Scale of Operation: Not reported

5.3 State of Development: System was fully implemented.

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Feedstock Use:	1,190 kg/day	775 kg/day

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs:

Particulars	Before Study (kg)	After Study (kg)
Mercerizing production/ day of fabric	10,000	10,000
Caustic soda input/day	3,500	3,500
Collection from washwaters	2,630	2,975
Reuse of dilute solutions in bleaching	310	475
Caustic soda recoverable	2,320	2,500
Recovery of caustic soda	2,000	2,225
Total caustic soda consumed in mercerizing (Total input less recovery/reuse)	1,190	775

Saving of caustic soda/day = 415 kg

Savings per day = 2,282.50 rupees

Savings per year = 684,750 rupees

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Savings in caustic produced monetary benefits of 684,750 rupees per year and improved the quality of the fabric.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date of Case Study: 1985

10.0 Contacts and Citation

10.1 Type of Source Material: Conference proceedings

10.2 Citation: "Seminar on avenues for Cost Reduction in Chemical Processing of Textiles", held on February 26, 1985 by Bombay Textile Research Association, Bombay 400 086, BTRA No.06.3.1

10.3 Level of Detail of Source Material: Additional information is available.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Work Group, Paris. Reformatted by: Marilu Hastings, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Caustic soda

11.2 Process Type/Waste Source: Mercerizing, SIC 2299

11.3 Waste Reduction Technique: Reuse, recovery

11.4 Other Keywords: Textiles

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Caustic Soda, Mercerizing, SIC 2299, Reuse, Recovery, Textiles

***** DOCNO: 400-085-A-314*****

HEADLINE:	Batch degreasing of cloth with solvent and solvent recycling reduce generated wastes.
INDUSTRY/SIC CODE:	Spinning, Weaving and Finishing Textiles/ISIC 3211
POLLUTION PREVENTION OPTIONS SUMMARY:	This case study presents the effects of automating the degreasing of cloth in aqueous solution. Degreasing of cloth is achieved with detergent before dying in an aqueous solution. This process generates large amounts of waste. When using solvent to degrease cloth in a continuous mode, the volume of waste is reduced because the solvent is recycled.
FEEDSTOCKS:	Solvent, cloth
WASTES:	The wastes generated by this process consist of solvent distillation/recovery column bottoms, and solvent resulting from the drying process. Solvent fumes are collected by an activated charcoal filter. Fats are incinerated.
MEDIUM:	Water
COST:	
CAPITAL COST:	FF 660,000 per 1,035 tons of cloth (1976 figures).
OPERATION/MAINTENANCE:	FF 171.5 per ton of cloth (1976 figures).
MONTHS TO RECOVER:	Not Reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 640,000 per 1,035 tons of cloth in capital cost FF 144.5 per ton of cloth in O&M costs.
FEEDSTOCK REDUCTION:	For one ton cloth, the low-pollution technique requires 14.5 kg of solvent and 2.47 GJ of primary energy. The standard technique requires 14 m^3 of softened water, 29 kg of detergent and 5.85 GJ of primary energy. The low-pollution technique rejects solvent from the drying process while fats are separated when distilling used solvents. The standard technique rejects 45 m^3 of used water loaded with fats and washing products (135 kg of oxidizable matter, 2 kg of equitox) per one ton of cloth.
WASTE PRODUCTION:	With the low-pollution technique, effective wastes are nearly non-existent.
IMPACT:	Another advantage of the low-pollution technique is that it permits energy recovery by burning fats. With the low-pollution technique the quantity of operations (continuous degreasing) is reduced. Therefore, working conditions are improved.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Batch Degreasing of Cloth with Solvent," Monograph ENV/WP.2/5/Add.85.
KEYWORDS:	Textiles, Solvent Recovery, Water-Based Detergents, Degreasing, Distillation, ISIC 3211

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Modified pressure kiers saves energy - case study on a textile mill in India.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Shri Ranjitsinghji Mills, Solapur and several other mills in Solapur, India

4.0 Clean Technology Category

Technology principle: This technology involves equipment modifications that allow the use of higher temperatures and chemical concentrations and reduce total time required for total kiering operation.

5.0 Case Study Summary

5.1 Process and Waste Information: The productivity of conventional pressure kiers was increased by reducing the time required for total kiering operation. Conventional pressure kiers were modified in a few mills so as to allow steaming of different types of fabrics, pre-saturated with appropriate chemical for scouring or bleaching. The temperature and concentration of the treating solution were increased within controlled limits to reduce the time of treatment. The concentration of chemical on the fabric was increased and the fabric steamed in the fashion of the J. Box system. This is the first instance of the use of conventional pressure kier boiling using the J.Box steaming process.

5.2 Scale of Operation: Daily production of 2 lots of 2000 kg each.

5.3 State of Development: This technology is fully implemented.

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investment Costs: Cost of modification is Rs 30,000 (1985)

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Estimated at less than one month.

7.0 Cleaner Production Benefits

Savings in electrical and thermal energy, water and time required for processing without sacrificing the product quality. A significant economic saving of Rs 50,000 per month was obtained.

8.0 Obstacles, Problems and/or Known Constraints

Not reported

9.0 Date case study was performed: 1985

10.0 Contacts and Citation

10.1 Type of Source Material: Conference Proceedings

10.2 Citation:

(1) M.D. Dixit, Bombay Textile Research Association, Bombay, India. In 43rd All India Textile Conference in Bombay, December, 1986.

(2) S.N. Bhide and S.D. Mahajan, B.R. Damani Research Center, Ranjitsinghji Mills, Solapur, India.

10.3 Level of Detail of Source Material: Additional information available from source material.

10.4 Industry/Program Contact and Address:

(1) M.D. Dixit, Bombay Textile Research Association, Bombay, India.

(2) S.N. Bhide and S.D. Mahajan, B.R. Damani Research Center, Ranjitsinghji Mills, Solapur, India.

10.5 Abstractor and Address: Reformatted: Isaac Diwan, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Not reported

11.2 Process Type/Waste Source: Not reported

11.3 Waste Reduction Technique: Not reported

11.4 Other Keywords: Not reported

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Textiles, SIC 2299

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Change from peroxide bleaching to sodium hypochlorite bleaching reduces costs.

2.0 SIC Code: 2211, Cotton Fabric Mills

3.0 Name & Location of Company: Bombay Textile Research Association (BTRA) Member Textile Mill, Bombay, India

4.0 Clean Technology Category

Technology Principle: This technology involves the substitution of sodium hypochlorite for hydrogen peroxide in bleaching.

5.0 Case Study Summary

5.1 Process and Waste Information: A cotton textile mill in Bombay was using hydrogen peroxide bleaching treatment for textiles, including for those materials that were going to be dyed in medium and dark colors. The BTRA suggested that the mill change to a sodium hypochlorite beaching system. For antichloring of the treated goods, the mill was advised to use only about a 0.3% hydrogen peroxide solution in order to achieve better results. The new process allowed the mill to use less chemicals and reduce pollution.

5.2 Scale of Operation: Not provided

5.3 State of Development: The system was fully implemented.

5.4 Level of Commercialization: Not provided

5.5 Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Hydrogen Peroxide	1.5% solution	0.3% solution
Sodium Hypochlorite	None	3g/l

6.0 Economics*

6.1 Investment Costs:

6.2 Operational and Maintenance Costs: The mill's earlier practice of using peroxide bleaching cost 94,650 Rs./month. The new sodium hypochlorite system cost 24,930 Rs./month. The mill could save 836,640 Rs./year. [Assume Rs. is abbreviation for "rupees."]

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Savings in overall chemical consumption, reduced pollution load, and resulting monetary benefits.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date of Case Study: 1985

10.0 Contacts and Citation

10.1 Type of Source Material: Conference proceedings

10.2 Citation: "Seminar on Avenues for Cost Reduction in Chemical Processing of Textiles", held on February 26, 1985 by Bombay Textile Research Association, Bombay 400 086, BTRA No.06.3.1

10.3 Level of Detail of Source Material: No further information is available.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Work Group, Paris. Reformatted by: Marilu Hastings, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Bleach

11.2 Process Type/Waste Source: Bleaching, SIC 2211

11.3 Waste Reduction Technique: Process redesign, substitution

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Bleach, Bleaching, SIC 2211, Process Redesign, Substitution

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: An all-aqueous method of pthalogen blue dyeing.

2.0 SIC Code: 2299, Textile Goods Manufacturer

3.0 Name & Location of Company: Bombay Textile Research Association Member Mill, Bombay, India

4.0 Clean Technology Category

Technology Principle: This technology involved the replacement of solvents from the pad bath formulation with an all-aqueous method of pthalogen blue dyeing.

5.0 Case Study Summary

5.1 Process and Waste Information: In one of the member mills of the BTRA, pthalogen blue dyeing was carried out by a solvent method using Ahurasol TRAF. It was suggested to the mill that it begin using an all-aqueous method of pthalogen blue dyeing. Large scale trials using this method were carried out. The new method's results were found to be comparable to the conventional process. In fact, the new method produced better coverage by the incorporation of small quantities of reactive dyes in the process.

5.2 Scale of Operation: This mill produced 100,000 meters/month of material in the pthalogen blue shade.

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions:

Material Category	Quantity Before	Quantity After
Feedstock Use:		
Chlore Blue 3GX	6.818	6.818
Copper Complex	13.636	13.636
Ahurasol TRAF	15.679	0
Urea	15.679	12.272
Noigen HC 30	0	6.818
Reactofix Red H8B	0.5	0.5
Ahuralan 42	0.1	0.1
Sodium Bicarbonate	1.136	1.136

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Savings per meter of fabric dyed is 0.156 rupees and total annual savings of 187,200 rupees.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Savings per liter of pad bath formulation = 2.09 rupees. Savings per month of same = 15,600 rupees. Annual savings = 187,200 rupees. Apart from direct economic benefits, there was an improved coverage of dye by incorporation of small quantities of reactive dyes.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date of Case Study: 1985

10.0 Contacts and Citation

10.1 Type of Source Material: Conference proceedings.

10.2 Citation: "Seminar on Avenues for Cost Reduction in Chemical Processing of Textiles," held on February 26, 1985 by Bombay Textile Research Association, Bombay 400 086, BTRA No.06.3.1

10.3 Level of Detail of Source Material: Additional information is available from this source.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Work Group, Paris. Reformatted by: Marilu Hastings, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Dye, solvent

11.2 Process Type/Waste Source: Textile dyeing, SIC 2299

11.3 Waste Reduction Technique: Material substitution

11.4 Other Keywords: Annual cost savings

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Dye, Solvent, Textile Dyeing, SIC 2299, Material Substitution

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Elimination of the problems of sulfides by chemical substitution in the textile industry.

2.0 SIC Code: 22, Textile Mill Products

3.0 Name and Location of Company: Century Textiles and Industries Limited, Worli, Bombay 400 025, India.

4.0 Clean Technology Category: This case study presents chemical substitutions for sulphur dyes.

5.0 Case Study Summary:

5.1 Process and Waste Information: Sulphur dyes are water insoluble and must be converted into a water soluble (leuco) form before application to textile materials. The traditional method is treatment with an aqueous solution of sodium sulfide. Since the leuco compounds have an affinity for cellulosic fibers and are sensitive to atmospheric oxygen, they must be applied from the aqueous solution. After the dye has been absorbed on the fiber surface, the reduced form of the dye must be reconverted into the water insoluable form. Generally, this is carried out through exposure to air or by using a chemical oxidizing agent.

Black dye is an important member of the sulfur series due to its fastness in washing and light and its low cost as compared to other synthetic dyes. It is converted using the process described above. The facility encountered difficulties, however, when the State pollution control board established a 2 ppm maximum sulfide content for treated effluent from textile mills. Rather than attempt to reduce the sulfide in the effluent, the facility sought options to reduce or replace the sodium sulfide. During studies conducted by the facility, it was discovered that an alkaline solution of glucose can satisfactorily reduce the sulfur colors, enabling the facility to substitute the glucose solution for the sodium sulfide. Because the glucose solution prepared in the studies would be cost prohibitive, the facility sought an inexpensive source of glucose. This lead to the use of liquid glucose, a by-product of the starch industry.

The facility replaced 100 parts sodium sulfide (50%) with 61 parts liquid glucose (80% solids) and 26 parts caustic soda in its sulfur black color dye operations. The facility continued to have difficulties with this mixture because the thick glucose solution required special arrangements for emptying drums. The operation was still cost intensive.

The facility finally substituted an alkaline solution from sugar reduction for the sodium sulfide. A by-product containing 50% reducing sugars was technologically and financially feasible. The facility substitutes 100 parts sodium sulfide (50%) with 65 parts of the product (containing 50% reducing sugars) plus 25 parts caustic soda. Dye qualities were equivalent to the standard process for depth of shades, fastness, and other properties.

5.2 Scale of Operation: Unknown

5.3 Stage of Development: The technology is fully implemented

5.4 Level of Commercialization: The substitute materials are commercially available

5.5 Material/Energy Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investments Costs: No capital expenditure was involved.

6.2 Operational & Maintenance Costs: Not provided

6.3 Payback Time: Not applicable

7.0 Cleaner Production Benefits: The facility met the mandatory effluent level for sulfide and eliminated the foul smell of sulfide in the workplace.

8.0 Obstacles, Problems, and/or Known Constraints: The high cost of glucose was the main constraint in making the technology have practical applications. Further, the glucose solution required special handling when drums were emptied and solution replacement was cost intensive. These problems were resolved by the use of suitable by-products containing reducing sugars.

9.0 Date Case Study Was Performed: 1990

10.0 Contacts and Citation

10.1 Type of Source Material: Unpublished materials

10.2 Citation: Mr. Mahesh A. Sharma, Chief Chemist, Century Textiles and Industries Limited, Worli, Bombay 400 025, India.

10.3 Level of Detail of Source Material: Unknown

10.4 Industry/Program Contact and Address: See citation.

10.5 Abstractor Name and Address: The information in this case study was derived from abstracts provided by the United Nations Environment Program (Paris). This abstract was prepared directly from the abstract without access to the source material cited. Mary L. Wolfe, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Wastewater

11.2 Process Type/Waste Source: Black sulfur dye, Textile Mill Products, SIC 22

11.3 Waste Reduction Technique: Chemical Substitution

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Textile Mill Products, SIC 22, Chemical Substitution

***** DOCNO: 400-086-A-315*****

HEADLINE:	Computer process control reduces tank bottom losses and improves pigment analysis and reduces feedstock requirements as well as waste generation rate in textiles industry.
INDUSTRY/SIC CODE:	Spinning, Weaving and Finishing Textiles/ISIC 3211
POLLUTION PREVENTION OPTIONS SUMMARY:	This audit presents the advantages of introducing process control in the pigmentary printing of cloth. First the paste is prepared, then the cloth is printed, dried, and the printing is polymerized. Differences between the conventional and low-waste technologies are in the dressing of the paste. Computer control which is used in the low-pollution process reduces tank bottom losses, and improves the paste's analysis. The paste produced by the low-pollution process contains less white spirit and more water.
FEEDSTOCKS:	For 1,000 m^2 of cloth: 55 kg of white spirit 10 kg miscellaneous products 185 m^3 of water
WASTES:	Rejected washing water containing white spirit, white spirit fumes generated during the drying stage, and reusable tank sediments.
MEDIUM:	Aqueous, air, solids
COST:	
CAPITAL COST:	FF 3,730,000 (1980 figures) for an annual production of 2,300,000 m^2 of cloth.
OPERATION/MAINTENANCE:	FF 5.93 per 1,000 m^2 of cloth (1980 figures)
MONTHS TO RECOVER:	
SAVINGS:	
DISPOSAL & FEEDSTOCK:	FF 1.53 per 1,000 m^2 of cloth
FEEDSTOCK REDUCTION:	165 kg of white spirit per 1,000 m^2 of cloth.
WASTE PRODUCTION:	Low-pollution technique generates the following quantities of wastes per 1,000 m^2 of cloth: 7.5 kg of rejected washing water containing white spirit (against 57 kg), 50 kg of white spirit fumes discharged at drying stage (against 175 kg), and 28 kg of reuseable tank sediments (against 57 kg).
IMPACT:	The additional consumption of energy results from the analysis of the paste which contains more water and therefore takes longer to dry. 5.85 GJ for the low-pollution process against 4.60 GJ for the conventional process.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Pigmentary Printing of Cloth with Paste Containing Little White Spirit," Monograph ENV/WP.2/5/Add.86.
KEYWORDS:	Textiles, Wastewater, Pigments, ISIC 3211

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Water and energy conservation in textile industries of Rajasthan, India.

2.0 SIC Code: 2200, Textile Mill Products

3.0 Name & Location of Company: Referred to as "Textile Mills" located in Rajasthan State, India

4.0 Clean Technology Category

Recycling, reuse and reclamation: This technology involves the installation of recovery systems to reduce wastewater in three textile mills.

5.0 Case Study Summary

5.1 Process and Waste Information: (1) In the first plant, a 13,300 pound "Kier" on steam with no water recovery was using approximately 700,000 gal water/day. A 5000 pound Kier was added and a recovery system was activated into a new hot water system under pressure. The plant restricted the water use by placing flow reducers into large lines. (2) In the second plant, 30-35 gallons of water were being used/pound of fabric dyed. Conservation measures of examining the process and restricting water use reduced the water use to 30 gal/pound of fabric dyed. (3) In the third plant, there was a reduction of approximately 800,000 gal/day of wastewaters by the addition of a cooling tower for recirculation of water.

5.2 Scale of Operation: Not reported

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Not reported

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study Was Performed: 1987

10.0 Contacts and Citation

10.1 Type of Source Material: Document

10.2 Citation: Document on Textile Processing Industries. Rajasthan State Board for Prevention and Control of Water Pollution. Jaipur, India. September 1983.

10.3 Level of Detail of the Source material: Additional information is available from this source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater, rinse water

11.2 Process Type/Waste Source: Textile mill products, SIC 2200, textile mill production

11.3 Waste Reduction Technique: Process waste recovery

11.4 Other Keywords: Wastewater recovery

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Rinsewater, Textile Mill Products, SIC 2200, Textile Mill Production, Process Waste Recovery, Wastewater Recovery

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Recovery and reuse of water in wet processing in a textile mill.

2.0 SIC Code: 2299, Textile Goods Manufacture

3.0 Name & Location of Company: Bombay Textile Research Association Member Textile Mill, Bombay, India

4.0 Clean Technology Category

Technology Principle: The technology involves the recovery and reuse of wastewater in wet processing.

5.0 Case Study Summary

5.1 Process and Waste Information: In a BTRA member mill, a month-long study was carried out to study the opportunities for conservation and reuse of water in its wet processing department. The following measures were suggested:

Reduce the rate of flow of water and the throttling of water supply in washing machines.

Counter the current flow of washing on soapers, mercerizing machines, J-box range, etc.

Effectively reuse wash waters at some preceding point in the processing sequence, or by a common sump and pump technique.

Collect and reuse steam condensate for boiler feed water.

Reuse steam condensate from caustic soda recovery plant in washing of mercerized goods.

Apply static washes on jiggers in place of overflow washes.

Use sodium bicarbonate in place of acetic acid for the oxidation of vat-dyed goods for easy removal of caustic soda.

Recycle water for washing of blankets on printing machines.

Reduce the number of washings in a process sequence by giving appropriate treatments to fabric.

The bulk trails for such conservation and reuse measures were carried out in the mills during the processing of a number of fabric varieties like bleached longcloth, dyed poplin, bleached mulls/voiles, and dyed mulls and voiles.

5.2 Scale of Operation: Not reported

5.3 State of Development: Process suggestions fully implemented.

5.4 Level of Commercialization: Not reported

5.5 Balances and Substitutions: Total fresh water consumption before the survey was 183,350 liters/day. After the survey, consumption was 11,950 liters/day. Net savings in fresh water consumption per year was 21,720,000 liters.

Material Category	Quantity Before	Quantity After
Water Use:	183,350 liters/day	110,950 liters/day
Water Reused:	85,200 liters/day	157,550 liters/day

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Total fresh water consumption before survey was 183,350 liters/day. After survey, it was 11,950 liters/day. Total savings in water consumption per year equals 21,720,000 liters. Monetary benefits amounted to 130,320 rupees per year.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Savings from reduced water consumption amounted to 130,320 rupees per year (taking cost of water at 60 rupees per 10,000 liters of water).

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date of Case Study: 1985

10.0 Contacts and Citation

10.1 Type of Source Material: Conference proceedings

10.2 Citation: "Seminar on Avenues for Cost Reduction in Chemical Processing of Textiles," held on February 26, 1985 by Bombay Textile Research Association, Bombay 400 086, BTRA No. 06.3.1

10.3 Level of Detail of Source Material: Additional information is available from the source.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Work Group, Paris. Reformatted by: Marilu Hastings, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater

11.2 Process Type/Waste Source: Wet processing, SIC 2299

11.3 Waste Reduction Technique: Wastewater recovery, reuse

11.4 Other Keywords: Annual cost savings

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Wet Processing, SIC 2299, Wastewater Recovery, Reuse, Annual Cost Savings

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Wastewater reuse in a synthetic textile mill in Bombay, India.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Orkay Textile Processors, Saki Naka, Andheri (East), Bombay, India

4.0 Clean Technology Category

Technology Principle: This technology involves treated wastewater reuse at a textile unit where the entire volume was reused.

5.0 Case Study Summary

5.1 Process and Waste Information: Wastewater reuse was implemented at a textile unit in Bombay processing 30,000 meters/day of polyester and polyviscose piece dyed shirting and suiting. The total quantity of wastewater discharged including floor washing was about 900 cubic meters per day.

The wastewater was treated in the scheme such as equalization and neutralization, chemical assist (using alum) sedimentation, pressure sand filter and a fluidized polishing reactor based on activated carbon. The entire volume of treated wastewater was reused in the process.

5.2 Scale of Operation: Daily production of 30,000 meters/day of polyester and polyviscose piece and fiber dyed shirting and suiting.

5.3 State of Development: This clean technology is fully implemented.

5.4 Level of Commercialization: This clean technology is fully commercialized.

5.5 Balances and Substitutions: Entire quantity of wastewater was recycled.

6.0 Economics*

6.1 Investment Costs: Civil capital costs (Rs. 200,000) plus mechanical capital costs (Rs. 700,000) totalled Rs. 900,000 for investment costs.

6.2 Operational and Maintenance Costs: Costs of chemicals per day (Rs. 1,700) plus power costs per day (Rs. 300) plus manpower costs per day (Rs. 100) brought the total O & M costs to Rs. 2,100 per day.

6.3 Payback Time: For 300 working days in a year, the pay back period was calculated to be 9 months.

7.0 Cleaner Production Benefits

Environmental and economic benefits include reduced consumption of fresh water and a net savings of Rs. 4,300 per day since there was a reduction in costs for purchase of 800 cubic meters of fresh water at Rs. 8 per cubic meter.

8.0 Obstacles, Problems and/or Known Constraints

The plant was commissioned in 1983-84. Recently operational problems were found in the fluidized column if activated carbon.

9.0 Date case study was performed: 1984

10.0 Contacts and Citation

10.1 Types of Source Material: Conference proceeding.

10.2 Citation: Handa, B.K. "Wastewater Management in a Synthetic Textile Industry," All India Workshop on Environmental Management of Small Scale Industries, July 22-23, 1989, Nagpur.

10.3 Level of Detail of Source Material: Additional information is available in the source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Workgroup, Paris. Reformatted: Lynn L. Curry, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater

11.2 Process Type/Waste Source: Textile industry, SIC 2299

11.3 Waste Reduction Technique: Wastewater reuse

11.4 Other Keywords: Water reuse, fresh water

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Textile Industry, SIC 2299, Wastewater Reuse, Treated Wastewater, Fresh Water

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Reclamation of sewage for process use in textile industry.

2.0 SIC Code: 2200, Textile Mill Products

3.0 Name & Location of Company: Referred to as "Textile Industry," located in Bhutan

4.0 Clean Technology Category

Recycling, reuse and reclamation and material/product substitution: This technology involves reclaiming sewage effluent for the use in textile mill production process.

5.0 Case Study Summary

5.1 Process and Waste Information: Recycled water from sewage effluent at a textile mill is used in the entire mill production.

The research on this project was carried out in two stages; (1) feasibility studies through laboratory and mill experiments and (2) with the conversion of the entire mill production to the use of recycled water from sewage effluents.

5.2 Scale of Operation: Not reported

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Not reported

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Not reported

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study Was Performed: 1980

10.0 Contacts and Citation

10.1 Type of Source Material: Journal

10.2 Citation: American Dyestuff Reporter, No. 1, 1980

10.3 Level of Detail of the Source material: Additional information is available from this source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater, sewage water

11.2 Process Type/Waste Source: Textile mills, SIC 2200, sewage effluent water

11.3 Waste Reduction Technique: Sewage effluent reuse, sewage effluent recycling, wastewater recovery

11.4 Other Keywords: Wastewater reduction, Bhutan, water conservation

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Sewage Water, Textile Mills, SIC 2200, Sewage Effluent Water, Sewage Effluent Reuse, Sewage Effluent Recycling, Wastewater Recovery, Wastewater Reduction, Bhutan, Water Conservation

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Recycling of wastewater in the textile industry for horticultural purposes.

2.0 SIC Code: 2200, Textile Mill Products

3.0 Name & Location of Company: The Raymond Woollen Mills, Ltd. located in Jekegram, Thane, Maharashtra, India.

4.0 Clean Technology Category

Recycling, reuse and reclamation: This technology involved the recycling of treated wastewater for horticultural purposes.

5.0 Case Study Summary

5.1 Process and Waste Information: The firm is engaged in the manufacture of woolen fabrics, polyester fabrics, viscose fabrics, etc. Raw materials used for production included wool fiber, polyester fiber, viscose fiber, and dyes and chemicals.

The recycling of treated wastewater for horticultural purpose has added to the profits of the firm with better crop yield and creating vegetation around the premises. The surroundings were hot and dry before modifications due to the lack of trees and grasses. After the modifications, the whole complex was made green with plantation of many trees or lawns.

5.2 Scale of Operation: Not reported

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions:

6.0 Economics*

6.1 Investment Costs: The total capital cost of the recycling unit was Rs 3.5 lakhs.

6.2 Operational and Maintenance Costs: The cost of water consumption per meter of fabric produced was reduced from Rs 0.94 to Rs 0.58. The total water cost savings/day was from Rs 18,000 to Rs 6,400. Energy costs were 200,000 Rs/day.

6.3 Payback Time: 8 months.

7.0 Cleaner Production Benefits

Economic benefits were calculated as the reduction in the cost of water consumption/meter of fabric produced (from Rs 0.94 to Rs 0.58) and total water cost savings/day (from Rs 18,000 to Rs 6.400).

8.0 Obstacles, Problems and/or Known Constraints

There is a more frequent out-growth of trees and grass.

9.0 Date Case Study Was Performed: Not reported

10.0 Contacts and Citation

10.1 Type of Source Material: Unpublished material

10.2 Citation: Not reported

10.3 Level of Detail of the Source material: Additional information is available from this source document.

10.4 Industry/Program Contact and Address: Mr. G. Sankara Narayanan, Manager (Engineering), The Raymond Woollen Mills Limited, P.O. JEKEGRAM. Thane - 400 606, Maharashtra, India.

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater, rinse water

11.2 Process Type/Waste Source: Textile mill products, SIC 2200, textile mill production

11.3 Waste Reduction Technique: Effluent recovery

11.4 Other Keywords: Wastewater reduction

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Rinsewater, Textile Mill Products, SIC 2200, Textile Mill Production, Effluent Recovery, Wastewater Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Water reuse in textile industries in Bombay, India.

2.0 SIC Code: 2200, Textile Mill Products

3.0 Name & Location of Company: Referred to as "Textile Mills Under Mill Owner's Association" located in Bombay, India

4.0 Clean Technology Category

Recycle, reuse and reclamation: This technology involved the use of the installation of wastewater recycling systems.

5.0 Case Study Summary

5.1 Process and Waste Information: An average water consumption estimate from 25 textile mills in Bombay, India was around 120-280 liters/kg of cloth.

Remodelling sewer systems to separate reusable wastewaters and direct them to a separate sumps of adequate size to balance inflows and outflows (approximately 10-15% of the volume of water to be reused). The reusable water will then be pumped and distributed by pipes to the point of direct water reuse.

5.2 Scale of Operation: Not reported

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions:

6.0 Economics*

6.1-2 Investment Costs and Operational and Maintenance Costs: For one of the mills in the study, detailed cost breakup (1970 costs in U.S. $) for various degrees of water reuse was provided as follows:

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Not reported

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date Case Study Was Performed: 1969.

10.0 Contacts and Citation

10.1 Type of Source Material: Conference proceedings

10.2 Citation: Arceivala, S.J., Kapadia, J.R. and Wadekar, V.R. Economy and Reuse of Water in Textile Mills. All India Textile Conference. 1969. pp. E-9 to E-17.

10.3 Level of Detail of the Source material: Additional information is available from this source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Wastewater, Rinse water

11.2 Process Type/Waste Source: Textile mill products, SIC 2200, Textile mill production

11.3 Waste Reduction Technique: Process water recovery

11.4 Other Keywords: Wastewater recovery

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Rinsewater, Textile Mill Products, SIC 2200, Textile Mill Production, Process Water Recovery, Wastewater Recovery

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Evaluation of three clean technologies for adoption in textile industries in Thailand.

2.0 SIC Code: (1) 7216, Dry Cleaning Plant Exc Rug; (2) 2269, Finishers of Textiles, NEC; (3) 2200, Textile Mill Products

3.0 Name & Location of Company: Referred to as "Textile mills" located in Bangkok, Thailand

4.0 Clean Technology Category

(1) Process/equipment modification: This technology involves the use of a dry cleaning machine which uses a refrigeration unit to cool the drying air to reduce the amount of solvent remaining at the end of the drying period. (2) Process/equipment modification: This technology involves the use of transfer printing. (3) Material/product substitution: This technology involves the use of hyperfiltration in textile mills.

5.0 Case Study Summary

5.1 Process and Waste Information:

(1) In a conventional dry cleaning machine, an activated carbon filter is used at the end of the drying period which evaporates the solvent (perchloroethylene) into the cleaning room air. A dry cleaning machine developed by BOWE of West Germany was evaluated. The BOWE machine uses a refrigeration unit to cool the drying air to the degree so that only a little amount of solvent remains at the end of the drying period.

(2) Transfer printing reduces the consumption and loss of dye materials.

(3) This technology implements the use of hyperfiltration plants reducing the pollutional load of chemicals.

5.2 Scale of Operation: Not reported

5.3 State of Development: Not reported

5.4 Level of Commercialization: Not reported

5.5 Material/Energy Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: (1) The operating cost of the BOWE machine was found to be 4 Bahts/load less than the conventional machine. The fixed costs of the BOWE machine was found to be higher by 5.68 Bahts/load. Operational and maintenance costs for the other two technologies is not provided. The economic calculations made for the BOWE dry cleaning machine assumed a load of 12 kg., working time of 8.5 hours/day and a cycle time of 30 minutes.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Economic benefits: (1) The BOWE machine was found to be 1.58 Bahts/load costlier than the conventional dry cleaning machine, so no benefits. No details of economic benefits was provided for the two other technologies.

Regulatory compliance: (1) The emission of perchloroethylene are expected to be lower in the BOWE machine but no standards exist (as of 1985) in Thailand for perchloroethylene. No details of regulatory compliance was provided for the two other technologies.

8.0 Obstacles, Problems and/or Known Constraints

(1) The BOWE machine was found to be technically beneficial but not economical. The number and size of dry cleaning mills in Thailand are very small, lending little commercial opportunities.

(2) The transfer printing technology is restricted to certain types of synthetic fibers. The market share of transfer printing machines is less than 5% of the Thai textile industry, hence the impact of this technology on the Thai textile sector is expected to be low.

(3) While this option was considered to be economically attractive and relevant to the Thai textile industry, in-house technology support, especially with the design of and implementation of hyperfiltration plants, was considered weak and therefore wide spread acceptance of the technology is lacking. Also, the Thai weavers are resistant to change and keep the size formulations secret.

9.0 Date Case Study Was Performed: 1985

10.0 Contacts and Citation

10.1 Type of Source Material: Report

10.2 Citation: Clean Technologies for the Paper and Pulp Industry, the Textile Industry, and the Metal Coating and Finishing in Thailand. Report submitted by Thailand Development Research Institute Foundation to United Nations Environment Program. 1986.

10.3 Level of Detail of the Source material: Additional information is available from this source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor Name and Address: UNEP Workgroup, Paris. Reformatted: Elizabeth J. Mooney, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Perchloroethylene, wastewater, textile dyes

11.2 Process Type/Waste Source: Dry cleaning machines, SIC 7216, SIC 2269, finishers of textiles, NEC, SIC 2200, textile mill products, desizing effluent, dry clean air emissions

11.3 Waste Reduction Technique: Refrigeration of solvents, textile dye reduction, hyperfiltration process

11.4 Other Keywords: Wastewater reduction

(*) - **Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.**

Keywords: Perchloroethylene, Wastewater, Textile Dyes, Dry Cleaning Machines, SIC 7216, SIC 2269, Finishers of Textiles, NEC, SIC 2200, Textile Mill Products, Desizing Effluent, Dry Clean Air Emissions, Refrigeration of Solvents, Textile Dye Reduction, Hyperfiltration Process, Wastewater Reduction

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Recovery and reuse of solid waste from a synthetic textile industry.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Harihar Polyfiber, GRASIM, Karnataka, India

4.0 Clean Technology Category

Technology Principle: This technology involves recovery of solids in the effluent and selling the recovered material.

5.0 Case Study Summary

5.1 Process and Waste Information: At this facility the rejects from the last centri-cleaner stage were sent to the sewer. This resulted in the jamming of the primary clarifier sludge screen and higher suspended solids in the effluent as well as fiber loss. Also, the underflow sludge from the primary effluent clarifier was very dilute and the disposal of the same was very difficult. In the new process the solids were slurryied and passed through a vibrating screen and finally dewatering to 35% dry content. This was then bagged and sold to board and cellulose powder manufacturers.

To alleviate the problem of the dilute underflow sludge, the sludge was dewatered to 35% dry content by passing it through a vibrating screen and screw press and then bagged and sold to board manufacturers and for packing purposes.

5.2 Scale of Operation: Not reported

5.3 State of Development: The clean technology is fully implemented.

5.4 Level of Commercialization: The clean technology is fully commercialized.

5.5 Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Savings of 0.3 million Rs./year were realized from the sale of the water.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Economic benefits were estimated to be Rs. 0.3 million/year from the wastes sales.

8.0 Obstacles, Problems and/or Known Constraints

Not reported

9.0 Date Case Study Was Performed: Not reported

10.0 Contacts and Citation

10.1 Types of Source Material: Unpublished

10.2 Citation: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers (GRASIM), Karnataka, India.

10.3 Level of Detail of Source Material: Additional information is available in the source document.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Workgroup, Paris. Reformatted: Lynn L. Curry, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Textile solid wastes, sludge

11.2 Process Type/Waste Source: Textile Industry, SIC 2299

11.3 Waste Reduction Technique: By-product recovery, reuse

11.4 Other Keywords: India

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Textile Solid Wastes, Sludge, Textile Industry, SIC 2299, By-Product Recovery, Reuse, India

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Recycling of process waste to reduce chemical requirements in a synthetic fiber industry.

2.0 SIC Code: 2299, Textile Goods, NEC

3.0 Name & Location of Company: Harihar Polyfibers, GRASIM, Karnataka, India.

4.0 Clean Technology Category

Technology Principal: This technology involves recycling of HCl and caustic soda.

5.0 Case Study Summary

5.1 Process and Waste Information: At this facility, the cation units were regenerated with HCl and the back wash and rinse water were being drained to the effluent plant. The anion unit was regenerated with alkali (NaOH) and the spent waste was also being drained to the effluent plant.

To recover and recycle HCL and caustic soda, the cation back wash was analyzed and checked for content of acid and other impurities. This was deemed suitable for neutralizing the effluent from the staple fiber plant, which was neutralized earlier in the process by addition of fresh HCl. The anion back wash containing alkali was used for effluent treatment where fresh soda had been used earlier.

5.2 Scale of Operation: Not reported

5.3 State of Development: The clean technology is fully implemented.

5.4 Level of Commercialization: The clean technology is fully commercialized.

5.5 Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investment Costs: Not reported

6.2 Operational and Maintenance Costs: Savings of 1.5 million Rs./year in chemical purchases were realized.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits

Reduced mineral acid and alkali (i.e., fresh HCl and caustic to effluent resulted in a savings of Rs. 1.5 million/year.

8.0 Obstacles, Problems and/or Known Constraints: Not reported

9.0 Date case study was performed: Not reported

10.0 Contacts and Citation

10.1 Types of Source Material: Unpublished.

10.2 Citation: Mr. Shailendra Jain, Senior Executive President, Harihar Polyfibers, GRASIM, Karnataka, India.

10.3 Level of Detail of Source Material: Additional information on technical aspects of the industrial process and cleaner production benefits is provided.

10.4 Industry/Program Contact and Address: Not reported

10.5 Abstractor and Address: UNEP Workgroup, Paris. Reformatted: Lynn L. Curry, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste Type: Ion exchange back wash

11.2 Process Type/Waste Source: Ion exchange regeneration, textile industry, SIC 2299

11.3 Waste Reduction Technique: Recycling, reuse

11.4 Other Keywords: Ion exchange, hydrochloric acid, caustic soda

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Ion Exchange Backwash, Ion Exchange Regeneration, Textile Industry, SIC 2299, Recycling, Reuse, Ion Exchange, Hydrochloric Acid, Caustic Soda

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Water conservation in a textile industry.

2.0 SIC Code: 22, Textile Mill Products

3.0 Name and Location of Company: Binny Textile Mills, Madras, India

4.0 Clean Technology Category: This case study focuses on reuse of wastewaters and water conservation.

5.0 Case Study Summary:

5.1 Process and Waste Information: Four areas within the facility are the major wastewater producers: (1) process and treatment department; (2) captive power generation unit (coal fired thermal power station); (3) sizing department; and (4) yarn dyeing and printing department. The following changes were undertaken to conserve water and reduce wastewater generation.

Reuse of pressure filters backwash water. Suspended solids that can easily settle are the main pollutants in pressure filter backwash water. By collecting the backwash water in a pond, with a minimum hydraulic retention time of 12 hours, the supernatant freed from the suspended solids can be reused for gardening purposes. Periodically, the retained suspended solids are removed from the pond and disposed of a solid waste in a landfill site. The net effect is conservation of 20 cubic meters/day of freshwater, which the facility used for gardening purposes.

Reuse of wastewater from the dyeing and finishing department - About 1,200 cubic meters/day of fresh water, including the evaporation loss, was used for quenching hot ash from the boiler house prior to its disposal. Laboratory experiments confirmed that it is feasible to reuse hard wastewater from the dyeing department for ash quenching in lieu of fresh water. Due to adsorption of colors and dyes on the ash particles, there is a approximately a 20% reduction in BOD content in the reused dye department wastewater. Approximately 1,200 cubic meters per day of fresh water was conserved, with a reduction of 552 kg BOD/day.

Reuse of wastewater from the sizing department - In order to avoid spontaneous combustion and to reduce the fines loss, freshwater was used to wet coal in the yard. By collecting in a pond the low volume, high organic strength wastewater from the sizing department, all of the wastewater could be reused for coal wetting. Appropriate facilities must be available at the pond to avoid septicity. Wastewaters from the sizing department were completely reused and 27 cubic meters per day of fresh water were conserved.

5.2 Scale of Operation: Unknown.

5.3 Stage of Development: The technology was fully implemented.

5.4 Level of Commercialization: Not applicable

5.5 Material/Energy Balances and Substitutions: Not reported

6.0 Economics*

6.1 Investments Costs: Investment costs include the facility for pH neutralization pumps and pipeline costs.

6.2 Operational & Maintenance Costs: Savings and reduction in the capital investment is Rs. 7 lakhs annually, and annual O&M costs are Rs. 6 lakhs. Annual savings for 300 workings days per year for purchase of fresh water from the municipal corporation totalled Rs. 4 per cubic meter.

6.3 Payback Time: Not reported

7.0 Cleaner Production Benefits: Wastewater reused equals 2,690 cubic meters per day and freshwater consumption was reduced 1.227 cubic meters per day. The overall reduction in wastewater quantity and BOD load were 31% and 25% respectively.

8.0 Obstacles, Problems, and/or Known Constraints: Not available

9.0 Date Case Study Was Performed: 1984

10.0 Contacts and Citation

10.1 Type of Source Material: Unpublished materials.

10.2 Citation: Mr. L. Paneerselvam, Director (PC), National Productivity Council, Lodhi Road, New Delhi 110 003, India.

10.3 Level of Detail of Source Material: Unknown

10.4 Industry/Program Contact and Address: Unknown

10.5 Abstractor Name and Address: The information in this case study was derived from abstracts provided by the United Nations Environment Program (Paris). This abstract was prepared directly from the abstract without access to the case study cited. Mary L. Wolfe, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Wastewater.

11.2 Process Type/Waste Source: Textile mill products, SIC 22

11.3 Waste Reduction Technique: Reuse

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Textile Mill Products, SIC 22, Reuse

***** DOCNO: DOCUMENT NOT AVAILABLE *****

1.0 Headline: Nordic project on water use reduction in textile industries.

2.0 SIC Code: 22, Textile Mill Products

3.0 Name and Location of Company: 15 textile facilities in Denmark, Finland, Norway, and Sweden.

4.0 Clean Technology Category

Process/Equipment Modification: This technology involves the introduction of automatic water stops to encourage water conservation.

5.0 Case Study Summary:

5.1 Process and Waste Information: Between 1976 and 1981, a Nordic "water care" project was launched to examine avenues of water conservation in textile industries in Denmark, Finland, Norway, and Sweden.

The following changes were reported for batch operations:

Winch dyeing: By dropping the dye batch and avoiding overflow rinsing, water consumption could be reduced 25%.

High and Low Pressure Jet Dyeing: Approximately 50% of water consumption could be reduced by replacing the overflow with batchwise rinsing.

Beam Dyeing: Avoiding overflow during soaking and rinsing can reduce water consumption by approximately 60%.

Jig Dyeing: Switching to stepwise rinsing from the overflow practice resulted in water consumption reductions of 15%-79%.

Cheese Dyeing Apparatus: A water consumption reduction of 70% can be expected with the use of an intermittent rinsing procedure.

For continuous operations, a savings of 20%-30% was reported by the introduction of automatic water stops. Counter current washing was found to be most effective. Horizontal washing equipment was found to deliver the performance of two vertical washing machines for the same water consumption.

5.2 Scale of Operation: Initially, laboratory studies were carried out to ascertain potential possibilities. Approximately 25 setups were installed at 15 textile plants.

5.3 Stage of Development: At the time the case study was reported, the technology was in the pilot stage.

5.4 Level of Commercialization: It is unknown whether the technology was commercially available at the time of the case study.

5.5 Material/Energy Balances and Substitutions: Not reported

6.0 Economics*:

6.3 Payback Time: The only technology with a known payback time is beam dyeing, which has a payback time of about four months.

7.0 Cleaner Production Benefits: Substantially reduced fresh water consumption and reduced cost of effluent treatment plant.

8.0 Obstacles, Problems, and/or Known Constraints: None reported.

9.0 Date Case Study Was Performed: 1976

10.0 Contacts and Citation

10.1 Type of Source Material: Conference Proceedings

10.2 Citation: H. Asnes, "Reduction in Water Consumption in the Textile Industry," IFATCC Conference, London, 1978.

10.3 Level of Detail of Source Material: Unknown

10.4 Industry/Program Contact and Address: Unknown

10.5 Abstractor Name and Address: The information in this case study was derived from abstracts provided by the United Nations Environment Program (Paris). This abstract was prepared directly from the abstract without access to the conference proceedings cited. Mary L. Wolfe, Science Applications International Corporation, 7600-A Leesburg Pike, Falls Church, Virginia 22043.

11.0 Keywords

11.1 Waste type: Wastewater.

11.2 Process Type/Waste Source: Textile Mill Products, SIC 22

11.3 Waste Reduction Technique: Wastewater reduction, equipment modification

(*) - Disclaimer: Economic data will vary due to economic climate, varying governmental regulations, and other factors.

Keywords: Wastewater, Textile Mill Products, SIC 22, Wastewater Reduction, Equipment Modification

TIMBER PRODUCTS

***** DOCNO: 400-037-A-226 *****

INDUSTRY/SIC CODE:	Wood industry, manufacturing of wood objects, including furniture/ISIC 3311
NAME/CONTACT:	Ministere de l'Environnement et du Cadre de Vie Direction de la Prevention des Pollutions 14, Boulevard du General Leclerc 92521 Neuilly-sur-Seine Cedex, France
TECHNOLOGY DESCRIPTION:	In the low pollution technique, the water necessary for manufacturing circulates in a closed circuit and the fluid used to transport the fibers is itself the final effluent. Only a quantity of water exactly equal to the amount that evaporates during manufacturing is introduced into the closed circuit. The pollution discharged comes from the washing of the roof and floor by rainwater and losses of cooling water. There are 0.8 kg of oxidizable and suspended matter per ton, against 110 kg in the standard technique.
FEEDSTOCKS:	Wastewater
WASTES:	Not reported
MEDIUM:	Aqueous
COST:	Not reported
CAPITAL COST:	Not reported
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	The low pollution technique is more efficient than a standard treatment solution and permits a greater technical adaptability in manufacturing, given the possibility of utilizing toxic products.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Recycling of Water in the Manufacturing of Wood Fiber Panels," Monograph ENV/WP.2/5/Add.37.
KEYWORDS:	Wood Fiber, Closed-Loop Water Recycle, ISIC 3311

TRANSPORTATION

***** DOCNO: 450-003-A-379*****

HEADLINE: Budd automotive uses ultrafiltration system to recover large volumes of oily wastes and wastewaters from an automotive chassis manufacturer.

INDUSTRY/SIC CODE: Transportation Equipment/ISIC 32

NAME/CONTACT: Budd Automotive
Kitchener, Ontario

POLLUTION PREVENTION OPTIONS SUMMARY: A manufacturer of automotive chassis, generates wastes that are heavy with oil, grease and solids from industrial washers and die-washing equipment, along with cutting fluids. An ultrafiltration (UF) system was purchased to recover the oil used in the press shop. The system breaks the oil-water emulsion so that a dilute oil solution can be recovered. The oil solution recovered from the UF unit is about 30-40% oil. An acid can be added to concentrate the solution to about 60-70% oil. Some of the recovered oil is reused in the plant, and some is sent to a company for rerefining. The remaining oil is mixed with lime to form a dried lime slurry which is disposed of at a landfill.

FEEDSTOCKS: Wastes high in oil, grease, and solids

WASTES: Unrecovered oil, dried lime slurry

MEDIUM: Liquid

COST:
CAPITAL COST: $100,000
OPERATION/MAINTENANCE: Not reported
MONTHS TO RECOVER: Less than 24

SAVINGS:
DISPOSAL & FEEDSTOCK: The washing system, consisting of four or five 8,000-gallon tanks, are now emptied and refilled with fresh water every 6-12 months instead of every 3-6 weeks.
FEEDSTOCK REDUCTION: Waste requirements are reduced.
WASTE PRODUCTION: Oily waste generation is reduced.

IMPACT: Large volumes of oily wastes and washwaters are now being recovered instead of requiring disposal. The system greatly reduces oil raw material costs, water, and disposal costs.

CITATION: "Catalogue of Successful Hazardous Waste Reduction/Recycling Projects," Energy Pathways Inc. and Pollution Probe Foundation, prepared for Industrial Programs Branch, Conservation & Protection Environment Canada, March, 1987, page 94.

KEYWORDS: Automotive, Ultrafiltration, Oily Waste, Recovery, ISIC 32

WASTE RECLAMATION SERVICES

***** DOCNO: 400-082-A-253*****

INDUSTRY/SIC CODE:	Manufacture of Chemical Products, NEC/ISIC 3529
TECHNOLOGY DESCRIPTION:	The Foster Wheeler pyrolysis technology is a process in which used, shredded tires are heated in absence of air to produce a light fuel oil, solid fuel, and high grade steel. Hot gases (600°C), containing no oxygen, are passed through the bed of tires causing pyrolysis to occur. Oil in the vapor phase is condensed and collected in the quench column. Remaining gases either fuel the process or are recycled through the reactor. Solid products are continuously removed from the reactor.
FEEDSTOCKS:	Tires up to 1.75 meters. 32% steel content. 4.577 GJ/ton energy required per ton.
WASTES:	Light oil, solid fuel, steel, carbonaceous char
MEDIUM:	Liquid and solid wastes
COST:	
CAPITAL COST:	6.65 million Pounds Sterling
OPERATION/MAINTENANCE:	1.655 million Pounds Sterling in first year
MONTHS TO RECOVER:	Return on investment of up to 35% based on 10 year operational life.
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Cost of landfill, incineration, or reclaiming of used tires.
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Presenting disposal alternative for approximately 65% of 3,000,000 metric tons/year of used tires.
IMPACT:	This technology addresses the problem of disposing of the 3,000,000 metric tons/year of used tires estimated to be generated in the U.K. 20-25% are retreaded, 15-20% have alternate end uses, while up to 65% present an immediate disposal problem. The products of this pyrolysis process are readily distributable energy sources for which markets exist. Possibility exists to apply the technology to a variety of feeds ranging from plastics to urban wastes.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Foster Wheeler Power Products Limited Pyrolysis Technology for Energy from Used Tires", Monograph ENV/WP.2/5/Add82.
KEYWORDS:	Tires, Energy Recovery, Waste Recovery, Pyrolysis, SIC 3529

MISCELLANEOUS

***** DOCNO: 400-004-A-195 *****

INDUSTRY/SIC CODE: Oil-fired Furnaces/SIC 3433

NAME/CONTACT: Canadian Combustion Research Laboratory, Energy Research Laboratory, CANMET, Department of Energy, Mines, and Resources, Ottawa, Ontario / Mr. R. Breaton

TECHNOLOGY DESCRIPTION: Retrofitting oil-fired heating systems with special air mixing tube, positive damper control, fuel shut-off valve to improve energy efficiency and to reduce emissions. The changes to a conventional oil-burning furnace are:

(1) Replace air mixing tube
(2) Install smaller nozzle
(3) Solenoid shut-off valve in fuel line
(4) Positive damper in stack
(5) Interlocking wiring

Benefits range from 15-20% fuel cost reduction.

FEEDSTOCKS: Oil

WASTES: Emissions of CO, particulates, and hydrocarbons

MEDIUM: Not reported

COST: (1979 Canadian Dollars)
CAPITAL COST: $400
OPERATION/MAINTENANCE: Not reported
MONTHS TO RECOVER: 36 to 84

SAVINGS:
DIRECT COST: Not reported
FEEDSTOCK REDUCTION: 20%
WASTE PRODUCTION: 9% reduction in SO_2 and NO_2

IMPACT: Reduces fuel consumption and waste emissions

CITATION/PAGE: Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Retrofitting Oil Fired Furnaces," Monograph ENV/WP.2/5/Add.4.

KEYWORDS: Residential Heating, Heating Oil, SIC 3433

***** DOCNO: 400-007-A-198 *****

INDUSTRY/SIC CODE:	Sea Water Desalination, Nuclear Power Generation/ISIC 4200
NAME/CONTACT:	Nörd-Aqua Oy, Vuorimiehenpuistikko 4D, 00140 Helsinki 14, Finland.
TECHNOLOGY DESCRIPTION:	The company uses low temperature waste heat distillation as a means of heat recovery. Nuclear power plant cooling water discharges may be used. A water stream containing waste heat is partially evaporated in vacuum and the vapor is condensed to fresh water in heat exchange with colder cooling water. The vacuum is created by barometric columns and air is pumped out of the vacuum by means of water flows. A temperature difference of 7 degrees Centigrade between the warm and cold water streams is an economical minimum requirement for the process.
FEEDSTOCKS:	Not reported
WASTES:	No waste, no chemicals
MEDIUM:	Not reported
COST:	(1979 Dollars)
CAPITAL COST:	$1,842,000
OPERATION/MAINTENANCE:	$1,503/ton
MONTHS TO RECOVER:	Not reported
SAVINGS:	Not reported
DIRECT COST:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	None
IMPACT:	Local thermal pollution of power plants can be reduced by using larger cooling water flow rates. The risk of radioactive pollution of water is reduced, if all cooling water of a nuclear power plant condenser is used for waste heat desalination.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Nord-Aqua Low Temperature Waste Heat Desalination", Monograph ENV/WP.2/5/Add.7.
KEYWORDS:	Waste Heat, Desalination, Heat Recovery, Nuclear Power, ISIC 4200

***** DOCNO: 400-090-A-257*****

INDUSTRY/SIC CODE:	Printing, Publishing and Allied Industries/ISIC 3420
TECHNOLOGY DESCRIPTION:	The process demonstrates the savings achievable by an over-all review of the energy consumed in the manufacturing of adhesive tapes. Modifications involve a change from indirect steam heating to direct gas firing, improved air circulation and web transport in the oven, and supplementing the gas supply with incinerated evaporated solvents. Three ovens are used in the process. Solvents from one are returned to the burner which supplies drying energy for all three ovens. Two of the ovens incorporate heat wheels to preheat make-air.
FEEDSTOCKS:	Natural gas (22 GJ/ton product)
WASTES:	Solvent vapors
MEDIUM:	Gaseous
COST:	
CAPITAL COST:	421,000 British Pounds
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	32
SAVINGS:	
DISPOSAL & FEEDSTOCK:	151,000 British Pounds
FEEDSTOCK REDUCTION:	6.5 - 10.2 (23-35%) GJ energy/ton of product
WASTE PRODUCTION:	360 ton/year solvent vapors
IMPACT:	Since current technology consists of emitting the solvent to the atmosphere or burning the solvent in the exhaust air, pollution and fuel requirements are reduced. Energy savings are realized by a more efficient drying system which uses direct gas firing rather than steam heated drying. Air circulation is also improved in the ovens.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Energy Saving and Pollution Prevention In Adhesive Tape Ovens Using Gas-fired Solvent Incinerators and Waste Heat Recovery", Monograph ENV/WP.2/5/Add90.
KEYWORDS:	Paper, Energy Review, Solvent Recovery, ISIC 3420

***** DOCNO: 400-102-A-263 *****

INDUSTRY/SIC CODE:	Electricity, Gas and Steam/ISIC 41
TECHNOLOGY DESCRIPTION:	The process controls coal-fired boiler particulate emissions through the use of side stream separator technology. This technology can provide a highly cost-effective means of reducing particulate emissions below levels currently obtainable with conventional high efficiency mechanical collectors. A portion (side stream) of the combustion gas is drawn off at the point in which the gas stream reverses through a bag filter. This system has demonstrated an improvement in the over-all efficiency of emissions control for 15 boilers by an average of 55 per cent. The particulate emissions levels have been reduced from 0.29 lb/MMBtu to 0.13 lb/MMBtu. In addition, the collection efficiency of finer particulates increased to approximately 90 percent from 66 per cent. All of this was done at substantially less cost than a conventional control system.
FEEDSTOCKS:	
WASTES:	Gaseous and particulate emissions from coal-fired boilers.
MEDIUM:	Gaseous
COST:	
CAPITAL COST:	$700,000
OPERATION/MAINTENANCE:	Not reported
MONTHS TO RECOVER:	Not reported
SAVINGS:	
DISPOSAL & FEEDSTOCK:	Not reported
FEEDSTOCK REDUCTION:	Not reported
WASTE PRODUCTION:	Not reported
IMPACT:	The side-stream separator system utilizes 60 per cent less energy than operation of a full bag filter. The compact design and size of the system allows for retrofitting of existing installations without major modifications.
CITATION/PAGE:	Compendium on Low and Non-waste Technology, United Nations Economic and Social Counsel, "Side Stream Separator Control of Particulate Missions", Monograph ENV/WP.2/5/Add102.
KEYWORDS:	Particulate Emissions, ISIC 41, Pollution Control, Coal-Fired, Boilers

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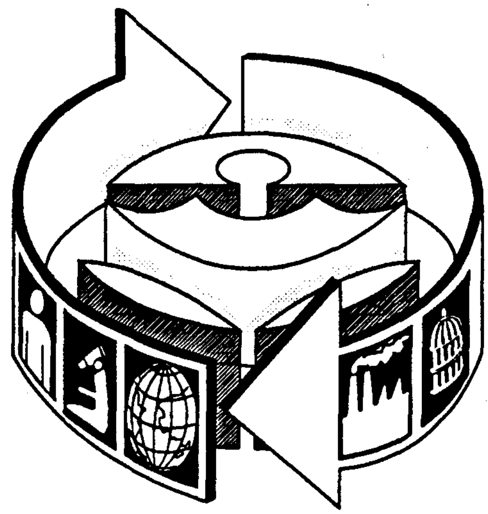
APPENDIX A

POLLUTION PREVENTION INFORMATION CLEARINGHOUSE

Pollution Prevention Information Clearinghouse

The Pollution Prevention Information Clearinghouse (PPIC) is dedicated to reducing or eliminating industrial pollutants through technology transfer, education, and public awareness. The Clearinghouse contains technical, policy, programmatic, legislative, and financial information concerning source reduction and recycling efforts in the United States and abroad. It is a free, nonregulatory service of the U.S. EPA and is accessible by personal computer, telephone hotline, or mail.



PPIC Structure

The Clearinghouse comprises four information exchange mechanisms:

Repository

A hard copy reference library containing the most current pollution prevention information. Case studies, fact sheets, programmatic and legislative information, and training materials are included in the Repository.

Pollution Prevention Information Exchange System (PIES)

A 24-hour electronic network consisting of message centers, technical data bases, issue-specific "mini-exchanges," and a calendar of events devoted exclusively to pollution prevention. The system enables the user to access the Repository, a document ordering service, and PPIC technical staff.

Hotlines

Toll free telephone services to answer or refer questions and provide links to the PIES for users without access to a personal computer.

Outreach Efforts

Workshops and information packets containing industry-specific materials on pollution prevention opportunities.

Accessing the PPIC

Users without a Personal Computer and a Modem:

Hotline

The PPIC uses two EPA hotlines and its own technical support service to answer or refer pollution prevention questions:

RCRA/Superfund Hotline:	(800) 424-9346	
Small Business Ombudsman (SBO) Hotline:	(800) 368-5888	
PPIC Technical Support Office:	(703) 821-4800	Phone
	(703) 821-4784	Fax

Mail

Pollution Prevention Information Clearinghouse
c/o SAIC
8400 Westpark Drive
McLean, Virginia 22102

Users with a Personal Computer and a Modem:

Regular Phone Line

Anyone can access the PIES using either an IBM PC (or compatible), Apple, or a dumb terminal equipped with a modem (1200 or 2400 baud), and appropriate communications software (e.g. Crosstalk™). Set your communication software to 8 data bits, no parity, 1 stop bit and call (703) 506-1025.

Example:

Using Crosstalk™, type in the bold characters at the "Command?" prompt:

NAme	PIES
NUmber	703-506-1025
MOde	Call
DAta	8
PArity	N
STop	1
GO	

Note: You may have to prefix the number with "8" or "9" to access an outside line, or "1" for long distance calls, as appropriate to your installation. A toll-free 800 number has been established for authorized Federal, State, and local government users — contact the PPIC Technical Support Office (listed above) to see if you qualify.

Upon first calling the PIES, you must answer some brief questions, and select and enter a password (you must remember your password for subsequent calls to the system).

Telenet

Telenet is a private data network service. If you already subscribe to this service, dial your local Telenet access number. At the @ prompt, type: c 20256131 to access the PIES. If you would like to receive information about how to subscribe to Telenet, contact the PPIC. Note: Telenet is not affiliated with the U.S. EPA or the PPIC.

Accessing the PPIC (cont.)

Other U.S. Data Services

If you have access to one of the U.S. private data services that has a gateway to Telenet, you can connect to the PIES. These data systems are: BitNet, Western Union, SNET, Bell Atlantic, Bell South, Ameritech, NYNEX, Pacific Bell, Southwestern Bell, U.S. West, and Cincinnati Bell. Follow the local access procedures established by your data network to connect to another network. At their prompt, type: 311020256131 to access the PIES.

Overseas Data Service Provider

If you are a user outside North America, you must access a data service in your country that has a gateway to Telenet (contact the PPIC for a complete list of participating networks). Follow the local access procedures established by your data network to connect to another network. At their prompt, type: 311020256131 to access the PIES.

PIES User Guide

A PIES User Guide is available and may be obtained free-of-charge by either leaving a message on the system addressed to "Sysop," writing the above address, or calling one of the hotlines.

The International Cleaner Production Information Clearinghouse

The International Cleaner Production Information Clearinghouse (ICPIC) is the PPIC's sister clearinghouse operated by the United Nations Environment Programme's (UNEP) Industry and Environment Office (IEO). The ICPIC provides information to the international community on all aspects of low- and non-waste technologies and methods. Patterned after the PPIC, the ICPIC has similar functions and components, including an electronic information exchange system that is indirectly accessible to PIES users through nightly exchanges of messages on the PIES Main Menu message center. For more information about the ICPIC, contact the PPIC (see above) or the ICPIC.

Accessing the ICPIC

Mail

The Director
Industry and Environment Office
United Nations Environment Programme
39-43 quai Andre Citroen
75739 Paris CEDEX 15
France

Phone/Fax

Telephone: 33-1-40-58-88-50
Fax: 33-1-40-58-88-74

APPENDIX B

CASE STUDY FORMAT GUIDELINES

Appendix B: Guidelines for Case Study Submissions to PIES

The PPIC is constantly in search of new information describing how companies or organizations successfully prevent pollution generation. This information is useful to others who are faced with similar waste generation problems, but who need more practical information about technology, method, or cost options. The PPIC has helped design a case study format to make this information available to its users in a concise, yet useful manner. By sharing this case information with each other, PIES users contribute to the improvement of our common environment.

If you have case studies that describe useful pollution prevention technologies, methods, or approaches, please consider submitting them to PIES' case study data base. The guidelines in this appendix are intended to assist abstractors in preparing case studies with the format required for the PIES system—please follow them closely.

Once the PPIC has received your submissions, the case studies will undergo engineering/technical reviews, quality assurance checks, and style/format review. This review process will be conducted by a combination of the following organizations:

PPIC
ICPIC
UNEP Cleaner Production Industry Working Groups
American Institute for Pollution Prevention (AIPP)
Illinois Hazardous Waste Resource Information Center (HWRIC)

During the review process, you may be contacted by members of the review teams to supply additional/missing information or to clarify statements.

You may submit potential case studies by uploading a text file to the PIES (See "PIES File Transfer" section) or by transmitting them to the PPIC by mail or facsimile.

PPIC
c/o SAIC
7600-A Leesburg Pike
Falls Church, Virginia 22043

Telephone: (703) 821-4800
Fax: (703) 821-4775

Case Study Format Guidelines

1.0 **Headline:** A short attention-getting phrase or sentence highlighting the significance of the case study. The headline should include industry or process, waste type, waste volume/toxicity reduction, and pollution prevention techniques. Describe quantitatively the problem that was solved.

2.0 **SIC Code and/or ISIC Code:** Four-digit Standard Industrial Classification code(s) that best describe the industry segment(s) referenced by the case study. Employ the highest level of specificity (i.e., use three- or two- digit SIC/ISIC codes if information does not allow more detailed identification). Use as many SIC/ISIC codes as are relevant to the subject study; however, the primary SIC/ISIC code should always be the first code listed. Precede all International SIC codes with "I" (e.g., I2261).

3.0 **Name and Location of Company:** The name and location of the facility that implemented the case study. Include address if possible (street, city, state or province, country, and postal code).

4.0 **Pollution Prevention Category:** A brief description of the principle(s) behind the pollution prevention technology referenced in the case study, such as:

- Periodic assessments
- Process/equipment modification
- Recycling, reuse, and reclamation
- Material/product substitution
- Training and supervision
- Housekeeping
- Production planning and sequencing
- Waste segregation and separation.

5.0 Case Study Summary: Summarize information, to the level of detail provided in the case study, in the following areas:

5.1 Process and Waste Information: A description of the relevant original manufacturing process or area of the plant to which the pollution prevention technique applies, physical state of the target waste streams (solid, liquid, gas, or sludges), changes in the process resulting from the pollution prevention technique, and a description of any positive or negative effects on the wastes, products, or production rate after implementing the new technology. Include any changes in:

- Products or production rates resulting from the application
- New or existing waste stream generation and composition
- New or existing raw materials and consumption rates
- Energy usage
- Operating procedures.

5.2 Scale of Operation: A description of the size of the process or operation. If possible, include quantitative information on the amount of product being produced or manufactured and the amount of waste being generated.

5.3 Stage of Development: A one-line description of the stage of development the pollution prevention technique was in at the time of the case study (e.g., planning stage, bench test, pilot state, or fully implemented). Indicate whether quantitative figures are estimated or based on actual production.

5.4 Level of Commercialization: An indication of whether the technology or process was commercially available at the time of the case study. Indicate whether or not the equipment and/or materials were readily available, or if they were specifically designed for this application.

5.5 Material/Energy Balances and Substitutions (optional): A tabulation of quantitative changes in material generation and use prior to and resulting from the pollution prevention technique. Include in the following table information for each waste stream or product, and designate "N/A" when information is not available (provide units of measurement for all numerical data):

Material Category	Qty. Before	Qty. After
Waste Generation:		
Feedstock Use:		
Waster Use:		
Energy:		

6.0 Economics[1]: A summary of the costs and savings reported in the case study. Include dates and currencies for all economic data reported.

6.1 Investment Costs: A summary of all capital costs and a detailed description of the purchased item(s) or service. Include any specifications (i.e., number, size, capacity, etc.) for each item used.

6.2 Operational and Maintenance Costs: Changes in operational and maintenance costs (per month or year) and changes in personnel or hours required.

6.3 Payback Time: The approximate payback period for the particular pollution prevention technology used in the case study (total investment/net/savings/year).

7.0 Pollution Prevention Benefits: A detailed discussion of the benefits resulting from the pollution prevention technique, including, but not limited to:

- Economic benefits (include source of savings, e.g., reduced feedstock)
- Improved public relations
- Changes in regulatory compliance.

Indicate, if possible, what factors were the driving force behind implementing the technique.

8.0 Obstacles, Problems, and/or Known Constraints (optional): A description of the technical constraints that could prevent implementation of the technology (e.g., physical, chemical, or biological limits of a manufacturing or treatment process). Discuss any regulatory barriers in implementing the technology and indicate what other problems were encountered during implementation of the technology.

9.0 Date Case Study Was Performed: The actual data the pollution prevention measures were initiated.

10.0 Contacts and Citation

10.1 Type of Source Material: The type of source material abstracted:

- Book or chapter
- Journal or journal article
- Organizational report
- Conference proceedings
- Unpublished material
- Other (specify).

10.2 Citation: Citation for the document abstracted, including: author(s); title of book, journal article, or proceedings; volume; number; and month and year of publication (see the *Chicago Manual of Style* for appropriate formats). In addition, if the document is available through NTIS, enter the NTIS number.

10.3 Level of Detail of the Source Material: An indication of whether or not additional detail is available in the source document for this case study (applicable only for documents that are publicly available). Indicate what additional information is available (e.g., process, waste, etc.).

10.4 Industry/Program Contact and Address: The name, address, and phone number of the person who can be reached for further information concerning the case study. Authorization must be given by the contact prior to including their name in this field.

10.5 Abstractor Name and Address: The name, organization, and address of the person preparing the case study abstract.

11.0 Keywords: Descriptive keywords selected from the ICPIC keyword list[2] for each of the following categories:

11.1 Waste Type: The conventional waste(s) that is/are acted on by the pollution prevention option, not the waste(s) generated after implementing the pollution prevention techniques.

11.2 Process Type/Waste Source: The original industrial process(es) or sources of the waste(s) that is/are modified by the pollution prevention technique.

11.3 Waste Reduction Techniques: The techniques that were implemented at the facility and are principally responsible for reducing waste generation.

11.4 Other Keywords: Other keywords, as appropriate, that accurately describe the case study and assist users in locating this abstract, including:

- Environmental media (air, water, soil)
- Product names
- Feedstocks
- Special incentives
- Geographical/institutional keywords (Italy, Ruhr Valley, USDA, etc.).

Use as many keywords as are necessary to accurately describe the case study in each category. If ideal keywords are not found in the keyword list, please add new ones to the list.

12.0 **Assumptions:** A listing of any assumptions used when abstracting. Reference the sections of the abstract that relied upon the assumption. Any discrepancies encountered in the source document should also be presented.

13.0 **Peer Review:** An indication of whether or not the source document has gone through a technical peer review process. Indicate: Yes, No, or Unknown.

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[1] Disclaimer: economic data will vary due to economic climate, varying governmental regulations, and other factors.

[2] A list of keywords can be obtained by contacting the PPIC or leaving a message to the PIES SYSOP.

Note: Samples of completed case studies are available for guidance in developing your own case study. To receive samples, contact the PPIC.