A GUIDE TO U.S. SUPPLIERS OF TECHNOLOGIES TO REDUCE POLLUTION AND SAVE ENERGY IN THE TEXTILE INDUSTRY

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B. PUBLICATIONS ON POLLUTION PREVENTION IN THE TEXTILE INDUSTRY 49
Environmental regulations are being tightened throughout Asia, and the market increasingly demands products manufactured with environmentally sound technologies. It is therefore crucial that companies consider environmental aspects when selecting new equipment and upgrading existing production facilities.

Pollution is of particular concern in the textile industry. Textile wet processing and other textile manufacturing processes can create major pollution problems, including waste water contamination, chemical wastes, and air pollution.

As environmental standards tighten, textile companies have two alternative approaches:

- "End-of-pipe" treatment: addition of equipment to collect or neutralize wastes after they have been generated, or payment to a waste contractor to handle hazardous and non-hazardous wastes; or
- Pollution prevention: introduction of production equipment and processes that reduce energy use, limit waste streams, and lower the amount of wastes requiring treatment.

The second strategy, pollution prevention, offers important business advantages. By using production processes that incorporate pollution prevention technologies, companies can avoid the continuing cost of end-of-pipe treatment, while often realizing additional cost savings from reduced energy use, reduced water use, lower use of expensive chemicals, and more rapid processing. Pollution prevention is good business.

American textile machinery producers and service companies are world leaders in pollution prevention. Their machinery has been developed to meet the tight environmental standards in the United States. Over the past twenty years, these companies have developed technologies that comply with strict environmental requirements, while also saving time, energy, and inputs. This equipment can be highly cost-effective, even where environmental standards are not yet strictly enforced.

This booklet identifies U.S. sources for textile finishing processes technologies and technical consulting that offer "clean technologies" for the textile industry. The booklet is designed to assist Asian companies to identify technologies that are significantly improved to utilize less energy, require less chemicals, produce less waste water, and/or reuse, recover, or recycle materials or energy.
The booklet is organized around the main textile production processes where pollution prevention technologies are available. Each section contains a brief description of the technological advances and how they enhance production, and then provides a list of the leading U.S. producers that can supply products or services. The index at the end of the booklet provides an alphabetical listing of the equipment companies, together with additional information on consultants who can assist with process design and cost minimization. Please contact the companies for additional information.

We have made every effort to identify and include as many U.S. producers as possible, but no single guide can cover all of the textile technology sources in the United States. We urge the readers to contact the nearest U.S. commercial office at the U.S. embassy or consulate for additional help in locating U.S. suppliers.

Product and company descriptions are based on information provided by the manufacturer. The Kenan Institute has not independently verified the performance characteristics or other features described by the manufacturer.

This booklet was produced by the Kenan Institute of Private Enterprise of the Kenan-Flagler Business School of the University of North Carolina at Chapel Hill, with support from the Environmental/Energy Technology Fund of the United States-Asia Environmental Partnership, and the U.S. Agency for International Development, in cooperation with the National Association of State Development Agencies. The Institute takes sole responsibility for any errors or omissions in the information provided.
II. DYEING

Dyeing is an area of textile finishing that has the potential for process improvements resulting in greater efficiency and reduced waste. The three most significant methods for such improvements are low liquor ratio dyeing, pad batch dyeing, and vacuum extraction dyeing. U.S. companies offer a full range of equipment incorporating these technologies.

A. LOW LIQUOR RATIO

The liquor ratio is the ratio of the amount of water in liters to kilograms of fabric in the dye bath. To reduce the liquor ratio is not simply a matter of reducing the amount of water in the dye bath. This may cause pump cavitation, or poor fabric movement through the dye chamber. In order to employ low liquor ratio dyeing, modifications to the process are generally required.

The advantages of low liquor ratio dyeing include: reduced usage of ratio dependent chemicals; reduced water usage benefitting the company not only in terms of purchased water savings, but also in a reduction in effluent volume and water treatment costs; and reduced cycle times due to quicker drains and fills. In addition, the reduced volume in the dyebath results in a decrease in energy consumption for heating the dyebath which in turn leads to reduced steam usage, less boiler usage, reduced fuel consumption, and less emissions to the atmosphere from combustion.

Jet dyeing is one of the piece dyeing methods that can be used in low ratio dyeing. Jet dyeing takes place in a closed system where a jet emits a high pressure stream of dye which penetrates the fabric and moves the fabric along the tube. The fluid moves faster than the fabric, thereby moving the fabric through the tube. The turbulence aids in dye penetration and prevents the fabric from touching the walls of the tube. Jet dyeing machines with air transport medium are also available.

The following manufacturers developed products that offer low liquor ratio dyeing. Included under each manufacturer is a description of selected products from their product line, features, and impact on the textile process.

GASTON COUNTY DYEING MACHINE COMPANY
P.O.Box 308
Stanley, NC 28164 USA
Tel: 704-822-5000
Fax: 704-822-0753

Gaston County offers choices in jet dyeing machines to match dyeing requirements. Available is an allied family of versatile jet piece dyeing machines designed to provide short cycle, low cost dyeing of wide varieties of knitted and woven fabrics. Each Gaston model has a different load
capacity per chamber, allowing the dyer to choose the machine best suited for a particular product mix. The fabric transport and liquor circulation systems for each model are carefully engineered for virtually tangle-free operation with level, repeatable dyeings. Most fabrics, including 100% cotton, are dyed satisfactorily at 6:1 ratio. Many fabrics can be dyed even lower at 5:1, yet the GASTON machines allow much higher ratios than required. Low liquor ratio processing means shorter dyeing cycles and significant savings in dyes, chemicals, steam and water. Less dyes and chemicals also reduce effluent load.

MARTINT EQUIPMENT CO.
4455 Morris Park Dr.
Suite B
Charlotte, NC 28227 USA
Tel: 704-573-1625
Fax: 704-573-1725

The UniMac fully automatic dyeing/extracting machine for batch processing utilizes all the flexibility of a built-in microprocessor and can be programmed for any formula to suit dyeing, washing, bleaching, special stonewashing, or any other treatment of garments or fabrics. Available units include the following characteristics: test machine capacities to larger production machines, end-loading, 316 stainless steel construction, indirect steam heat, automatic chemical dispensing, low liquor ratios, and quality dyeing and accurate shade repeatability, and more. The UniMac is available in sizes ranging from 2 pounds to 100 pounds.

The Braun Dye-Extractors are available in both Open Pocket and multi-pocket Top/Side Loader models. Each model provides a high degree of precision, speed, economy and confidence. Braun Dye-Extractors also offer savings on time, water, energy, floor space and labor. The microprocessor controls all dyeing processes. The Dye Extractor utilizes low liquor dyeing, saving water, chemicals, and energy costs. The Liquor ratio controls allow the programming and maintenance of a specific ratio of mass of water to mass of goods to insure consistency of dyeing. Other features include versatility, gentleness, temperature control, smooth load and unload, capacity selections, simplicity, stability, ergonomics, and strength. The Dye-Extractors are available in sizes ranging from 100 pounds to 800 pounds.

B. PAD BATCH DYEING

Pad batch dyeing is a cold method of dyeing cellulosics. The prepared fabric is saturated with the premixed dye liquor, then passed through rollers which squeeze out the excess and force the dyestuff inside the fabric for greater penetration. The fabric is then stored or batched on rolls or in boxes which are covered with a plastic film to prevent carbon dioxide absorption and water evaporation for 2 to 12 hours. While in batching, the dyestuff is reacting and penetrating the fabric resulting in even and consistent color. After the reaction is complete, the fabric is washed.

There are many benefits to this method of dyeing. Salt and specialty chemicals for the dyebath, such as antimigrants, leveling agents, and fixatives, are virtually eliminated. The efficient use of dye and the elimination of specialty chemicals reduces chemical costs and waste loads in the effluent, which in turn saves money on municipal sewage and waste water treatment. Chemical
use and resulting BOD and COD loadings in the waste streams can be reduced up to 80% over atmospheric becks. The dye is used efficiently leaving less color in the waste water.

Pad batch dyeing reduces water consumption and energy consumption. By comparison, pad batch dyeing with beam wash-off typically consumes 17 liters per kilogram of fabric and less than 4400 Btu per kilogram of fabric, versus 170 liters per kilogram of fabric and 20,000 Btu per kilogram for the atmospheric beck for the same fiber reactive dyed shades.

Consistent dye quality is another benefit of pad batch dyeing. This method results in even color absorbency, colorfastness, and produces much lower defect levels than in rope dyeing when the fabric is properly prepared. The high reactivity dyes have rapid fixation and stability resulting in shade reliability and repeatability.

The pad batch method offers simplicity, speed, and flexibility. It can be used on wovens or knits in many constructions. The water soluble reactives allow easy clean-up and frequent shade changes. The simplicity and flexibility of the system allow the use of available equipment, such as becks, beams, and continuous equipment for washing.

MORRISON TEXTILE MACHINERY CO.
P.O. Drawer 1
Fort Lawn, SC 29714 USA
Ford Elliott & Trimble, Inc.
1009 East Blvd.
Charlotte, NC 28203 USA
Tel: 704-335-1617
Fax: 704-335-1825

The Morrison Textile ACCU-PAD features all stainless steel construction. The pneumatically operated low volume dye pan drops and rotates away from the immersion roll and dumps, thereby providing easy access for washing and cleaning. The Accu-Pad also features an automated wash cycle which is air purged at the end of the cycle to prevent water spots. A Remote Interface Control Package allows operation from a centralized control room or computer.

For many years, Morrison has designed and manufactured reaction chambers to suit the needs of the textile industry for various processes from preparation to dyeing, and other special requirements. These reaction chambers are more commonly referred to as "Steamers", "J" Boxes, etc. Roller or tight strand Steamers are usually associated with Pad Steam Dye Ranges, but variations of these are used extensively in preparation lines.

Morrison Textile offers complete dye ranges including a universal dye range comprised of the following units: continuous scray entry (or from truck if preferred); low volume dye pad; infrared pre-drying; intermediate controlled drying; thermosol; cooling; chemical padder; steamer; wash, oxidize, soap and rinse; final drying, batch or fold (an acid pad and skying would be added for Indigosol).
The Tube-Tex DYROL is a specialized two-roll pad for the continuous application of dyestuff or a bleaching formula on circular knit fabrics in tubular form. Fabrics may be in the greige, scoured, or bleached form coming to the machine.

A variable speed roll feeds the fabric in a tensionless manner to a pair of heavy-duty ring guiders which spread to the natural fabric width, eliminating skewing, creasing, and wrinkling. Width of the guiders can be changed without stopping the machine by pushing a button. The DyRol is 60 inches wide and allows for multi-strand operation. As the fabric enters the dye pan, it is quickly saturated and enters a series of driven, submerged nips which increase penetration of dyestuff, eliminate air from inside the tube, and provide a driving force for tensionless control of fabric. Both sides of the fabric are equally exposed as the fabric leaves the nip and turns to travel vertically toward the squeeze rolls. As it leaves the solution level, the dyestuff is allowed to cascade down all sides of the tube.

DyRol’s pad batch process has the following advantages: a reduction in dyeing cost per kilogram of fabric; substantial savings in chemicals, water, energy, and labor; elimination of chafing, rope marks, and other defects due to physical handling in becks or jets; ability to dye greige fabric; uniformity of shade from lot to lot with excellent repeatability; and improved hand and appearance of fabric, including luster and the ability to cover immature cotton fibers.

Tube-Tex also manufactures the Automatic Batcher, which allows continuous rolling and doffing of finished fabric rolls without stopping or slowing down the range by an automatic tube placement and fabric counter. The unique design provides a perfect start on the tube without the use of a mandrel and with minimum end waste.

C. VACUUM EXTRACTION DYEING

Refer to Vacuum Extraction Category, below.
III. VACUUM EXTRACTION

Vacuum extraction has been utilized in many capacities. The technology has been used for lint removal, water removal, chemical finishing, dyeing, washing, and removal and recovery of chemicals. Vacuum extraction lint removal systems remove lint from fabric prior to printing, eliminating a potential unprinted spot where lint was attached to the fabric. In addition, by removing the lint prior to the printing process, lint does not become attached to the printing screen thereby resulting in unprinted spots repeatedly along the printed fabric. By removing lint before the fabric is printed, the quality, consistency, and appearance of the printed fabric is improved.

One of the most common and simplest uses of vacuum extraction is for water removal prior to drying. Moisture removal before drying saves energy in the drying process, increases production speed by decreasing the overall drying time, and also assists in washing the fabric.

In wet processing, it is critical that the fabric have the correct moisture level to prevent bath dilution from fabric which is too wet. Vacuum control is crucial to maintain consistent extraction rates for even chemical application. By applying reactive chemicals on wet fabric versus dry fabric, savings are not only realized chemically, but drying is eliminated. The period of return on investment is extremely short.

Utilizing vacuum extraction technology in washing significantly increases the contaminant removal from fabric compared to water removal using a squeeze roll. Vacuum extraction equipment is space efficient, can be added to existing systems, and requires relatively low capital outlay.

EVAC CORPORATION
A Subsidiary of Kusters Corp. USA
885 Simuel Road
P.O. Box 3274
Spartanburg, SC 29304-3274 USA
Tel: 803-439-8744
Fax: 803-439-8211

EVAC Corp. offers a complete line of vacuum extraction systems. EVAC systems include the EVAC Water Removal System, DYEVAC System, Lint Removal System, Wet-On-Wet Finishing System, the UltraKnit Mark III Tensionless Processor, and the Stage Washer System. Listed below are the advantages of some of the EVAC systems.

Applications of the EVAC Water Removal System include water removal prior to drying fabric and chemical application, and as a means of improving the washing process. Some of the
benefits of removing water prior to the drying of fabric are increased drying and process speed, reduced energy requirements for drying, reduced of lint accumulation on rolls and dry cans, and elimination of a drying process for wet-on-wet chemical finishing. Water removal before chemical application removes fabric contaminants and assures uniform wet pick-up prior to chemical application. The washing process is improved by vacuuming out, not squeezing in, contaminants, and allows controlled counterflow and filtering of water in the wash line.

The EVAC DYEVAC enables the dyer and finisher to produce a quality dyed fabric in a low add-on mode. Advantages include the elimination of disperse dye migration; improved dye penetration, dye fixation, color yield and light fastness, and repeatability; and reduced wet pick-up, pre-drying time, energy consumption, and auxiliary chemical costs.

The EVAC Low Add-On Finishing System has many advantages. The system reduces chemical cost, chemical waste, build-up of surface chemistry on rolls and cans, build-up of chemical emissions in the tenter frame, air emissions, overall clean-up time, and dusting. It also eliminates migration with improved moisture control, improves penetration, maintains shade repeatability/continuity, and increases tenter speed.

The EVAC Stage Washer utilizes vacuum technology and state-of-the-art computer process controls. It is equipped with complete counterflow and chemical addition capabilities. The primary function of the Stage Washer is short lot washing of any batch type preparation, dyeing or printed fabrics. Like the other EVAC systems, the Stage Washer has many advantages. Among them are reduced water consumption, energy consumption, and washing time, reduced manpower through completely computerized controls, removal of contaminants from the fabric, optimum washing flexibility with minimal capital investment, little floor space requirement, and the capability of applying finishing chemicals in the last pass.

TEXTILE VACUUM EXTRACTOR CO.
2734 S. Cobb Ind. Blvd.
Smyrna, GA  30082 USA
Tel: 404-436-2998
Fax: 404-436-3043

Textile Vacuum Extractor Co. offers the following vacuum extraction systems:

SVW Spray Vacuum Washer is used for desizing, scouring, caustic removal, unfixed dye removal, and lint removal applications. The SVW removes contaminants from the wash system, enables a better interchange of clean water, produces low moisture in fabric, and is easy to add to existing wash systems.

MRS Moisture Removal System can be installed for use before drying, between wash boxes, and before chemical application (wet-on-wet). Benefits include increased drying speeds, homogeneous moisture profile, elimination of predryers and expensive heavy squeeze rolls, and lint removal.

CRS Chemical Recovery System is for the application of resins, softeners, hand builders, flame retardants, water repellents, fluorocarbons, and for wet-on-wet finishing. Benefits include a 20% to 40% reduction in chemicals, side to side consistency and repeatability, reduced stenter clean-
VPA Vacuum Pad Applicator is for the application of chemicals and dyes, wet-on-wet finishing, and replacing conventional padders. Benefits include the elimination of expensive padders, reduced migration and shading problems, achievement of 10% to 60% moisture before stenters, and side to side consistency and repeatability.

WOW Wet-On-Wet Finishing System eliminates predryers or a drying step, increases production, uses 20% to 40% less chemicals, and reduces migration.

CAR Carpet Washing and Drying System for washing and drying steps achieves low residual moisture, faster line speeds, better washing, water and energy savings, and consistent side-center-side, and provides lint removal.

TUBULAR TEXTILE MACHINERY
TUBE-TEX
Hargrave Road at I-85
P.O. Box 2097
Lexington, NC 27293-2097 USA
Tel: 704-956-6444
Fax: 704-956-8956

The Tube-Tex Jet Extractor was designed and developed to be used as the finishing operation following dyeing, bleaching, or scouring for the continuous extraction of all types of circular knit fabrics. The Jet Extractor employs proven vacuum slot extracting with mach nozzle principles for superior extracting without edge creases, distorted knit construction, or flattened fabrics. After the fabric is spread to a natural width, a moving screen supports the wet fabric over a vacuum slot, allowing the mach nozzle to impart a high speed jet of steam downward through the fabric. This jet of steam loosens the hydrogen bonded water molecule from the fabric core allowing the vacuum to remove a higher percentage of moisture from the body of the fabric. Chemical application is applied utilizing a slinger or spray type system to insure a crease free tubular fabric with even application of softeners and lubricants. The Jet Extractor provides benefits including soft edges/no edge crease, reduced moisture content, reduced dryer energy use, and improved width stability.
IV. WASHING

Advantages of improved washing technologies include reduced water usage, improved cleansing, increased production speed, and reduced energy and waste water. These improvements translate into less environmental impact and significant operation savings. The main improved wash methods include Countercurrent Washing, Low Wash Methods, and Vacuum Extraction Washing.

A. COUNTERCURRENT WASHING

Countercurrent washing reuses and maximizes the effectiveness of the wash water. Countercurrent washing employs the strategy of utilizing the wash water from the last step, the least contaminated water, for the second to last step, then reusing this water for the preceding wash step, etc. The wash water essentially flows counter to the fabric. This method conserves water, reduces waste water, and conserves energy. The process is simple, relatively easy to implement, and requires little capital investment. The process can be used for washing after continuous dyeing, desizing, scouring, and bleaching.

GASTON COUNTY DYEING MACHINE COMPANY
P.O.Box 308
Stanley, NC 28164 USA
Tel: 704-822-5000
Fax: 704-822-0753

Gaston County’s TENSITROL ROPE WASHER provides fast, thorough, tension-free washing of bleached or dyed woven fabrics and towelling. In continuous rope form, the fabric twice traverses the full width of the washer for a total of 28 immersions in a two-compartment tub arranged for counter-flow.

The Tensitrol Rope Washer has proven performance on poplins, broadcloth, oxford, sheeting, dress goods, towelling and many other woven fabrics.

MORRISON TEXTILE MACHINERY CO.
P.O. Drawer 1
Fort Lawn, SC 29714 USA
Ford Elliott & Trimble, Inc.
1009 East Blvd.
Charlotte, NC 28203 USA
Tel: 704-335-1617
Fax: 704-335-1825

Countercurrent washing is an important step in the overall wet processing of fabrics, whether it be in Bleaching/Mercerizing, or Dyeing, but nowhere is it more important than in the preparation...
In the past, bleachers had to put up with so-called washers which were no more than large open tanks with guide rolls consuming anything up to 400 liters of water per minute and saturating the working atmosphere with steam vapor. After studying the mechanics of washing, Morrison designed and patented the Incline Mod I and Mod II Washers.

The Incline Washers are efficient in terms of wash water/cloth ratios and cloth capacity and time factor, capable of achieving temperatures of 90°C; are robust and easy to clean; are easily accessible and have an open squeezing nip so operators can see the cloth as it progresses down a range; and take up little floor space. The effectiveness and efficiency of the Incline Washers lies in the partially submerged cloth rolls; the wiper bars which cause a suction effect; the fact that the cloth run is inclined, not horizontal resulting in water that runs down through the cloth and does not just pour over the edges; the temperature inside a heated unit is 95°C to 100°C; and there is true countercurrent liquor flow.

B. LOW WASH PROCESS

The Low Washing Method is a wash process for piece dyeing systems that reduces water usage and decreases cycle times leading to increased rate of production, and fabric washfastness equal to or better than conventional drop/fill or overflow procedures.

GASTON COUNTY DYEING MACHINE COMPANY
P.O.Box 308
Stanley, NC 28164 USA
Tel: 704-822-5000
Fax: 704-822-0753

Gaston County’s new low wash process (LWAS) on "Gaston" model jet dyeing machine improves operating economics of dyeing cotton fabrics with reactive dyes. The process objectives of the LWAS are to substantially reduce the quantity of water required to achieve satisfactory rinsing, and reduce cycle times, particularly in the portion of the cycle involving "clean-up". The quality objectives include: the fabric wash fastness performance with LWAS must meet or exceed results being achieved by the customer using conventional drop/fill or overflow procedures; the rinsing effectiveness as judged by the quantities must equal or surpass the effectiveness of the current, conventional wash/rinse method. The economic benefits are the reduction of rinse water by approximately 30%, rinse cycle times by more than 50%, and overall cycle times for complete dye procedure by about 18%. These results are obtained while still achieving the equivalent level of rinsing effectiveness obtained with the previous methods.

C. VACUUM EXTRACTION WASHING Please refer to Vacuum Extraction Category, above.
V. DRYERS AND INCINERATION

In the past, dryers were extremely inefficient, consuming enormous quantities of energy/fuel and producing a lot of pollution. Through the use of today's technology, process improvements have been identified to maximize dryer efficiency and reduce pollution.

One method of reducing the pollution output of dryers is through the use of incinerators and thermal oxidizers in conjunction with the dryers. These units heat the exhaust stream from the dryers to a sufficiently high temperature burning undesired emissions and reducing combustion products. The resulting heated clean air is then recirculated to the dryers as a pre-heated air source. These units provide an efficient heat source and clean polluted air.

Another way to conserve energy and reduce pollutants is through the use of electrically convected air for the dryer's heat source. These units have been found to reduce pollutant emissions, run more efficiently, and produce better product due to the cleaner drying environment.

Vacuum extraction has been used to reduce drying time, increase production speed, and increase drying efficiency. Vacuum extraction systems vacuum out the moisture and water from the fabric prior to drying. Please refer to the Vacuum Extraction category above for additional information.

AZTEC MACHINERY COMPANY
960 Jacksonville Road
Ivyland, PA 18974 USA
Tel: 215-672-2600
Fax: 215-441-0289

Thermal oxidation is the most reliable method available for significantly reducing pollution associated with oven exhaust streams. The exhaust stream to be treated is heated to a sufficiently high temperature that the objectionable compounds are reduced to products of combustion. The clean air can then be exhausted or returned to the oven as a source of clean heat for the oven.

The significant features of Aztec's discrete and integral oxidizers are: optimal interface to the oven process—the clean exhaust is achieved with absolutely no negative impact on the textile material processing; low energy requirement through the use of air pre-heating and the use of the oxidized air as heat for the oven; low operating pressure resulting in a low horsepower requirement and minimal leakage problems; durable surfaces—all surfaces in contact with high temperature oxidized air are a high alloy stainless steel and the enclosure has several layers of high temperature ceramic fiber-type insulation to minimize heat leakage; large hot box volume provides a long dwell time at high temperature; and totally open flow through oxidizer with no catalyst to plug or foul.
ENTEC INDUSTRIES INC.
P.O. Box 5511
Greenville, SC 29606 USA
Tel: 803-277-6361
Fax: 803-299-9818

ENTEC manufactures both Infrared Dryers and Convection Dryers for drying and heatsetting various fabrics in the textile industry. The equipment is designed to be thermally efficient by using the minimum exhaust air volume at the lowest stack temperature possible.

Infrared dryers are efficiently used to predry and heatset fabrics. Infrared dryers use less space, less energy per pound of water evaporated, and cost less to purchase than convection dryers. They are not recommended for complete drying of fabrics due to the heat intensity, and overdrying of outside fibers resulting from the outside to inside drying process.

ENTEC can supply new equipment such as Tenter Dryers and Predryers, or rework existing equipment to improve efficiency.

FAB-CON MACHINERY DEVELOPMENT CORPORATION
P.O. Box 591
75 Channel Drive
Port Washington, NY 11050-5216 USA
Tel: 516-883-3999
Fax: 516-883-3880

The "Versa Tenter" was designed to assist textile finishing plants in meeting environmental standards and reducing energy costs. When the Incinerator is supplied as an integral part of the Tenter Frame it provides heat for all chambers in the Tenter, eliminating the need for individual burners in each chamber. Exhaust particles which are recirculated through the Incinerator are burned off, reducing particle emissions from the stack. The built-in incinerator cleans the polluted air and acts as a heat source, resulting in lower total fuel consumption than required for drying only. By selecting the appropriate number of modular drying sections for the expected production level, the manufacturer can easily use the multi-zoned tenter dryer to meet a wide range of production requirements. The modular construction facilitates expansion of the dryer.

MASCOE SYSTEMS CORPORATION
Box 370
Maudlin, SC 29662 USA
Tel: 803-277-3246
Fax: 803-299-3183

Mascoe selected electrically convected air as the heat source for their new dryers. The design target was to reduce emissions and the energy required to produce the desired drying temperature.
of more conventional drying methods. Other electric dryers on the market use infrared or radiant heat, which are difficult and expensive to run. The Mascoe 886 Levitator Tenter Dryer has been found to reduce emissions by 92%, run more efficiently, produce better fabric due to its cleaner environment, and reduce down time needed for heating and repairs.

The 886 Levitator is a highly sophisticated "Drying Machine" designed to do more than just simple moisture removal. The high tech, separated, multi zone air flow allows freedom to adjust control of rate of moisture removal, relaxed bulking conditions, finish penetration, wicking, and migration. The patented short loop air flow with encapsulated return offers internal air exchange 4 times faster than previous designs, providing efficient moisture removal rates with substantially lower fan horsepower input.

Use of space age ceramic insulating materials combined with the patented low internal volume and low surface area design substantially reduce the heat input requirement. Mascoe has used this advantage to develop a very efficient electric heating system for this dryer. Electric heating provides a clean fabric processing environment and allows the convenience of single switch starting. Features of the unit include parallel tenter entry, versatility, economical operation, easily cleanable, low exhaust emission, and multi-zone temperature control.

TUBULAR TEXTILE MACHINERY
TUBE-TEX
Hargrave Road at I-85
P.O. Box 2097
Lexington, NC 27293-2097 USA
Tel: 704-956-6444
Fax: 704-956-8956

The Tube-Tex HQ D/C Dryer combines the high productivity of conventional suction drum dryers with an advanced design conveyor dryer that gives both high production and low length shrinkage in one innovative package. This dryer uses two drying principles, suction drum and relax conveyors. These two systems of drying working together are more efficient than any one drying system alone. The additional automatic lint cleaning system allows for minimum cleaning time and effort. The engineering and design of the HQ II D/C Dryer provides the user with many options including the flexibility in factory design and layout for those who can operate on a continuous basis and those who desire a batch system due to the variety and number of styles of input fabrics.
VI. MOISTURE MONITORING

Moisture monitoring is a method of improving the efficiency in the dye house and in the drying cycle. Moisture monitoring systems check the moisture of the product or of the product's closed process environment, and make process adjustments based upon the actual versus setpoint moisture. By monitoring and controlling the process based on moisture content, the manufacturer can realize improved efficiency, product quality improvements, and increased production speed.

FORTE TECHNOLOGY, INC.
201 Carnegie Row
Norwood, MA 02062 USA
Tel: 617-769-9150
Fax: 617-769-5308

FORTE MOISTURE CONTROL increases control in dye houses by monitoring the actual moisture of the incoming yarn and controlling the moisture during the dyeing process. By monitoring and controlling, you can eliminate over-dried yarn, mildew, missing weight, customer complaints, and realize energy savings, maximum speed backwinding, perfect color the first time, and more dyeing jobs as a result of happy customers.

Forte customers include spinners, dyers of yarn, carpet manufacturers, wool combers, top makers, scourers, staple fiber manufacturers, synthetic fiber manufacturers, and glass fiber manufacturers. The Moisture Control 7590 measures the percentage of moisture in cones, cops, bobbins, tops, bumps, hanks, skeins, etc.

STRANDBERG ENGINEERING LABORATORIES, INC.
1302 N. O'Henry Boulevard
Greensboro, NC 27405 USA
Tel: 919-274-3775
Fax: 919-272-4521

The moisture monitor, Dry Stop Model M-702, stops the drying cycle when the moisture is right by exhaust humidity detection. It can be used on tumblers and other time cycle dryers. It eliminates timer guesswork, steps up production and lowers energy consumption, accurately controls product residual moisture for all conditioning levels as well as full dry, and eliminates fires and restarts. The unit stops the drying cycle when the actual moisture in the goods is at the desired level, not after a preset number of minutes which can lead to overdrying and excess energy usage.

The Dry Stop Model M-702A has moisture setpoint cut-off and cool-out time initiation, 25 foot
wire and Humidity sensor, and a maximum exhaust temperature 177°C, which is recommended on gas-fired dryers.

The Moisture Monitor Model 1603 for enclosed convection-type dryers is also available.
VII. PRINTING

Heat transfer printing is one of many printing methods. Heat transfer printing involves printing dyes onto heat transfer printing paper, and rolling the paper and the fabric together under high temperature and pressure, resulting in the transfer of the dye from the paper to the fabric. It can be used on nyons, polyesters, acrylics, triacetates, and polyester/cotton blends where the percentage of polyester is high.

Unlike other methods, in heat transfer printing all of the colors are applied in one step. This reduces process time and costs, and production design changes can be made quickly and simply by changing the transfer paper instead of changing rollers or screens. With this quick change capability, short dye lots are feasible. Other advantages include lower energy costs, clear and sharp prints, and reduced faulty printing.

GESSNER COMPANY
4004G Spring Garden Street
Greensboro, NC 27407 USA
Tel: 919-852-3941
Fax: 919-852-5122

The Gessner Transcolorizer has prime requisites built into it for successful dry heat transfer printing including: precise control of fabric speed, processing temperature, blanket pressure, and batching tension; electrically heated oil circulating system to maintain uniform heat across the transfer printing cylinder; and accurate feeding, tension-free handling of fabric, and controlled paper let-off tension. The economic advantages of dry heat transfer printing versus conventional printing include: lower capital investment, reduced costs for labor and energy, fast pattern changing to meet fashion demand, no washdowns, no pollution problems, clear patterns, and excellent color fidelity.

The capital investment required for heat transfer printing is a fraction of the cost of wet printing. It does not require a dyehouse, nor pre-print or after-print processes. Manufacturing space requirements are at a minimum and no investment in pollution control equipment is necessary.

Heat transfer printing with the Gessner Transcolorizer results in a substantial reduction in day-to-day operating costs. Just two employees provide optimum operation of the machine and no skilled dyehouse personnel are required. There is no pre-print or after-print processing, and heat transfer printing requires a small fraction of the energy required for wet printing. In addition, there is no effluent disposal cost because water is not used in the printing process.
VIII. COATERS / FINISHES / CHEMICAL APPLICATION

One method of applying textile chemicals to fabrics is by foam application. The process chemicals are diluted with air instead of water to form foam. Advantages to foam application include reduced water usage, significant chemical savings, energy savings, and even distribution of the process solution. Common foam applications include carpet dyeing, coating operations, and finishing.

Another method of applying finishes is with coating machinery. In general, the units have a dip pan or trough containing the coating substance. The fabric is guided by rollers through a dip pan for immersion coating, and/or under a trough with a gap for chemical release onto the fabric. Coaters have good repeatability, and a wide range of coating application methods on one machine. Additional advantages include efficient use of chemical coatings and improved quality.

Also refer to the Vacuum Extraction category for other chemical application systems.

ENTEC INDUSTRIES INC.
P.O. Box 5511
Greenville, SC 29606 USA
Tel: 803-277-6361
Fax: 803-299-9818

ENTEC manufactures a variety of web coating equipment including Knife Over Roll Coaters, Nip and Dip Coaters, Gravure Coaters, and Laboratory Coaters, as well as Powder Applicators, Flocking Machines, and lead-in and exit machines. The equipment is designed to be efficient, easily maintained, and competitively priced.

GASTON COUNTY DYEING MACHINE COMPANY
P.O.Box 308
Stanley, NC 28164 USA
Tel: 704-822-5000
Fax: 704-822-0753

The CFS Chemical Foam System provides precise uniform application of chemical treatments to open-width substrates at wet pick-up levels as low as 10% and at speeds up to 300 m/min. Foamed chemicals are being used to apply soil release finishes and various stain or water repellents, softeners, binders, release coatings, flame retardants, and many other chemicals. Most water soluble or water dispersible chemicals can be formulated for foaming and application on the CFS. Because the CFS provides uniform chemical add-ons regardless of substrate moisture...
content it is well suited for wet-on-wet applications.

The benefits of the CFS include: significant chemical savings without sacrifice of performance; energy savings up to 60% with lower end product wet pick-up with less water to evaporate; elimination of pre-drying and increased range speeds; improved material aesthetics through more uniform distribution of chemicals, negligible migration, and elimination of squeeze rolls after treatment; chemicals concentrated on back and face as desired; chemical penetration controlled into substrate; and substantially reduced thickness of add-ons.

MASCOE SYSTEMS CORPORATION
Box 370
Maudlin, SC 29662 USA
Tel: 803-277-3246
Fax: 803-299-3183

Mascoe Coaters are manufactured out of aluminum. Aluminum absorbs vibration, which has severely affected many coaters since metal frames accentuate vibration. In addition to the units being made of aluminum, they are also popular as a result of the technology, the repeatability, and the wide range of methods that one Coater can incorporate.

Mascoe manufactures the System "4" Coaters which include the 4TC On Frame Coater with the new floating blade, the 4KC Knife Over Roll Coater, and the 2CC Combination Coater. The units offer application versatility. The 4TC offers a compound retaining trough with adjustable gap which precisely limits compound to fabric exposure. In addition, a single handwheel adjusts the gap width to select a desired compound sink rate. The trough opens and closes automatically with tenter start and stop. The systems use the coatings or compounds efficiently, and also result in improved quality and consistent product.

Mascoe's new 3LC Coating/Laminating Processor offers small and large mills a new dimension in the flexibility to coat developmental fabrics and low yardage orders at profitable levels. Larger orders sparked by participation in these new markets can be handled on Mascoe's higher production equipment utilizing direct setting transfers from the 3LC. The multi-function processor enables change over in less than 15 minutes. A single operator can process up to 2000 meters per 8 hour shift. It is the economical way to handle samples and small lot orders.
IX. CALENDER SYSTEMS

Thermal bonding methods are being used for nonwoven production instead of chemical and mechanical methods. The fibers are pressed together by heated steel rolls which may be smooth or engraved, depending on the desired finish of the nonwoven fabric. Texture and strength of the nonwoven can be optimized by speed, temperature and pressure settings. Thermal bonding methods produce less pollution than other methods and have production flexibility and increased energy efficiency.

B.F. PERKINS
939 Chicopee Street
Chicopee, MA 01013-2797 USA
Tel: 413-536-1311
Fax: 413-536-1367

Utilizing a variety of standard designs and components, BF Perkins’ nonwoven calendering systems can be customized to achieve optimum results with a variety of web materials. Speed, pressure, temperature and microgap nip settings are selected to match specific applications: point bonding, thermal bonding, compacting, laminating, embossing, and porosity control.

BF Perkins’ thermal and point bonding calenders yield the following benefits: less air and water pollution, less space requirement, reduced or eliminated toxicity on web, less capitalization and installation costs, increased output speed, cleaner operation, more production flexibility, and increased energy efficiency.

ENTEC INDUSTRIES INC.
P.O. Box 5511
Greenville, SC 29606 USA
Tel: 803-277-6361
Fax: 803-299-9818

ENTEC manufactures equipment to draft and thermobond Geotextile nonwoven fabrics for use in landfills, soil erosion, highway overlay, etc. The Stretch Roll Machine and Incline Tenter are used to draft the web for added strength. The web is heatset for width stabilization using infrared heat. Infrared heat utilizes less space than convection dryers, and is more thermally efficient resulting in greater energy efficiency. The exhaust air is cleaned prior to release to atmosphere with an air scrubber, reducing environmental pollutants.
X. RESOURCE RECOVERY

In most instances, recovery of resources results in substantial savings and short timeframes for return on investments, in addition to reducing pollutants. Recovery systems for chemical recovery, water recovery, waste water treatment, and heat recovery conserve and reuse resources, conserve energy, and decrease waste. While the concept is not new, the advanced technology, the current competitive production environment, and increased raw material expenses are an ideal climate for recovery systems.

A. WATER RECOVERY AND WASTE WATER TREATMENT

Due to the demands on the municipal waste water treatment facilities, many systems are limiting the amount of waste water and level of waste water contaminants that they will accept from industrial companies. In addition, they are introducing charges not only for the amount of water that they treat, but also based on the levels of the various contaminants. These expenses and quantity limitations make it necessary for companies to implement their own waste water treatment, and/or reduce their effluent, to meet current requirements and to prepare for tighter restrictions in the future.

In addition to the expense of the waste water, the company is paying for the water coming in to the process. By recovering or reusing the water, instead of paying for it to be treated as waste water, companies can realize significant savings and reductions in water consumption. In some situations, reliable access to clean water is also a problem, or likely to pose a problem in the future, and selection of equipment should be made with this problem in mind.

Listed below are companies with water recovery systems, waste water treatment systems, and other water treatment companies including consultants who can assist with the selection and/or design of suitable systems. Please contact them for additional company and product information.

BRINECELL, INC.
2109 West 2300 South
Salt Lake City, UT 84119 USA
Tel: 801-973-6400
Fax: 801-973-6463

The Brinecell Model "302" is primarily designed to decolorize effluents in textile printing, finishing and dyehouse plants, without using chemicals. It can also be adapted to serve other industries.

The Model "302" consists of three 200L and one 800L poly tanks, a DC power supply, two
electrolytic cells, and four submersible pumps. The complete system is shipped ready for immediate operation. The Model "302" is Brinecell’s smallest system of this configuration. Its capacity is 12 cu. meters per day, at a rate of 12L per minute. Brinecell’s largest system with this configuration, Model "456", can decolorize 757 cu. meters per 24 hour day, at a rate of 1.3 cu. meter per minute, on a continuous flow basis.

Brinecell manufactures systems to meet any type and volume of industrial effluent, without using chemicals.

FILTER FLOW TECHNOLOGY, INC.  
3027 Marina Bay Dr., Ste 100  
League City, TX 77573 USA  
Tel: 713-334-6080  
Fax: 713-334-5993

ACS ENVIRONMENTAL, INC.  
303 Silver Spring Rd.  
Conroe, TX 77303 USA  
Tel: 409-856-4515  
Fax: 409-856-4589

Filter Flow Technology, Inc., working together with strategic business partner ACS Environmental, Inc., have developed a basic treatment system for textile, garment, and carpet industry waste water treatment. The system removes reactive dyes, high color, basic and other dyes plus other suspended solids and organic stain protectors. The basic treatment system consists of a primary reaction tank (chemical preconditioning), and secondary reaction tank (microflocculation and precipitation using a proprietary powder ChemSorb-500), polymer agglomeration, clarifier solids removal, sludge thickener, sandfilter, and filter press. Alternatively, for low to moderate flow rates, the clarifier, sludge thickener, and sandfilter can be replaced with an innovative, continuous cleaning, "micropore" belt filter that can operate at high performance without polymers.

In excess of 30 different dyes (reactive, high color, basic), organic stain protectors, suspended solids, C.O.D.’s, B.O.D.’s, and heavy metals have been successfully treated. Conducted studies have indicated that the two reaction tank microflocculation method, when used in conjunction with either unit gravity clarifier/sandfilter equipment or belt filter solids removal (downstream from the reaction tanks) can be used to successfully and cost-effectively treat a wide spectrum of textile/garment/carpet industry dye waste water streams.

A major advantage of the dye waste water microflocculation treatment as provided by Filter Flow Technology, Inc. is the option to reuse up to 50% of the treated water for non-critical uses. Water reuse can translate not only to water conservation, but to cost savings if the plant’s incoming water source cost per unit volume exceeds the treated water cost. In addition, textile/garment/carpet plants that have strict discharge standards can reduce the cost of achieving the stricter performance standards by discharging less water.

GASTON COUNTY DYEING MACHINE COMPANY  
P.O.Box 308  
Stanley, NC 28164 USA  
Tel: 704-822-5000  
Fax: 704-822-0753

The RINSE BATH REUSE SYSTEM (RBR) improves economics for batch bleaching piece
goods. The RBR on Gaston County's low ratio jet machine improves the economics for batch bleaching piece goods to make it a sensible alternative to continuous ranges. The RBR is a system for reclaiming and reusing bath liquor during the process. A series of reclaim tanks are interconnected with the jet machine piping system. Under the direction of the machine controller, bath liquor from each process step can be sent to the drain or diverted to one of the reclaim tanks for reuse as make-up or rinse water later in the process or on subsequent production lots.

The RBR System makes it possible to reduce water consumption more than 60% compared to typical batch bleaching methods. Payback is often less than two years based on water savings alone. The RBR reduces bleaching cost and increases dyehouse production flexibility. When demand for "full whites" decreases and the product mix swings to colors, the RBR feature is easily made "inactive", allowing the machine to be used for normal piece dyeing.

OSMONICS
5951 Clearwater Drive
Minnetonka, MN 55343-8990 USA
Tel: 612-933-2277
Fax: 612-933-0141

Membrane technology is playing an increased role in the economical operation of plants in the textile industry. Valuable chemicals, organics, and process water can be reclaimed for reuse at substantial savings. Osmonic's Water Purification Systems can be used for the following applications: dye bath make-up water and other process water, rinse waters for higher product quality, and boiler feed water.

Waste water Treatment/Recovery Systems are being used for the following applications:
- Concentrate PVA, CMC and other sizes for reuse with OSMO UF. High temperature operating capability saves energy as well.
- Continuously reclaim for reuse up to 2% concentrations of textile lubricants with high BOD.
- Concentrate and recover valuable dyes and limit discharges to acceptable levels with UF.
- Purify and reuse indigo dye.
- Reclaim caustic wash water.

Additional sources for water treatment equipment and technology include:

BECKART ENVIRONMENTAL, INC.
6900 46th Street
Kenosha, WI 53142 USA
Tel: 414-656-7680
Fax: 414-656 7699

BLUE PACIFIC DISTRIBUTORS, INC.
P.O. Box 1749
Keaau, Hawaii 96749 USA
Tel: 808-966-6463
Fax: 808-982-5303
B. CHEMICAL RECOVERY

Chemical recovery can be done for different purposes. One purpose is to recover valuable chemical products to be reused in the process, another is to decrease the amount of chemicals in the effluent waste water stream to decrease the cost of treatment. Both reasons can lead to significant savings providing a quick return on investment.

One method of chemical recovery is ultrafiltration. Ultrafiltration utilizes a membrane for separating the effluent stream into two components. The separation occurs as a function of the molecular size of the products. Based upon the molecular size, products such as oil, wax, latex, polymer and indigo dye can be separated out of the waste water stream. Ultrafiltration systems typically have high reliability and reasonable maintenance costs relative to the savings of the recovered material and reduction in effluent treatment.

Also refer to Vacuum Extraction category for other chemical recovery systems.

C. HEAT RECOVERY

Like other recovery systems, heat recovery systems have many benefits which translate into savings. Heat recovery systems maximize and efficiently use energy. Heat produced for one
stage of a process may be recovered and reutilized from the heated product, thereby, providing a cooling stage for already heated product, and a heating stage to unheated incoming product.

As a simple example, assume that a product requires heating in an initial stage and then must be cooled in a later stage of the process. To reduce the energy use in the heating step, a preheating step takes place using heat from the later stage to reduce the temperature differential between the input temperature and the desired temperature. After being preheated, the product goes to the heating stage for a shorter period of time than it would without preheating. By exchanging the heat of the heated product with incoming unheated product, it is possible to preheat the incoming product.

Through heat transfer, a shorter cooling time is required for the heated product, as well as providing preheat energy to the inlet product resulting in a reduced heating stage. Energy savings are realized in the amount of energy required to heat and cool and energy-producing raw materials are conserved. The environmental impact is minimized due to reduced energy production, leading to reduced pollution and the use of less natural resources. Listed below are some companies that provide various heat recovery technology.

**MARTINT EQUIPMENT CO.**
4455 Morris Park Dr.
Suite B
Charlotte, NC 28227 USA
Tel: 704-573-1625
Fax: 704-573-1725

Martint Equipment Co. offers the Kemco Waste water Heat Recovery System. This system uses heat from the waste water in one operation to pre-heat the fresh water for use in the next operation. This system utilizes a counter-flow shell and tube type stainless steel heat exchanger equipped with an automatic back flushing system guaranteed to eliminate any plugging or manual cleaning of the exchanger. Capable of reducing water heating costs by 40 to 60 percent, a return on investment can be expected within a 12 to 24 month period of operation. The heat exchangers come with a ten-year warranty.

**MORTON MACHINE WORKS, INC.**
P.O. Box 2547
Columbus, GA 31994-2699 USA
Tel: 404-322-5541
Fax: 404-322-0497

Morton acts on the philosophy that the manufacturers of energy-expending machines and systems have the responsibility to apply the principles of energy conservation and recovery to increase their customer's efficiency. Morton applies this concept to its design, application and operation of machines and systems, as well as waste heat recovery systems. Morton offers a Seven Point Plan for conserving energy through machine and process improvements and waste heat recovery. This energy audit is a service offered by Morton to reduce industrial energy consumption. A typical heat recovery system will often pay for itself in less than two years through energy
Morton offers shell and tube heat exchangers built to ASME and Tubular Exchanger Manufacturers Association standards. The exchangers are available in a practically unlimited range of sizes, pressures, and temperatures and may be fabricated from a wide variety of metals in any TEMA arrangement.
XI. PROCESS AUTOMATION, CONTROL, AND MANAGEMENT SYSTEMS

The rapidly growing field of process control and automation enable the manufacturer to reduce product inventory and manufacture "just-in-time". Automated control systems can maximize production capability, improve efficiency, reduce labor overhead, enable the production of consistent product, reduce hazardous material handling by workers, and much more.

The new systems emphasize user-friendly characteristics to reduce the extensive training and skilled personnel that was required for past control systems. No longer is it necessary to have the control system manufacturer or specialist come to the production facility anytime a change in control configuration is desired. Systems are also becoming more affordable and expandable, allowing system growth in stages. This reduces the initial investment, allows system growth and expansion with the changes in the facility, and increases system versatility.

Automation and control systems are being produced with greater communication capability. In the past, a manufacturer had to purchase the same control system for each area of the plant in order for all of the systems to communicate. With the new products and communication drivers, control systems throughout the plant can communicate without having to replace all the systems with new, identical units. This improves data acquisition, data management, and intelligent control.

GASTON COUNTY DYEING MACHINE COMPANY
P.O.Box 308
Stanley, NC 28164 USA
Tel: 704-822-5000
Fax: 704-822-0753

The SuperTex +SQL is a modular dyehouse management system. The manufacturer can start with the basic ControlTex system then expand with additional software modules as the business and needs grow. User-friendly and seamless, each module adds specific management and control functions. Other modules include: steam supply and demand, metering and delivery of liquid chemicals and dyes, dye/chemical weigh room supervision, process execution and cost analysis, complete formula management, and video communications for labor scheduling.

The non-proprietary software design of the SuperTex +SQL enables it to tie together otherwise isolated control and information systems within the plant, providing an effective, efficient integrated operation. With an open floor plan, SuperTex +SQL allows for great flexibility in initial configuration, easy upgrading and virtually unlimited expansion.

Expected improvements include: increased production output by minimizing downtime between
unloading and reloading; reduced dye and chemical costs as a result of effective inventory control; minimized losses by having the information available to identify specific areas of low efficiency and poor quality; increased manufacturing through effective management of personnel; eliminated costly dye misweighs through computer supervised dye and chemical weighing; reduced inventory costs with formula management and material forecasting; and improved product quality with precision process control.

MORTON MACHINE WORKS, INC.
P.O. Box 2547
Columbus, GA 31994-2699 USA
Tel: 404-322-5541
Fax: 404-322-0497

Morton’s PLC type controls are versatile so that the control systems are expandable, system size is application dependent, and the controls can be used for any type of process. Input and Output modules are available for Morton Control Systems in almost every type and style. The Morton Control systems require less skill training for programming and maintenance personnel. The systems also have networking capability, and without the use of a host computer, can interface to operator displays and printers, and can share information and data with other Morton control machines. In addition to its many features, all major control modules in a Morton Control Unit are under a full one year warranty.

Morton’s "Master Dyer" software is used to start/stop a dyeing procedure, change dyeing procedure steps, monitor machine status, alarm reporting, machine maintenance, historical/real time trending, and report generation.

The Morton "Advantage" Supervisory Software has the following functionality: dye formula extensions; file entry and maintenance for raw materials, formulas, dye formula/dye procedure comments; and report generator. The "Advantage Plus" Modules are available for lot tracking, production scheduling, raw material inventory control, greige goods inventory control, dye and chemical weighing, and SPC/SQC (P-CIM).

TUBULAR TEXTILE MACHINERY
TUBE-TEX
Hargrave Road at 1-85
P.O. Box 2097
Lexington, NC 27293-2097 USA
Tel: 704-956-6444
Fax: 704-956-8956

The TUBE-TEX YIELD MONITOR utilizes the krypton source and digital detector to convey information about the characteristics of the material. The computer and software will take inputs from the detectors and categorize the information into recipes and views for monitoring and control needs. With this system it is possible to establish system controls, create and maintain different recipes, monitor and control measurement readings, and transmit information to a central location.
The TUBE-TEX WIDTH MONITOR is a versatile, intelligent sensor for use in industrial gauging. The device can determine the width and the angle to a special reflective target, while being insensitive to ambient lighting conditions.

The TUBE-TEX SEAM DETECTOR will mount directly on to the spreader system and gauge the material thickness as it passes over the spreader. The TUBE-TEX OPERATOR INTERFACE, IDT Panelmate II, gives an operator instant recognition of all operations at his station, with simultaneous sight, sound, and touch feedback for fast response and total control. It replaces up to 1024 hard-wired input and output devices found in conventional control panels. To be fully operational, panelmate requires a single cable to connect to a programmable controller, computer, or intelligent device. In addition, it virtually eliminates the design costs of conventional control panels. A user can configure all the control functions and system diagnostics within a ten screen menu using a library of template devices.

TUBE-TEX DATA ACQUISITION SYSTEM combines a mouse, communications co-processor board, and Lotus to create a data acquisition package. Besides offering unparalleled convenience, speed, and effectiveness, the system is user friendly. The CRT screens are developed in AutoCad and the data base is developed in Lotus.
XII. CONSULTANTS

BECKART ENVIRONMENTAL, INC.
6900 46th Street
Kenosha, WI 53142 USA
Tel: 414-656-7680
Fax: 414-656 7699

BLUE PACIFIC DISTRIBUTORS, INC.
P.O. Box 1749
Keaau, Hawaii 96749 USA
Tel: 808-966-6463
Fax: 808-982-5303

FORTUNE CONSULTANTS
P.O. Box 98388
Raleigh, NC 27624 USA
Tel: 919-848 9929
Fax: 919-848 1062
Contact: Martin Kaplan

HB ENVIRONMENTAL ENGINEERS, INC.
3000 Honolulu Ave. #4
Glendale, CA 91214 USA
Tel: 818-248-3529
Fax: 818-248-6343

HYDROSCIENCE
1273 Sea Island Parkway
St. Helena Island, SC 29920 USA
Tel: 803-838-4225
Fax: 803-838-5441

INTERNATIONAL MANAGEMENT
P.O. Box 1213
Gainesville, GA 30503-1213 USA
Tel: 404-532-4262
XIII. SUPPLIERS OF USED EQUIPMENT AND MACHINERY

AMERICAN TEXTILE MACHINERY INC.
2597 S. Milledge Avenue
P.O. Box 1628
Athens, GA 30603 USA
Tel: 706-543-6552
Fax: 706-543-6554

AMMEX INC.
P.O. Box 250
Richburg, SC 29729 USA
Tel: 803-789-5055
Fax: 803-789-5002

CAROLINA TEXTILE MACHINERY INC.
P.O. Box 506
Greenville, SC 29602 USA
Tel: 803-297-8585
Fax: 803-297-7177

ENTEC INDUSTRIES INC.
P.O. Box 5511
Greenville, SC 29606 USA
Tel: 803-277-6361
Fax: 803-299-9818

GIBBS INTERNATIONAL INC.
P.O. Box 1727
Spartanburg, SC 29304 USA
Tel: 803-439-8753
Fax: 803-439-7544
XIV. INDEX

AMERICAN TEXTILE MACHINERY INC.
2597 S. Milledge Avenue
P.O. Box 1628
Athens, GA 30603 USA
Tel: 706-543-6552
Fax: 706-543-6554
Contact: Henry Walczyk

Category: Suppliers of Used Equipment and Machinery
Other Products: Nonwoven machines
Printing machines

AMMEX INC.
P.O. Box 250
Richburg, SC 29729 USA
Tel: 803-789-5055
Fax: 803-789-5002
Contact: David Hedgepeth

Category: Suppliers of Used Equipment and Machinery
Other Products: Calenders
Dyeing machines
Printing machines

AZTEC MACHINERY COMPANY
960 Jacksonville Road
Ivyland, PA 18974 USA
Tel: 215-672-2600
Fax: 215-441-0289
Contact: Joseph A. O’Leary

Category: Dryers and Incineration
Other Products: Dryers
Dyeing machines
Heat exchangers
Nonwoven machines
Ovens
Pollution control equipment/systems
BECKART ENVIRONMENTAL, INC.
6900 46th Street
Kenosha, WI 53142 USA
Tel: 414-656-7680
Fax: 414-656-7699
Contact: Gail Tostrud

Categories: Water Recovery and Waste Water Treatment Consultants

B.F. PERKINS
939 Chicopee Street
Chicopee, MA 01013-2797 USA
Tel: 413-536-1311
Fax: 413-536-1367
Contact: John Bok, Marketing Manager

Category: Calender Systems
Other Products: Calenders, laboratory Nonwoven machines Rolls Testers

BLUE PACIFIC DISTRIBUTORS, INC.
P.O. Box 1749
Keaau, HI 96749 USA
Tel: 808-966-6463
Fax: 808-982-5303
Contact: Michael Clark, President

Categories: Water Recovery and Waste Water Treatment Consultants
Other Products: Industrial pollution control equipment

BRINECELL, INC.
2109 West 2300 South
Salt Lake City, UT 84119 USA
Tel: 801-973-6400
Fax: 801-973-6463
Contact: Tim Themy

Category: Water Recovery and Waste Water Treatment Bleaching machines Pollution control equipment & systems Waste water equipment & supplies
CAROLINA TEXTILE MACHINERY INC.
P.O. Box 506
Greenville, SC 29602 USA
Tel: 803-297-8585
Fax: 803-297-7177
Contact: Victor Capeluto
Category: Suppliers of Used Equipment and Machinery
Other Products: Nonwoven lines
Printing machines, screen
Testing laboratories

ENTECC INDUSTRIES INC.
P.O. Box 551
Greenville, SC 29606 USA
Tel: 803-277-6361
Fax: 803-299-9818
Contact: Larry Wilson
Category: Calender Systems
Dryers and Incineration
Coaters/Finishes/Chemical Application
Suppliers of Used Equipment and Machinery

EVAC CORPORATION
88 Simuel Road
P.O. Box 3274
Spartanburg, SC 29304-3274 USA
Tel: 803-439-8744
Fax: 803-439-8211
Contact: Paul W. Mickler, President
Tom Walter, General Manager
Category: Vacuum Extraction
Products: Water removal systems
Dyeing systems
Lint removal
Finishing systems
Washers

FAB-CON MACHINERY DEVELOPMENT CORPORATION
P.O. Box 591
75 Channel Drive
Port Washington, NY 11050-2216 USA
Tel: 516-883-3999
Fax: 516-883-3880
Contact: Jim Catallo
FILTER FLOW TECHNOLOGY, INC.
3027 Marina Bay Dr., Ste 100
League City, TX 77573 USA
Tel: 713-334-6080
Fax: 713-334-5993
Contact: Tod S. Johnson, Ph.D.

Category: Water Recovery and Waste Water Treatment

FORTE TECHNOLOGY, INC.
201 Carnegie Row
Norwood, MA 02062 USA
Tel: 617-769-9150
Fax: 617-769-5308
Contact: Ralph Monaghan, President

Category: Moisture Monitoring
Other Products: Computer software
Instruments, production data collection
Measuring devices
Testers, moisture

FORTUNE CONSULTANTS
P.O. Box 98388
Raleigh, NC 27624 USA
Tel: 919-848 9929
Fax: 919-848 1062
Contact: Martin Kaplan

Category: Consultants

GASTON COUNTY DYEING MACHINE CO.
P.O. Box 308
Stanley, NC 28164 USA
Tel: 704-822-5000
GASTON  cont.)
Fax: 704-822-0753
Contact: Don Spurrier, International Sales

Categories:
- Low Liquor Ratio Dyeing
- Countercurrent Washing
- Low Wash Process
- Coaters/ Finishes/ Chemical Application
- Water Recovery and Waste Water Treatment
- Chemical Recovery
- Process Automation, Control, & Management Systems

Other Products:
- Bleaching machines
- Carpet dyeing & finishing equipment
- Computer software
- Controllers
- Dryers
- Dyeing machines
- Laboratory equipment
- Foamers
- Heat exchangers
- Size recovery plants

GESSNER COMPANY
4004G Spring Garden Street
Greensboro, NC 27407 USA
Tel: 919-852-3941
Fax: 919-852-5122
Contact: George W. Johnson, Director of International Sales

Category: Printing
Other Products:
- Raising/napping machines
- Shearing machines
- Sanding/sueding machines
- Decattizing machines
- Sponging machines

GIBBS INTERNATIONAL INC.
P.O. Box 1727
Spartanburg, SC 29304 USA
Tel: 803-439-8753
Fax: 803-439-7544
Contact: Jimmy Gibbs

Category: Suppliers of Used Equipment and Machinery
Other Products:
- Cotton
- Dyeing/finishing
- Nonwoven
- Wool/worsted
HB ENVIRONMENTAL ENGINEERS, INC.
3000 Honolulu Ave. #4
Glendale, CA 91214 USA
Tel: 818-248-3529
Fax: 818-248-6343
Contact: Harry Bronozian
Categories: Water Recovery and Waste Water Treatment Consultants

HYDROSCIENCE
1273 Sea Island Parkway
St. Helena Island, SC 29920 USA
Tel: 803-838-4225
Fax: 803-838-5441
Contact: Edwin L. Barnhart
Categories: Consultants Water Recovery and Waste Water Treatment

INTERNATIONAL MANAGEMENT
P.O. Box 1213
Gainesville, GA 30503-1213 USA
Tel: 404-532-4262
Contact: Frank Wilson
Category: Consultants

MARTINT EQUIPMENT CO., INC.
4455 Morris Park Drive
Suite B
Charlotte, NC 28227 USA
Tel: 704-573-1625
Fax: 704-573-1725
Contact: Eve Chapman, Office Manager
Jim Martin, President
Categories: Low Liquor Ratio Dyeing Heat Recovery Suppliers of Used Equipment and Machinery
Other Products: Bleaching machines Area rug dyeing & finishing Dryers Dyeing machines Heat exchangers
(MARTINT- other products cont.)

- Heat reclaimers
- Paddle dye machines
- Static dye equipment
- Textile equipment
- Washers
- Waste heat recovery units

MASCOE SYSTEMS CORPORATION
Box 370
Mauldin, SC 29662 USA
Tel: 803-277-3246
Fax: 803-299-3183
Contact: Joseph G. Poterala, Sales/Engineering

Categories: Coaters/Finishes/Chemical Applications
Dryers and Incineration

Other Products: Coating machines
- Controls, dyeing machine
- Dyeing machines
- Finishing machines
- Foamers
- Laboratory equipment
- Textile machinery

MCINTYRE & NEAL INC.
P.O. Box 1133
Athens, GA 30603 USA
Tel: 706-549-7488
Fax: 706-369-1910
Contact: Harold Neal

Category: Suppliers of Used Equipment and Machinery

MORRISON TEXTILE MACHINERY CO.
P.O. Drawer #1
Fort Lawn, SC 29714 USA
Tel: 803-872-4401
Fax: 803-872-4443
Contact: Tom Trimble, Vice President
Ford Elliott & Trimble, Inc.
1009 East Blvd.
Charlotte, NC 28203 USA
Tel: 704-335-1617
Fax: 704-335-1825
(MORRISON cont.)
Categories: Pad Batch Dyeing
Countercurrent Washing
Other Products: Cloth batchers
Dryers
Dyeing machines
Dyeing steamers
Engineering services
Textile equipment & machinery

MORRISON MACHINE WORKS, INC.
P.O. Box 2547
Columbus, GA 31994-2699 USA
Tel: 706-322-5541
Fax: 706-322-0497
Contact: Ronald Mullenix

Categories: Low Liquor Ratio Dyeing
Heat Recovery
Process Automation, Control, and Management Systems
Other Products: Autoclaves
Control systems
Dryers
Dyeing machines
Heat exchangers
Heat reclaimers
J boxes

NATIONAL ENVIRONMENTAL TECHNOLOGIES, INC.
9400-E Southern Pine Blvd.
Charlotte, NC 28273 USA
Tel: 704-529-5551
Fax: 704-529-5298
Contact: Mark T. Elliott, Manager, Business Development

Category: Consultants

OSMONICS
5951 Clearwater Drive
Minnetonka, MN 55343-8990 USA
Tel: 612-933-2277
Fax: 612-933-0141
Contact: Jennifer Watt, Advertising Coordinator

Category: Water Recovery and Waste Water Treatment
Other Products: Filters
Pollution control equipment & systems
Vapor recovery units
SALMON, KURT, ASSOCIATES INC.
1355 Peachtree St. NE
Atlanta, GA 30309-3257 USA
Tel: 404-892-0321
Fax: 404-898-9590
Contact: Beth Souther
Category: Consultants

STRANDBERG ENGINEERING LABORATORIES, INC.
1302 N. O’Henry Boulevard
Greensboro, NC 27405 USA
Tel: 919-274-3775
Fax: 919-272-4521
Contact: Charles F. Strandberg
Category: Moisture Monitoring
Other Products: Controls
Data collection systems
Stop-motion devices & systems
Width monitors

TEXTILE VACUUM EXTRACTOR CO.
2734 S. Cobb Ind. Blvd.
Smyrna, GA 30082 USA
Tel: 404-436-2998
Fax: 404-436-3043
Contact: International Sales Department
Category: Vacuum Extraction Systems
Products: Spray vacuum washer
Moisture removal system
Chemical recovery system
Vacuum pad application
Wet on wet finishing
Carpet washing and drying

TUBULAR TEXTILE MACHINERY
TUBE-TEX
Hargrave Road at I-85
P.O. Box 2097
Lexington, NC 27293-2097 USA
Tel: 704-956-6444
Fax: 704-956-8956
Contact: Jeffrey T. Dixon, International Sales
(TUBE-TEX cont.)

Categories:
- Pad Batch Dyeing
- Vacuum Extraction
- Dryers and Incineration
- Process Automation, Control, and Management Systems

Other Products:
- Batcher
- Compactor
- Jet extraction
- Entry systems
- Precision folder
- Stitch counter
XIV. REFERENCES

A. ADDITIONAL INFORMATION SOURCES FOR U.S. TECHNOLOGY

American Textile Machinery Association (ATMA), 7297 Lee Highway, Suite N, Falls Church, VA 22042 USA. Tel: 703-533-9251 / Fax: 703-241-5603

American Textile Manufacturers Institute (ATMI), 1801 K St., Suite 900, NW, Washington, DC 20006-1301 USA. Tel: 202-862-0533 / Fax: 202-862-0570. Contact: Charles V. Bremer

Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers (ETAD), 1330 Connecticut Ave, NW, Washington, DC 20036 USA. Tel: 202-659-0060 / Fax: 202-659-1699

United States-Asia Environmental Partnership, 1133 20th Street, NW, Suite 300, Washington, DC 20036 USA. Tel: 202-835-0333.

B. PUBLICATIONS ON POLLUTION PREVENTION IN THE TEXTILE INDUSTRY

Low Liquor Ratio Dyeing, Gaston County Dyeing Machine Company


