Chapter 7
Selected Case Studies of Pollution Prevention in the Textile Industry

This chapter presents summaries of 21 published case studies on successful implementation of pollution prevention in textile processing. These cases are from actual production settings and reflect commercial use of the concepts and methods presented in Chapters 2, 3, and 4. Hundreds of case studies have been published, and undoubtedly, many thousands of applications remain unpublished. The case studies presented in this chapter are typical, and many others are cited elsewhere in this document.

(For information on the American Textile Manufacturers Institute's program to promote pollution prevention throughout the industry, see ATM's 1994 report on its E3 program in Appendix A.)
Pollution Prevention Case Study: Adams-Millis, 1980

Location: High Point, North Carolina, and Franklinton, North Carolina

General target waste: Water

Specific target wastes: All water pollutants, energy

Pollution prevention techniques:
- Segregation, direct reuse
- Scheduling
- Audit and analysis

Unit processes:
- Dyeing (batch)
- Water conservation

Product: Nylon pantyhose

Summary of activities: This mill implemented dyebath reuse for the dyeing of nylon pantyhose in rotary drum dyeing machines. Water use decreased by 35 percent with a cost savings of $0.02 per pound of production. The mill also reduced energy use by 57 percent.

Pollution Prevention Case Study: Americal Corporation, 1993

Location: Henderson, North Carolina

General target waste: Water

Specific target wastes: Biological oxygen demand (BOD), chemical oxygen demand (COD), fats, oil, and grease (FOG), ammonia-nitrogen

Pollution prevention techniques:
- Design-stage planning for processes
- Chemical alternatives, substitution
- Incoming raw material control
- Raw material prescreening
- Improved process control
- Goal-setting, priorities
- Audit and analysis
- Substitution of physical (time/temperature) factors for chemicals

Unit processes:
- Raw materials-fibers
- Raw materials-chemical specialties
- Dyeing (batch)
- Global (vendor involvement through chemical substitutions)

Product: Nylon pantyhose

Summary of activities: This company monitored incoming yarns for oil content. Alternative dyeing auxiliaries and softeners were evaluated to find less-polluting alternatives. Dyeing processes were optimized to the best temperature for maximum dye exhaust without using excessive chemical dyeing assistants. The dye process was extended for 15 additional minutes to obtain better exhaustion. Results showed approximately a 60-percent drop in BOD and COD, a 20-percent drop in FOG, and a 98-percent drop in ammonia-nitrogen. This resulted in a savings of $35,000 annually. Work continues with low-bath-ratio dyeing machines to further improve pollution prevention.

## Pollution Prevention Case Study: Amital Spinning Corporation, 1992

<table>
<thead>
<tr>
<th>Location:</th>
<th>New Bern, North Carolina</th>
</tr>
</thead>
<tbody>
<tr>
<td>General target wastes:</td>
<td>Water, solid</td>
</tr>
<tr>
<td>Specific target wastes:</td>
<td>Packaging, process fiber waste</td>
</tr>
<tr>
<td>Pollution prevention techniques:</td>
<td>Design-stage planning for facility</td>
</tr>
<tr>
<td></td>
<td>Incoming raw material control</td>
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<td></td>
<td>Marketing wastes</td>
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<td></td>
<td>Process optimization</td>
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<td></td>
<td>Optimized chemical handling</td>
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<tr>
<td></td>
<td>Segregation, direct reuse</td>
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<td></td>
<td>Incentives</td>
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<tr>
<td></td>
<td>Goal-setting, priorities</td>
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<tr>
<td></td>
<td>Audit and analysis</td>
</tr>
<tr>
<td></td>
<td>Training, work practices</td>
</tr>
<tr>
<td>Unit processes:</td>
<td>Raw materials-chemical specialties</td>
</tr>
<tr>
<td></td>
<td>Raw materials-chemical commodities</td>
</tr>
<tr>
<td></td>
<td>Raw materials-dyes</td>
</tr>
<tr>
<td></td>
<td>Dyeing (batch, yarn)</td>
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<tr>
<td></td>
<td>Global (vendor involvement through packaging swap)</td>
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<tr>
<td></td>
<td>Support area improvements</td>
</tr>
<tr>
<td></td>
<td>Purchasing specifications-packaging</td>
</tr>
<tr>
<td></td>
<td>Water conservation</td>
</tr>
<tr>
<td>Product:</td>
<td>Dyed high-bulk acrylic yarn</td>
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</table>
Summary of activities: Amital combined process water reuse and solid waste control activities to reduce waste and energy consumption. The company now purchases dyes and chemicals in 400-gallon intermediate bulk containers (IBCs) or in bulk. Drum disposal decreased by 69 per week, or about 3,500 annually. Pallet disposal decreased by 40 per week, or 2,000 annually. Pallet reuse and other packaging-oriented activities involve raw material suppliers, so vendors were made a partner in the reduction of packaging materials. Vendors must accept a return pallet for every pallet delivered. For internal use, Amital fabricates custom pallets designed specifically for ease of handling. Noncontact cooling water is recycled to the mix kitchen. This reduces the need to heat water for mix kitchen use. Water use decreased from 19.34 gallons per pound to 2.7, an 86-percent drop. Chemical use was optimized, and process cycle times were reduced. Solid waste recycling activities included cardboard, plastic, and acrylic yarn waste recycling. About 1.1 million pounds of solid waste were produced in 1992. Of that, about 933,000 pounds, or over 90 percent, was recovered/recycled. Total savings was estimated at over $1.5 million annually for all activities combined. Amital received the Governor's Award for Significant Pollution Prevention Achievement for these activities.

Pollution Prevention Case Study: Bigelow Carpets, 1983

Location: Not disclosed

General target waste: Water

Specific target wastes: All water pollutants, water conservation

Pollution prevention techniques:
- Equipment modifications
- Process alternatives
- Segregation, direct reuse
- Scheduling

Unit processes:
- Dyeing (batch, carpet)
- Water conservation

Product: Carpet

Summary of activities: Dyebaths were reused by equipping pairs of dyeing machines with plumbing and pumps capable of moving a processing bath back and forth from one machine to the other. This allowed immediate reuse of dyebaths for over 20 cycles. Scheduling of lots on the pair was coordinated to ensure efficient reuse. The cost savings was $60,000 per year per pair of machines. Biological oxygen demand, color, and other water pollutants were reduced significantly.

Pollution Prevention Case Study: Binny Textiles, 1984

Location: Madras; India

General target waste: Water

Specific target wastes: Filter backwash water, washwater

Pollution prevention techniques: Segregation, direct reuse

Unit processes: Support area improvements
Water conservation

Product: General textile operations

Summary of activities: Suspended solids from filter backwashing usually are easy to settle. Filter backwash was collected in a settling pond, held for 12 hours, then decanted for nonprocess uses. The settled solids were periodically collected and landfilled. This saved about 2 million gallons of water annually. In addition, internal reuse of washwater in the preparation and dyeing departments reduced water use by over 100 million gallons annually. Also, about 2.5 million gallons were saved by reusing water in the size department.

### Pollution Prevention Case Study: Century Textiles and Industries, 1990

<table>
<thead>
<tr>
<th>Location:</th>
<th>Bombay, India</th>
</tr>
</thead>
<tbody>
<tr>
<td>General target wastes:</td>
<td>Air, water, solid, hazardous</td>
</tr>
<tr>
<td>Specific target waste:</td>
<td>Sulfide</td>
</tr>
<tr>
<td>Pollution prevention techniques:</td>
<td>Chemical alternatives, substitution, Process alternatives</td>
</tr>
<tr>
<td>Unit process:</td>
<td>Dyeing (continuous)</td>
</tr>
<tr>
<td>Product:</td>
<td>Dyed woven fabric</td>
</tr>
<tr>
<td>Summary of activities:</td>
<td>The company was applying sulfur dyes with the traditional sodium sulfide agents and replaced them with an alkaline glucose solution. Initially, a substitution of 61 parts of 80-percent solids glucose solution for 100 parts of 50-percent sodium sulfide was used. Handling difficulties were encountered because of the high viscosity and messy nature of 80-percent glucose solution. Further work with 65 parts of a 50-percent reducing sugar (e.g., corn sugar) waste stream from another industry was successful. Production and fastness properties of the dyed materials were not affected.</td>
</tr>
</tbody>
</table>
**Pollution Prevention Case Study: American Enka Company, 1985**

<table>
<thead>
<tr>
<th>Location:</th>
<th>Enka, North Carolina</th>
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</thead>
<tbody>
<tr>
<td>General target wastes:</td>
<td>Air, water</td>
</tr>
<tr>
<td>Specific target wastes:</td>
<td>Solvent emissions</td>
</tr>
<tr>
<td>Pollution prevention techniques:</td>
<td>Segregation, recycle, direct reuse</td>
</tr>
</tbody>
</table>
| Unit processes: | Raw materials-fiber manufacture  
Yarn formation  
Support area improvements |
| Product: | Nylon yarn, polymer films |
| Summary of activities: | American Enka uses isopropyl alcohol (IPA) in the production of polymeric film products. Attempts to use outside recovery of the IPA were not successful because of high losses (15 percent) and contamination from other materials (e.g., benzene, alkyl benzenes, chlorinated hydrocarbons, Dowtherm) that were being recovered in the same distillation operation. This is now being recycled/recovered in-house. The solvent is segregated from other wastes and distilled for production. The recovery rate is 90 percent, and the quality of recovered materials is sufficient for the production use. In addition, the still bottoms are used as an asphalt emulsifier in another product line. The annual cost savings is $90,000. The payback period for the purchase of the $7,500 distillation unit was 1 month. Air and water emissions decreased. Costs and liabilities of transporting IPA raw material and IPA waste were avoided. |
Pollution Prevention Case Study: Nordic Water Care Project, 1976 to 1981

Locations:  
Denmark, Finland, Norway, Sweden

General target waste:  
Water

Specific target waste:  
Water conservation

Pollution prevention techniques:  
Design-stage planning for processes  
Design-stage planning for facility  
Equipment selection  
Process alternatives  
Segregation, direct reuse

Unit processes:  
All wet processes  
Preparation  
Dyeing  
Printing  
Finishing  
Water conservation

Product:  
Dyed and finished textile fabrics

Summary of activities:  
Between 1976 and 1981, 15 textile operations minimized water use in the Nordic Water Care Project. Some of the more productive and notable activities to reduce water use were as follows: drop/fill replaces overflow washing in jigs, beams, becks, and jets; automatic water flow shutoffs on continuous ranges saved about 25 percent; countercurrent washing. Horizontal washers were shown in this study to be twice as efficient as vertical washers (i.e., one horizontal washer was as efficient as two vertical washers, all having the same water consumption).

Reference:  
Pollution Prevention Case Study: Hampshire Hosiery, Ellen Knitting Mills, 1985

Location: Spruce Pine, North Carolina

General target wastes: Water, energy

Specific target waste: Wastewater temperature

Pollution prevention techniques:
- Design-stage planning for processes
- Design-stage planning for facility
- Marketing wastes
- Incentives

Unit processes:
- Dyeing (batch, yarn)
- Global (acquisition and use of wastes from other nearby industries)
- Support area improvements (boiler, wastewater handling)

Product: Hosiery

Summary of activities:
High-temperature discharges from Hampshire Hosiery dyeing operations were damaging the city sewer system. Segregation of the hot water from dyeing and installation of a heat recovery unit for a cost of $100,000 allowed incoming water to be heated to 105°F from the ambient 80°F. Saved were 52,000 gallons of fuel oil per year. In another activity, the mill installed a hopper, storage silo, conveyor belt, and other handling equipment to burn sawdust from nearby furniture operations. This eliminated the need for 300,000 gallons per year of fuel oil. The sawdust is obtained at a cost of $20 per ton. Overall fuel savings is 66 percent. The boiler conversion to burn sawdust cost $800,000 and the annual savings was $225,000 for reduced fuel costs. Air quality impact was not documented, but the study reported that air pollution decreased.

**Pollution Prevention Case Study: Harriet & Henderson Yarns, Inc., 1993**

**Location:** Henderson, North Carolina; Clarkton, North Carolina; Summerville, Georgia

**General target waste:** Solid

**Specific target waste:** Cotton cleaning waste

**Pollution prevention techniques:** Process optimization
Marketing of wastes
Recovery for reuse
Incentives
Goal-setting

**Unit processes:** Yarn formation
Global (marketing of wastes)

**Product:** Spun cotton and cotton blend yarns

**Summary of activities:** Harriet & Henderson Yarns was landfilling about 44,000 pounds of cotton cleaning waste per week at a cost of $800 per week. A goal was set to find uses for the by-product, which comprised cellulosic plant parts other than fiber as well as some cotton cellulose hairs. Processes were optimized so that less cellulose fiber was lost during processing (i.e., some of the previously discarded short fibers were recovered as fairly pure cotton lint for resale). This reduced the amount of waste by 16,000 pounds per week and provided a payback because of better raw material use. The sale of the recovered lint brought about $250 per week income and saved about $300 in landfill costs. The nonrecovered cotton trash, stems, and leaves were investigated as animal feed and soil amendment for nutrient value and erosion control. The by-product must be analyzed to ensure suitability for feedstock and to determine nutrient value. Animal feed use pays about $200 per week for 13,600 pounds of this material. The company now has a waiting list of farmers wanting to buy the material.


Location: Lincolnton, North Carolina

General target wastes: Water, hazardous, indoor workplace air

Specific target wastes: Aquatic toxicity, odors

Pollution prevention techniques:
- Design-stage planning for facility
- Equipment selection
- Substitution of physical agent for chemical agent
- Process alternatives
- Improved monitoring and control
- Goal-setting, priorities
- Audit and analysis

Unit processes:
- Yarn formation (carding, roving, spinning, winding)
- Support area improvements (air washers)
- Water conservation

Product: Yarn

Summary of activities: Ultraviolet (UV) light was substituted for chemical biocides in air washers and cooling towers in a textile mill. During a 6-month test period, extensive data were collected. Results showed improved worker safety, reduced discharge of biocides to the sanitary sewer, reduced chemical inventory and handling, workplace air quality improvements, reduced foaming and pH problems in wastewater, better air washer performance, and more consistent control of workplace air quality. UV disinfection reduced microbial populations in the air washing/cooling units to an average of $10^4$ colony forming units per milliliter (CFU/mL) over a 6-month test period. The UV system operated with no required maintenance or repairs during the test. An alternative method using reduced UV light plus hydrogen peroxide produced similar results but was more expensive. A supplemental study (to be released later) is evaluating the addition of filters to the system. For the test system, capital costs were $4,560. Startup costs were $1,500. Based on chemical savings, the payback is 11 to 18 months. Extensive test protocol information, data, full analysis, and engineering details are presented in a 30-page report.

Pollution Prevention Case Study: Neuville Industries, Inc., 1993

Location: Hildebrand, North Carolina

General target waste: Solid

Specific target wastes: Paper, cardboard, polybags

Pollution prevention techniques:
- Incoming raw material control (packing)
- Segregation, recycle/reuse
- Incentives
- Goal-setting, priorities
- Audit and analysis
- Training, attitudes, work practices

Unit processes:
- Fabric formation-knitting
- Preparation
- Dyeing (batch)
- Finishing
- Global (vendor involvement through packaging)
- Purchasing specifications-packaging

Product: Hosiery products

Summary of activities:
A recycling committee was established to reduce the solid waste disposal burden. Employee suggestions were an integral part of program initiation. Cardboard, cones, paper, scrap metal, packing materials, knitting oils, polybags, and pallets were targets. Program savings are returned as employee benefits. Waste decreased by about one-third from 266 to 180 cubic yards per week over a P-year period, or about 4,300 cubic yards annually. The savings was $15,127 per year.

Reference:
Pollution Prevention Case Study: Riddle Fabrics, 1993

Location: Kings Mountain, North Carolina

General target waste: Water

Specific target waste: Biological oxygen demand (BOD)

Pollution prevention techniques:
- Chemical alternatives, substitution
- Process modification
- Segregation, direct reuse
- Housekeeping
- Audit and analysis
- Water conservation

Unit processes:
- Preparation
- Water conservation

Product: Cotton label tape

Summary of activities: Holding tanks were installed for bleach baths, allowing reuse. The bath was reconstituted to correct strength after analysis by titration. BOD decreased over 50 percent from 842 milligrams per liter to 400 milligrams per liter. Water use also decreased. The mill came into compliance with permits and realized economic benefits.

Pollution Prevention Case Study: Russell Mills, 1989

Location: Undisclosed

General target wastes: Water, energy

Specific target wastes: Heat recovery/reuse

Pollution prevention techniques:
- Design-stage planning for processes
- Design-stage planning for facility
- Equipment maintenance
- Segregation, direct reuse
- Improved process control

Unit processes:
- Preparation
- Dyeing
- Finishing
- Support area improvements
- Water conservation

Product: Dyed and finished textile fabrics

Summary of activities: The mill installed boiler blowdown and steam condensate recycling. The resulting savings in boiler fuel alone was $1,000 per day.

Pollution Prevention Case Study: Thiele Engdahl, 1988

Location: Winston-Salem, North Carolina

General target wastes: Water, air, hazardous

Specific target wastes: Solvents, isopropyl acetate (IPAc)

Pollution prevention techniques:
- Optimized chemical handling
- Segregation, recovery, direct reuse
- Nonprocess chemical control

Unit processes:
- Printing
- Support area improvements

Product: Printed fabric

Summary of activities: Printing equipment was cleaned with solvents, including IPAc. Solvents were reused twice before onsite redistillation for recovery and reuse. Payback for the distillation system was 2 years. The discharge of solvents to water and air decreased.

Pollution Prevention Case Study: Ti-Cafe, 1993

Location: Newton, North Carolina

General target waste: Water

Specific target waste: Biological oxygen demand (BOD)

Pollution prevention techniques:
- Chemical alternatives, substitution
- Design-stage evaluation-products
- Process alternatives
- Raw material prescreening
- Process optimization
- Audit and analysis

Unit processes:
- Raw materials--chemical specialties
- Fabric formation
- Preparation
- Dyeing (batch)
- Finishing
- Global (vendor involvement through prescreening)
- Purchasing specifications
- Water conservation

Product: Knitted fabric (dyed and finished)

Summary of activities: Ti-Caro required all suppliers to provide environmental impact statements on chemical specialties (e.g., knitting oils, softeners, emulsions, dyes) before production use. Bleaching was done by a pad-batch process, which uses much less water and energy. The bath ratio decreased on all batch processes to 10:1. All processing baths were neutralized (acid/base or redox) before discarding. In some cases, machines were double loaded by piggybacking two lots on the same dyeing machine. Also, scouring and dyeing steps sometimes were combined. Each shade was individually evaluated to determine if it required prebleaching. Water consumption was well below 10 gallons per pound, which is less than half the amount used by other knit dyers. For this reason, the City of Newton granted a modification in BOD permit limits, rewarding the water conservation efforts of the mill.

## Pollution Prevention Case Study:
### Ciba-Geigy Corporation, Toms River Plant, 1990

| Location: | Toms River, New Jersey |
| General target waste: | Water |
| Specific target wastes: | Color, total organic carbon (TOC), laboratory wastewater, landfill leachate, process water |
| Pollution prevention techniques: | Design-stage planning for processes, Design-stage planning for facility, Equipment selection, Equipment maintenance, Process alternatives, Optimized chemical handling, Scheduling, Segregation, direct reuse, Improved process control, Goal-setting, priorities, Audit and analysis, Training, work practices |
| Unit processes: | Raw materials-dyes, Support area improvements, Water conservation |
| Product: | Dyestuff and chemical standardization |
| Summary of activities: | A goal was set to reduce water from approximately 500,000 gallons per day to less than 10,000 gallons per day. Target wastewater streams were cooling water, steam quenching, process water, equipment cleaning, air washer condensate, and stormwater. The goal was achieved by an 18-step procedure over a 5-year period. Activities included recycling point sources, implementing “dry” cleaning methods, scheduling improvements, team building, and facility modification. Ultrafiltration and reverse osmosis were used as part of the study. The capital expenditure was $6 million for chillers, high-pressure cleaning equipment, plumbing and storage, ultrafiltration and reverse osmosis systems, and dust collectors. Engineering diagrams are provided in the study. Process optimization and design improvements were evaluated, especially nonproduction cleaning processes. Extensive data are presented. |
Pollution Prevention Case Study: Unidentified Company, 1985

Location: International

General target waste: Water

Specific target waste: Water conservation

Pollution prevention techniques:
- Design-stage planning for processes
- Design-stage planning for facility
- Process alternatives
- Segregation, direct reuse
- Goal-setting, priorities

Unit processes:
- All wet processing operations
- Preparation
- Dyeing
- Printing
- Finishing
- Support area improvements
- Water conservation

Product: Dyed and finished textile fabrics

Summary of activities:
Water consumption was reduced by several measures over a 1-month period. Flow on wash boxes was optimized. Countercurrent flow was installed on all soapers, mercerizing range, J-boxes, etc. Washwater was reused in upstream process for less crucial uses (e.g., print blanket washing). All boiler condensate was reused as boiler feed water. Steam condensate from caustic recovery evaporator was reused in mercerizer washer. Overflow/running washes on dye jigs were replaced with static washes. Alternate oxidizer systems, which were easier to wash off, were evaluated for use on continuous vat dyeing ranges. Similar modifications were made in other processes. Water consumption in the mill decreased by 40 percent.

Pollution Prevention Case Study: Unidentified Company, 1982

Location: Undisclosed

General target waste: Water

Specific target waste: Size-polyvinyl alcohol (PVA)

Pollution prevention techniques:
- Design-stage planning for products
- Design-stage planning for processes
- Chemical alternatives, substitution
- Process alternatives
- Segregation, direct reuse

Unit processes:
- Yarn formation
- Slashing and sizing
- Fabric formation
- Preparation
- Global (combined effort in several unit processes)
- Testing, analysis, monitoring

Product: Woven textile fabrics

Summary of activities:
A closed-loop ultrafiltration and recycling system was installed to recover PVA. The PVA was substituted for previously used starch and other nonrecoverable sizes. The project performance was closely monitored for 16 months for pollution and textile quality performance. The capital investment was $600,000, and the operating costs were $61,000 annually. Annual savings were reported to be $420,000 for the value of recovered size, $100,000 for savings in enzymes, and $20,000 for steam savings, or a total of $540,000 annually.

### Pollution Prevention Case Study: United Piece Dye Works, 1989

<table>
<thead>
<tr>
<th>Location:</th>
<th>Edenton, North Carolina</th>
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</thead>
<tbody>
<tr>
<td>General target waste:</td>
<td>Water</td>
</tr>
<tr>
<td>Specific target wastes:</td>
<td>Phosphates</td>
</tr>
<tr>
<td>Pollution prevention techniques:</td>
<td>Design-stage planning for processes</td>
</tr>
<tr>
<td></td>
<td>Design-stage planning for product</td>
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<td></td>
<td>Enhanced expertise</td>
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<td>Chemical alternatives, substitution</td>
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<td>Process alternatives</td>
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<td></td>
<td>Raw material prescreening</td>
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<td></td>
<td>Improving information</td>
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<tr>
<td></td>
<td>Goal-setting, priorities</td>
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<tr>
<td></td>
<td>Audit and analysis</td>
</tr>
<tr>
<td>Unit processes:</td>
<td>Raw materials--chemical specialties</td>
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<tr>
<td></td>
<td>Raw materials-chemical commodities</td>
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<tr>
<td></td>
<td>Dyeing (batch)</td>
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<tr>
<td></td>
<td>Finishing</td>
</tr>
<tr>
<td></td>
<td>Global (vendor involvement through prescreening)</td>
</tr>
<tr>
<td></td>
<td>Purchasing specifications-phosphates</td>
</tr>
<tr>
<td>Product:</td>
<td>Dyed fabric</td>
</tr>
<tr>
<td>Summary of activities:</td>
<td>Sources of phosphate were identified by reviewing vendor information, especially the material safety data sheet (MSDS). Processes, products, and process chemistry were reviewed. Many substitutions of nonphosphate materials for phosphate-containing materials were made. The result was a decrease in phosphate in the effluent from 7.7 milligrams per liter to 1.0 milligram per liter.</td>
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</tbody>
</table>
Pollution Prevention Case Study: West Point Pepperell, 1985

Location: Lumberton, North Carolina

General target wastes: Hazardous and all others

Specific target wastes: Hazardous metals and all others

Pollution prevention techniques: Chemical alternatives, substitution
Incoming raw material control
Raw material prescreening
Improving information
Audit and analysis

Unit processes: Raw materials-chemical specialties
Raw materials--chemical commodities
Raw materials-dyes
Fabric formation
Dyeing (batch)
Finishing
Global (vendor involvement through prescreening information)
Purchasing specifications

Product: Dyed knit cotton and cotton blend fabric

Summary of activities: A committee prescreened raw material (dyes and chemicals) to ensure that offensive, toxic, and other objectionable material use were minimized in the production facility. In the event that raw materials with undesirable properties had to be used (i.e., no alternatives exist), difficult raw materials were identified to all workers before use. This process entailed no capital costs. Benefits, such as the ability to dispose of waste treatment sludges (because they do not contain objectional metals or toxics), were realized.

Appendix A

Encouraging Environmental Excellence, also known as E3, was created by the American Textile Manufacturers Institute (ATMI) to advance the U.S. textile industry’s already strong environmental record. Launched in 1992, E3 is a voluntary initiative that provides ATMI member companies with a forum to share ideas and strategies for dealing with environmental concerns. More important, the program challenges textile companies to further strengthen their corporate commitment to the environment.

And that commitment to preserving the environment is exceptional. Each year, U.S. textile companies invest millions of dollars to try to make sure that their processes for manufacturing textiles are environmentally friendly. In 1993, the most recent year for which data is available, the industry spent approximately $313 million on pollution controls and related equipment.

“It’s one thing for a company to say it believes in protecting the environment, it’s another matter to take action and do something about it,” notes Gerald B. Andrews E3 chairperson and president and CEO of Johnston Industries, Inc. “And that’s what ATMI’s E3 program is all about - taking action. At Johnston Industries, we take the E3 program very seriously, involving everyone from the CEO to individual employees. The program has helped employees understand why environmental preservation is so important to our facilities and to our communities. For us, participating in the E3 program is good business. We wouldn’t have it any other way.”

To qualify for E3 membership and annual recertification, an ATMI member company must be in compliance with all federal, state and local environmental laws, something they must do anyway. The E3 program, however, encourages companies to get out in front of regulations and set standards for other industries to follow.

Besides being in compliance with the law, a company must adopt a IO-point plan. The plan’s guidelines require that a company develop a corporate environmental policy and set annual goals for reducing waste and conserving water and energy. In addition, a company must develop an outreach program with suppliers and customers to encourage pollution prevention and waste minimization, develop employee education and community awareness programs and audit its facilities.
At the end of each year, a company must submit a detailed report describing its progress in achieving its environmental goals and how those goals were achieved. A company also must develop new goals for the coming year.

Once a company qualifies for E3, membership renewal is not automatic. If an E3 member company violates an environmental statute, it is required to provide ATMI with a written explanation of the violation along with its plan for corrective action. ATMI reserves the right to remove a company from the E3 program if it fails to comply with an environmental statute or the program’s guidelines. In 1995, 52 companies were members of the E3 program.

For companies that qualify for membership, ATMI offers its assistance by providing manuals on how to conduct environmental audits. ATMI also supplies case studies and hosts annual education seminars.

To advertise their commitment to environmental excellence, member companies can use the E3 logo and hang tag on their products. They may also contract with their customers to use the hang tag on their products, provided customers specify the cloth, yarn or thread was produced by an American textile manufacturer that promotes environmental preservation.

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**E3 Program Guidelines**

The program’s IO guidelines provide the framework for a company’s application to and retention in the program. Each company must meet the following guidelines:

1. Formulate and submit to ATMI a company environmental policy.
2. Describe in detail senior management’s commitment toward environmental excellence and how greater environmental awareness is encouraged throughout the company.
3. Submit a copy of its environmental audit form describing how it ensures that officers and employees are in full compliance with existing laws.
4. Describe how it has worked with suppliers as well as customers to address environmental concerns.
5. List its environmental goals and targeted achievement dates.
6. Describe its employee education program.
7. Identify and describe its emergency response plans.
8. Describe how it has relayed its environmental interests and concerns to the surrounding community, residents and policymakers.
9. Describe how it has been able to offer environmental assistance and insights to citizens, interest groups, other companies and local government agencies.
10. Describe its interaction with federal, state and local policymakers.
The E3 program is managed by a general chairperson, an industry task force and an independent advisory board. The eight-person task force is made up of environmental engineers and public relations professionals from the industry. The group is responsible for managing the program’s day-to-day operations, carrying out policy recommendations made by the advisory board and organizing educational seminars and workshops.

The advisory board is made up of nine representatives from state environmental enforcement agencies, businesses, environmental organizations and academia. The board is responsible for reviewing the criteria for the E3 program and the environmental records of member companies. Board members also are required to tour several textile facilities each year.

The success of the E3 program is due in large part to the fact that it is a voluntary initiative. What distinguishes an E3 member company is its willingness to work with government regulators, community groups and employees to address environmental issues quickly and responsibly. In fact, the industry has been recognized as a leader in environmental preservation by the Environmental Protection Agency (EPA).

EPA’s WasteWiSe program is a voluntary initiative designed to encourage companies to reduce waste, which is defined as anything that is sent to a landfill. According to Lynda Wynn, manager of the WasteWiSe program, “ATMI and its members in the Encouraging Environmental Excellence program are doing an outstanding job of reducing waste and improving the environment. ATMI is one of the most proactive trade associations on pollution prevention issues, working with its members to demonstrate that conserving natural resources is good for business and for our environment.”

The U.S. textile industry has also been recognized as a leader in environmental preservation by a number of state and local governments as well as by many local communities.

**1995 Environmental Highlights**

**Recycling and Waste Minimization**

Evidence of E3 member companies’ commitment to the environment was especially strong in the recycling area. Companies recycled everything from office paper to dyes and fiber. Some textile companies helped other textile firms recycle their waste. Others recycled products - for example, soda bottles - to make new products, such as denim. Through efforts like these and others, the amount of waste sent to landfills was reduced dramatically.
When a 100-year-old textile mill and warehouse were demolished, Dan River Inc. recycled and resold roughly 4.7 million pounds of materials, including 2 million pounds of bricks and 1.2 million pounds of decking boards made from heart of pine, a wood that is all but extinct today.

Wellington Sears Company, a division of Johnston Industries, Inc., is involved in a project to compost waste fiber generated by the company’s Utilization Plant, which itself is a textile recycling facility. The plant takes waste fiber and scraps from other textile and apparel manufacturing facilities and converts them into useable forms, which go into making products such as mops and mattress pads. In the process of recycling, however, additional waste is generated. So the company conducted a study to determine the feasibility of composting the waste material. The study concluded that the waste would make an excellent compost and, as a result, Wellington Sears began operating a full-scale compost facility on site. The company estimates it is keeping more than 5,000 tons of waste out of the landfill each year.

Swift Textiles, Inc. is using recycled soda bottles to make denim. The fabric contains 80 percent cotton and 20 percent polyethylene terephthalate, which comes from recycled soda bottles. The empty soda bottles are sorted by color, washed, dried and melted into pellets. The pellets are then remelted, spun into fiber and combined with cotton yarn, dyed and woven to produce the denim.

Sunbury Textile Mills, Inc. recycles 90 percent or more of its office paper, aluminum cans, drums, cones, spools, cardboard and yam waste. Through design changes in its yarn manufacturing operation, the company reduced yarn waste in 1995 by 45 tons. The company reduced the overall amount of waste it sent to the local landfill in 1995 by 402 tons. (See chart at left.)

The Kent Manufacturing Company, which is in the business of manufacturing wool yam, does not generate much landfill-bound waste. Even so, the Pickens, SC., company enlisted the help of the county recycling department in setting up a recycling program. The company has placed a number of recycling containers throughout the organization. Each department has containers for paper, aluminum cans, plastic, fibers, cones and tubes. Before the recycling program began, Kent Manufacturing was sending an average of four dumpsters of waste a week to the county landfill. With the new program in place, the company averages just one dumpster of waste per week.
Southern Mills, Inc's biggest challenge was to reduce solid waste sent to local landfills. The company tackled the problem by challenging each manufacturing plant to organize a committee to work with its corporate waste reduction committee to identify what was being transported to the landfills. The result: the company discovered it was sending a lot of drums to the landfill. By working with its suppliers, Southern Mills now only uses drums that can be returned to the original vendor. The company estimates that in 1995 it saved 42,000 pounds of metal and fiber drums from being sent to the landfill.

Carolina Mills, Inc. also works with its vendors as well as its customers to reach the point where every item that comes on company grounds will be recycled. In 1995, the company reduced the amount of waste it sent to the landfill by 65 percent. Meanwhile, Fruit of the Loom reduced the amount of waste it sent to the landfill in 1995 by 2 million pounds a month.

When Fieldcrest Cannon, Inc. treats the wastewater that results from manufacturing sheets and towels, additional waste, known as biological solids, is generated. Rather than disposing of the waste at a landfill or burning it, the company gives it to local farmers, who use it as fertilizer. The waste makes an ideal fertilizer because of its high content of phosphorus and nitrogen.

Alice Manufacturing Co., Inc. no longer sends paper to the landfill since it implemented a recycling program. The company estimates that in 1995 it recycled 476,000 pounds of paper, 256,000 pounds of cardboard and 77,000 pounds of plastic bale wrap.

Unifi, Inc., with the help of Sonoco, expanded a company recycling facility, where fiber, paper, tube waste and corrugated cardboard are baled using highly automated equipment. The company recycles 95 percent or more of its aluminum cans, drums, cones, spools, packaging, plastic dye springs, cardboard, waste oil, wooden pallets and fibers.

Spartan Mills is working with its county recycling department to examine the possibility of recycling dust from fiber reclamation. The company also recycles 90 percent or more of its office paper, aluminum cans, drums, cones, spools, packaging, cardboard, wooden pallets and fibers.

A number of companies are proud of their 100 percent recycling record. Stonecutter Mills Corporation recycles 100 percent of its drums, plastic, packaging, cardboard, fluorescent bulbs, glass and waste oil. Wehadkee Yarn Mills is recycling 100 percent of its dyes, aluminum cans, drums, plastic, cones, spools, packaging, cardboard, wooden pallets and fibers.

American & Efird, Inc. has instituted a recycling program specifically for plastic. American & Efird customers can ship the company’s plastic cones, spools and polybags to one of American & Efird’s 11 recycling centers located around the country. These products are then consolidated and shipped to a reprocessing center.
Russell Corporation received an award from the Alabama Recycling Coalition for having the top in-house recycling program in the state. The company recycles on site 95 percent or more of its office paper, aluminum cans, drums, plastic, cones, spools, cardboard, wooden pallets, fibers and apparel waste from its cutting and sewing operations. And Artee Industries, Inc. reports that it recycles 95 percent or more of its office paper, aluminum cans, drums, plastic, cones, spools, packaging, cardboard, wooden pallets and fibers.

**Pollution Prevention and Water and Energy Conservation**

Pollution prevention as well as water and energy conservation were high priorities for many E3 member companies. By recycling wastewater, a number of companies saved thousands of gallons of water a week. Other actions companies took to protect the environment ranged from using chemicals and dyes that are more environmentally friendly to buying equipment that is more energy efficient.

The biggest challenge Mount Vernon Mills, Inc. faced was to help improve the operation of a 30-year-old local wastewater treatment facility. Because Mount Vernon Mills supplies almost all of the wastewater to the facility, the company funded the vast majority of an $11 million project to upgrade the facility. The company is trying to improve the quality of wastewater it sends to the treatment facility by using the most environmentally friendly dyes and chemicals and by working with its vendors to see whether some of those dyes can be recycled. In addition, by recycling packaging materials collected from its customers and reusing solid waste that is generated internally, Mount Vernon Mills has reduced the amount of waste it has sent to the landfill during the last two years by 32 percent.

When Dixie Yarns, Inc. purchased a company in North Carolina, it inherited the environmental contamination a previous owner had left behind. Rather than waiting for the EPA to mandate action, Dixie Yarns voluntarily took steps to clean up the site. The company removed 2.3 million pounds of contaminated soil at a cost of $60,000. Dixie Yarns currently is awaiting the appropriate permits from the state so it can begin cleaning up the water, which is also contaminated.

By recycling wastewater, Mayfair Mills, Inc. estimates it saved between 4,000 and 5,000 gallons of water a week in 1995.

At Harriet & Henderson Yams, every facility has a water tower on site, which helped the company reduce purchased water and wastewater flow by 20 percent. By reusing the water, the company also has reduced the amount of energy and chemicals it uses.
Cone Mills Corporation, which is headquartered in North Carolina, installed a color removal system to remove dye from its wastewater before the water is discharged into a local river. The state is encouraging other area companies to take similar action.

To conserve energy, Shuford Mills, Inc. installed a new dryer at its package dyeing facility. As part of the project, the company also renovated a 20,000-gallon storage tank so that hot water can be recovered during the drying process and reused in the dyeing operation.

At Armtex, Incorporated, each plant has formed an energy conservation team. The team is responsible for conducting plant audits and making recommendations for conserving energy.

Borden Manufacturing Company, in cooperation with the state power and light company, installed a computer system that notifies Borden whenever the utility company’s power usage is at peak capacity. When peak capacity is reached, the computer system sounds an alarm and Borden shuts down selected equipment for a specified duration. By voluntarily reducing power consumption during peak periods, Borden has received credits on its monthly power bills. In 1995, those credits translated into a savings of several thousand dollars.

At Coats American, all utilities and production equipment are inspected regularly to spot problems and repair leaks quickly. Production is evaluated periodically against standard usage amounts to spot waste other than leaks. As a result of these inspections, the company estimates that in 1995 it saved approximately $300,000 to $500,000 on its energy bill alone.

Converting to a more energy-efficient lighting system saved Pendleton Woolen Mills 4 million kilowatt-hours in 1995, which translated into a savings of $166 million.

Burlington Industries, Inc. continued its 15-year plan to replace all of its refrigeration machines with ones that contain a more environmentally friendly refrigerant. In 1995, the company replaced 13 machines.

Belding Heminway Co., Inc. improved air quality by eliminating the use of a common ozone-depleting chemical from its manufacturing operations.

Through chemical substitutions, Collins & Aikman Products Co. has reduced SARA 313 releases by 95 percent since 1988. (SARA is the Superfund Amendments and Reauthorization...
Act.) The 1986 amendments require companies to report which toxic chemicals they release into the air. The goal is to get industries to reduce the number of chemicals they emit.

By making some modifications at one of its textile finishing operations, WestPoint Stevens Inc. reduced air emissions by nearly 89 percent. As a result, the plant no longer has to apply for a permit under Title V of the Clean Air Act, the federal law that governs air emissions. Not only has the environment benefited, but WestPoint Stevens estimates that being removed from Title V will save $50,008 a year in compliance, record-keeping and personnel costs, and the plant also will be able to avoid the expensive process of applying for a Title V permit.

Because it reduced its air emissions, the New Cherokee Corporation is no longer required to file a permit with the state of Tennessee under the Clean Air Act. The company reduced emissions by eliminating the use of oil as a fuel and by designing a more efficient way to deliver dye to the production process.

The E3 program requires a strong commitment from senior management to protect the environment, and member companies’ environmental management and auditing systems are evidence of that commitment. Environmental management and auditing, however, cannot end there. Employee involvement through education and training is also critical to the success of any company’s environmental program.

The environmental manager for Johnston Industries, Inc. reports directly to the corporate vice president of operations. The environmental manager, who is a licensed engineer, is responsible for all aspects of environmental compliance, including air and wastewater permits, pollution prevention, recycling and hazardous and solid waste disposal. Each year, all facilities at Johnston Industries undergo a comprehensive environmental compliance audit. If necessary, corrective actions are scheduled and tracked until they are resolved.

Sara Lee Knit Products, a division of the Sara Lee Corporation, has an environmental awareness program in place at all of its facilities. The company tries to raise awareness about the importance of protecting the environment by periodically running articles in the company newsletter and by participating in events, such as Earth Day. The company’s corporate office sponsors annual, educational seminars for facility managers and environmental coordinators.

Bloomsburg Mills Inc. trained all employees on how to identify, store, handle and dispose of hazardous materials. Each plant has integrated the environmental program into its monthly safety inspections, with special emphasis on how to handle containers that are not labeled.
Although relatively few chemicals go into the manufacturing of woven fabrics, Arkwright Mills continually audits its facilities, looking for any potential chemical spills as well as possible water contamination. A report is given to the board of directors at each quarterly meeting.

Plant managers at Hamrick Mills are in constant communication with the company president about environmental issues. The company conducts voluntary walk-through inspections every month. To add credibility to the program, the company also hires independent auditors to inspect its facilities every other year.

The environmental program at Inman Mills is headed by a company vice president. The company holds monthly meetings for senior managers and plant personnel on safety and environmental issues.

At Dominion Yarn Corporation, plants are required to immediately notify the corporate office about spills or other environmental problems. A report is sent to the director of environmental safety and health at the Dominion Yarn’s parent company, Dominion Textiles, Inc. The parent company, in turn, reports this information to the board of directors.

**Community Involvement**

With policymakers and the public focusing increasingly on environmental issues, the relationship between textile companies and the communities in which they operate is more important than ever. One of the tenants of the E3 program is for each company to offer its assistance and expertise on environmental issues to others in the community, including citizens, civic organizations and schools. In turn, communities across the country have recognized the many contributions E3 member companies have made to their neighborhoods, cities and states.

Employees at Avondale Mills, Inc. teamed up with representatives from the state power company and various government and regulatory agencies to clean up a local stream so people could swim in it. In addition, a threatened species of water lily continues to thrive in sections of the stream.

Opp and Micolas Mills, a division of Johnston Industries, Inc., sponsored a poster and coloring contest for local schools, including preschools, to teach young children about the importance of preserving the environment.
China Grove Textiles, Inc. chose to teach young children about environmental preservation by inviting 60 fourth graders and their teachers to tour one of its plants. The children received an overview of the manufacturing process. In addition, they were told about the importance of reducing the amount of waste that is going to landfills and how they could help in that effort by recycling items at home.

Dyersburg Fabrics Inc. is active with the Boy Scouts of America, assisting young scouts in obtaining their environmental merit badge. The company also works with the National Bottling Association recycling plastic beverage bottles to make fabric from soda bottles.

Cleyn & Tinker International Inc. is involved in a venture with its local Rotary Club to recycle paper, cardboard boxes, cones and tubes. The company recycled an average of 1,000 pounds of material a month.

Guilford Mills, Inc. won the 1995 North Carolina Governor’s Award for Excellence in Waste Reduction. The company won for the large business category and is only one of three companies in the state to have received an award in this category. Guilford was recognized for its significant achievements in reducing air emissions and recycling.

Milliken & Company received first place in the 1995 Keep America Beautiful National Awards in the reduce, reuse, recycle category. Keep America Beautiful is a national, non-profit public education organization that honors individuals and businesses that come up with ways to reduce waste and conserve natural resources and energy. Milliken received the award for a process it developed to clean, retexture and restyle used modular carpets so the carpets can be reused in offices, public buildings and other commercial facilities rather than being disposed of in landfills. In addition, Milliken & Company was recognized by the EPA for its outstanding performance in EPA’s 33/50 Program. This voluntary pollution prevention initiative challenged companies to reduce their emissions of 17 toxic chemicals by 33 percent by 1992 and by 50 percent by 1995. Milliken reduced its emissions by 94 percent in 1995.

Renew America, a national environmental organization, recognized Springs Industries, Inc. as a national leader for its chemical reduction program and listed the program in its Environmental Success Index. In 1995, Springs reduced toxic chemicals it used by more than 96 percent. This is the second consecutive year Springs has been honored by the environmental organization. (See chart above.)
Thomaston Mills, Inc. and Forstmann & Company, Inc.’s Louisville, Ga. facility both received awards from the Georgia Water & Pollution Control Association (GWPCA) for having outstanding industrial biological wastewater treatment plants. The award is presented to industrial facilities that consistently demonstrate outstanding performance. This is the third time the Louisville facility has received an award from GWPCA.

**THE E3 PROGRAM:**
**ENSURING A CLEAN AND COMPETITIVE TEXTILE INDUSTRY**

The E3 program has become one of the textile industry’s most successful programs. It has changed the way companies look at their business operations by making them more aware of their environmental responsibilities. By becoming an E3 member, companies are saying that environmental preservation is the responsibility of everyone - employees, companies, communities and governments.

Protecting the environment for future generations also requires the U.S. textile industry to think globally. ATMI has been active in working with foreign governments and private organizations to develop stronger, more credible environmental labeling programs.

ATMI has also been active in developing international environmental standards, such as the International Standards Organization (ISO) 14000. The intent of ISO 14000 is to create an environmental standard that applies to all countries and minimizes trade barriers.

An example that typifies how committed companies are to the E3 program is the story of Maiden Mills Industries, Inc. In December 1995, a fire destroyed 90 percent of its facility in Lawrence, Mass. In the course of rebuilding, Malden Mills has demonstrated that preserving the environment is of the utmost importance.

The company believes in the philosophy of “sustainable development.” Explains Waker Bickford, the company’s director of the environment, health and safety department, “In addition to ensuring that our daily production processes don’t compromise the environment, we also look at the broader picture and the impact on the local community. We believe in staying in the city and rejuvenating the urban economy rather than fleeing to the country to greener pastures.”

As a result Malden Mills chose to rebuild its turn-of-the-century riverfront factory. The factory, which is in the inner city, is located in a nationally registered historic district. That meant rebuilding to stricter, more expensive standards and actually expanding to rehabilitate evacuated hazardous waste sites adjacent to the property.

“We want to maintain a healthy business without compromising the environment for future generations.”

Walter Bickford, director of the environment, health and safety department, Maiden Mills Industries, Inc.
As part of the estimated $300 million cost to rebuild, the company is paying particularly close attention to energy conservation and waste reduction. “Being in New England, we’re at the end of the energy pipeline,” says Bickford. “Our winters are cold and we use a tremendous amount of energy. Naturally, cost savings is important to us, but saving energy and raw materials are just as important.”

With that in mind, the company is buying state-of-the-art equipment that is more energy efficient. Also, teams of employees and managers are working together to change machine and process operations, which have reduced the amount of dye the company uses in its manufacturing operations by 30 percent.

Bickford sums up the company’s involvement in E3 in this way: “We want to maintain a healthy business without compromising the environment for future generations.”
ALABAMA
Russell Corporation
Alexander City, AL.

Wellington Sears Company
(as of 1996, a division of
Johnston Industries, Inc.)
Valley, AL

GEORGIA
Avondale Mills, Inc.
Monroe, GA

Forstmann & Company, Inc.
Dublin, GA

Johnston Industries, Inc.
Columbus, GA

Southern Mills, Inc.
Union City, GA

Swift Textiles, Inc.
Columbus, GA

Thomaston Mills, Inc.
Thomaston, GA

Whedbee Yarn Mills
West Point, GA

WestPoint Stevens Inc.
West Point, GA

KENTUCKY
Fruit of the Loom, Inc.
Bowling Green, KY

MASSACHUSETTS
Malden Mills
Industries, Inc.
Lawrence, MA

NEW YORK
Belding-Heminway Co., Inc.
New York, NY

Bloomsburg Mills, Inc.
New York, NY

Clevyn & Tinker
International Inc.
New York, NY

Frank Ix & Sons, Inc.
New York, NY

NORTH CAROLINA
American & Efird, Inc.
Mount Holly, NC

Armtext, Incorporated
Pilot Mountain, NC

Artee Industries, Inc.
Shelby, NC

Borden Manufacturing
Company
Goldsboro, NC

Burlington Industries, Inc.
Greensboro, NC

Carolina Mills, Inc.
Maiden, NC

China Grove Textiles, Inc.
Gastonia, NC

Crais American
Charlotte, NC

Collins & Aikman
Products Co.
Charlotte, NC

Cone Mills Corporation
Greensboro, NC

Dominion Yarn
Corporation
Landis, NC

Fieldcrest Cannon, Inc.
Kannapolis, NC

Guilford Mills, Inc.
Greensboro, NC

Harriet & Henderson Yarns
Henderson, NC

The New Cherokee
Corporation
Spindale, NC

Pharr Yarns, Inc.
McAdenville, NC

Sara Lee Knit Products
Winston-Salem, NC

Shuford Mills, Inc.
Hickory, NC

Stonecutter Mills Corp.
Spindale, NC

Unifi, Inc.
Greensboro, NC

OREGON
Pendleton Woolen Mills
Portland, OR

Pennsylvania
Sunbury Textile Mills, Inc.
Sunbury, PA

SOUTH CAROLINA
Alice Manufacturing
Co., Inc.
Easley, SC

Arkwright Mills
Spartanburg, SC

Graniteville Company
Graniteville, SC

Hamrick Mills
Gaffney, SC

Inman Mills
Inman, SC

The Kent Manufacturing
Company
Pickens, SC

Mayfair Mills, Inc.
Arcadia, SC

Milliken & Company
Spartanburg, SC

Mount Vernon Mills, Inc.
Greenville, SC

Spartan Mills
Spartanburg, SC

Springs Industries, Inc.
Fort Mill, SC

TENNESSEE
Dixie Yarns, Inc.
Chattanooga, TN

Dyersburg Fabrics Inc.
Dyersburg, TN

VIRGINIA
Dan River Inc.
Danville, VA

1996 New E3 Members
The following ATMI companies became E3 members in 1996:
The Amerelle Corporation
Vernon, CT
Bradford Dyeing Association
Westerly, RI
Weave Corporation
Hackensack, NJ
Greenwood Mills, Inc.
Greenwood, SC

287
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Georgia Power

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Burlington Industries, Inc.

James Keesler
Arkwright Mills, Inc.

Arthur Toompas
Cone Mills Corporation

T. Halliburton Wood
Johnston Industries, Inc.
Index

References in bold type indicate a general discussion of the entry topic.

accounting
  barriers to pollution prevention from, 245
  changes needed due to dye bath ratio changes, 183-184
  computer modeling to assist in, 245-248
  pollution prevention activities, role in incorporating, 244
  waste audit, role in, 231

air pollutants, 11. See also indoor air quality (IAQ) problems
  from boilers, 11, 14
  from dyeing operations, 180
  from finishing operations, 201
  fugitive sources of, 11, 14
  from heatsetting, 173
  measurement of, 48-47, 238
  from ovens, 14, 15
  point sources of, 11, 14
  prevention of, 18, 48-50
  as primary emitters, 15
  from printing, 47-48, 193, 198, 197
  regulation of, 44-48
  as secondary emitters, 15
  from solvent-based cleaning activities, 14
  sources of, 11, 14-15, 47
  from spills, 14
  from storage tanks, 14
  types of, 48
  from warehouses, 14
  from wastewater treatment systems, 14

alternative technologies for pollution prevention
  for coating systems, 98-99
  cold processes, 99-100
  in finishing, 205
  in printing, 118, 198
  in scouring and dyeing, 50, 118-118
  waterless, 74

American Association of Textile Chemists and Colorists, 85, 88
  buyer's guide, 138, 139, 201

American Textile Manufacturers Institute (ATMI)
  pollution prevention ideas, as source of, 85
  solid waste subcommittee of, 20

aquatic toxicity
  from biocides, 82-83
  causes of 57-59, 80
  dyes in, role of, 80-81

from miscellaneous toxic compounds, 64
from pesticide residues, 63, 124
pollution prevention strategies for, 61, 64, 175
from salt, 62
from sizing and desizing operations, 164
from surfactants, 61-62, 145-146, 174-175
synthetic and regenerated fibers, from processing of,
  125-126
testing for, 57, 59, 105
from toxic anions, 63-64
from toxic organic chemicals, 62

audit. See also waste audit
  of air pollutants, 235-236
  of fabric preparation procedures, 174
  of hazardous waste, 26
  of machinery and operations, 86-88, 204
  sizing/desizing operations, of waste from, 167
  of solid waste, 22
  walkthrough, of facility operations via a, 222
  of wastewater, 17

automated chemical systems
  capabilities of, 101, 102, 106, 107, 201, 215-216
  for color mixing and batching, 185-186
  for dosing of dyes, 185
  for finishing operations, 206
  maintenance of, 88
  for print paste makeup, 196-197

barriers to practicing pollution prevention, 242-244, 245-246

batch processes
  all-in dyeing with fiber reactive dyes, 36-37
  vs. continuous processes in dyeing, 178-179
  vs. continuous processes in fabric preparation,
    171-172
  dyeing with, described, 129
  exhaustion/fixation levels with, 129-131
  low-bath-ratio dyeing for, 111-112, 183-185
  pollution prevention techniques for, 38, 183-185
  salt use in, 40-41, 44
  single-step, cold-batch method to combine several steps, 176
  two-step dyeing with fiber reactive dyes, 36

biological oxygen demand. See BOD and COD

bleaching
  by combining with scouring/desizing in single-stage processing, 176
  continuous knit bleaching ranges, use of, 176
  fabric preparation, role in, 172-173
  pollution concerns of, 173
BOD and COD
bioavailability, as measures of, 90

cotton, levels in raw, 123-124
from dyeing operations, 179-181
handbuilders, levels from, 141
pollution prevention strategy for, 174, 263
preparation processes, levels from, 174
from printing operations, 192-193
of selected chemicals, 92
sewer fees based on, 93, 242-243
sizing and desizing, loadings from, 140-141, 146, 164, 172
surfactants, levels from, 144-145, 172
synthetic and regenerated fibers, from processing of, 125-126
testing for chemical specialties, 103
from textile industry, 17-19
waste treatment systems, effect on, 51

broadwoven mills, 1

CAAA. See Clean Air Act Amendments
capital investment, 3
carcinogenicity/mutagenicity
of dyes, 135-136
of formaldehyde-containing resins for permanent press finishing, 203-204
carding machine in natural fiber preparation, 4
carpentry
foam in, use of, 205-206
installation of carpets, pollutants associated with, 210
mothproofing in, pollution issues from, 207-208
pollution prevention opportunities in, 169-170
tufting in, 6
categorization of textile industry
general, 2
in Standard Industrial Classification (SIC) Manual, 2, 11, 12-14
categorization of waste in textile industry, 31
cellulosic fibers, manufacture of, 4
chemical commodities
bulk systems/automated dispensing for, 151-152
categories of, 150-151
contaminants in, 150
metal impurities in, 65
pollutants and waste streams associated with, 150
pollution prevention ideas for, 150, 151-152
prescreening for, 102-103
preventing hazardous waste from, 26-27
quality control for, 102-103, 151
chemical handling
automated systems for, 101-102
employee training for, 101, 197, 214-215
measuring for proper, 101
mixing for proper, 101
optimizing practices for, 100-102
packaging for proper, 100
purchasing practices for proper, 100
receiving practices for proper, 100
storage in, proper, 100-101
chemical measuring and dispensing devices. See also automated chemical systems
accuracy, to ensure, 101
automated color kitchens, 185-186, 196-197
automated mix kitchens, 106, 107, 215-216
capabilities of, 106
curing systems, 106, 108-109, 185
maintenance of, 88
chemical mixing areas
automated chemical dispensing systems in, 215-216
cleanup practices in, 215
design features of, 101, 214
employee work practices in, 214-215
implements in, use of proper, 215
mix tank design in, 215
chemical specialties
BOD testing for, 103
builders (or handbuilders), 141
categories of, 138, 139, 140
obtaining information from vendors for, 147-148
packaging for, selecting, 149-150
for permanent press finishes, 141
pollutants and waste streams associated with, 137-138
pollution prevention ideas for, 137-138, 146-150
prescreening of, 103, 148-149
preventing hazardous waste from, 26-27
proprietary nature of, 138-139, 243
quality control for, maintaining, 149
softeners, 141
surfactants, 141-146
warp sizes, 140-141
chemical substitutions
BOD and COD of, 90, 92, 93
decision to use, factors affecting, 89, 92, 243
for formaldehyde-containing resins, 202-203
for handbuilders, 203-204
for hard-to-treat wastes, 32
for mothproofing chemicals, 207-208
for phosphates, 92-93
for softeners, 203
for solvents, 93-94
obtaining information on, 89-91
prescreening for commodities, 102-103
prescreening for specialties, 103, 148-149
rationale for, 88
types of, 91
Clean Air Act Amendments (CAAA)
air toxics under, major sources of, 11
hazardous air pollutants (HAPs) identified in, 44-46
impact on textile industry, 44, 46
cleaning and maintenance chemicals
control of, 97
environmental problems with, potential for, 97
examples of, 97
solvents, 97

color in dyeing wastewater
characteristics of, 34
fiber reactive dyeing in, role of, 35-37, 133
measurement of, 34
prevention and minimization of, 35-36
reduction through use of fixatives, 37
sources of, 34, 243

colour index for dyes, 136-137, 243
combing machine in natural fiber preparation, 4
consumer care of textile products, 105-106, 210, 211
continuous processes vs. batch processes in dyeing, 178-179 vs. batch processes in fabric preparation, 171-172 countercurrent washing for fabric preparation using, 175 dyeing with, described, 129 for dyeing knits, 109, 110 horizontal washers for energy and water conservation, 175 knit bleaching ranges for pollution prevention, 176 pollution prevention techniques for, 38, 185-188 quick-change padders for, 113, 114 salt needs for, 41
corporate policy on pollution prevention, 219-220, 241-242
cotton BOD and COD levels found in, 123-124 carding of, 4 combing of, 4 metal levels found in, 123-124 opening/blending bales of, 3-4 pollutants in, 122-124 pollution prevention in spinning of, 157-159 roving of, 4 salt use in processing of, 42 sorting and cleaning of, 4 spinning of, 4
design-stage planning for pollution prevention chemical prescreening, 102-104 chemical selection, 80-81, 196 for facilities, 83-84 globalization of, 81 machinery selection, 80 for printing, 195 for processes, 79-80 for products, 81-83 questions to ask in, 79 to reduce salt use, 42 standardization of pollution prevention efforts, 105 substitute mechanical processes for chemical processing, 81, 82-83, 147
desizing. See also sizing aquatic toxicity from, 164 BOD loadings from, 164 combined with scouring/bleaching in single-stage processing, 176-177 described, 163 fabric preparation: role in, 172 fiber lint and yarn waste from, 165 pollutants and wastes associated with, 163-165 pollution prevention measures associated with, 165-168, 172 with water-soluble vs. water-insoluble sizes, 172
dispersible wastes examples of, 31 pollution prevention principles for, 31-32 from printing, 193 risk assessment methods, role in, 244-245 sources of, 31-32
drafting. See roving dry capture in printing operations, 197
dyeing, pollution prevention measures for, 176 with batch processes, 183-185 better controls, implement, 191 chemical auxiliaries, minimizing use of, 186 with continuous processes, 185-186 dyebath reuse, 107-108, 189-191 dye fixation, improving, 186 pad-batch dyeing, 186-188 right-first-time dyeings, 186 with specific dyes, 180-183 water reuse, 191
dryer efficiency air pollution improvement from, 106-107 from humidity sensors, 110-111, 204 from incinerators, 111
dry spinning described, 4 fibers formed by, 4
effluent. See wastewater
electrolytes. See salts
energy savings. See also heat recovery
cold processes, by using, 99-100
examples of, 259, 264
by minimizing wet pickup, 94-95
environmental friendliness
choosing dyes for, 134-135
designing products for, 81
educating and influencing consumers with information
on, 105-106, 241
misrepresentations of, 104, 105
PRIMA system, comparing suppliers with, 210
Enviro$en$e bulletin board, 220
equipment maintenance
auditing, 86
checklists for, use of, 86-87
common defects, 87
printing operations, for pollution prevention in, 196
slashing operations, for pollution prevention in, 168
equipment for pollution prevention
automated mix kitchens, 107
built-in bath reuse on dye machines, 107-108
chemical dosing systems, 108-109
chemical recovery, 108, 109
compacting, 112-113
continuous knit dyeing ranges, 109, 110
control, automation, and scheduling management
systems, 109-110, 111
countercurrent washing, 110
heat recovery, 110
humidity sensors in drying, 110-111
incinerator dryer, 111
laser engraving of printing screens, 114
low add-on finishing, 114-116
low-bath-ratio dyeing systems, 111-112
pad-batch dyeing, 187
quick-change padders on continuous ranges, 113, 114
transfer printing, 113, 115
waste reclamation in spinning, 116
water recovery, 116
fabric preparation
alkaline waste streams from, 174
bleaching, 172-173
continuous vs. batch processes, 171-172
desizing, 172
equipment for preventing pollution in, 175-176
heatsetting, 173
mercerizing, 173
pollutants and waste streams associated with, 170-171
pollution issues related to, 171
pollution prevention strategies for, 170-171, 173-176, 177
right-first-time dyeings, role in, 186
scouring, 172
singeing, 173
fabric production, 1. See also carpetmaking; knitting;
weaving
cutting room waste from, 209
cutting, sewing, product fabrication, 208-210
pollutants and waste streams associated with, 168
pollution prevention ideas for, 168, 209-210
fats, oil, and grease (FOG)
in natural fibers, 122
from printing paste in wastewater, 193-194
in wool, 124
fiber reactive dyes
batch dyeing with, 36
described, 133
environmental concerns about, 133
high fixation techniques for, 37
pad-batch dyeing with, 113
poor fixation in, 36
fiber reactive print pastes
replacing urea in, 197-198, 199
shelf life of, 197
fibers. 11. See also manmade fibers; natural fibers
contaminants in, 122, 125-126
conversion into yarn, 5
dyeing of, 178
pollutants and waste streams associated with, 121-122
pollution prevention measures for, 121-122, 126-127
preparation of, 3-4
research and development for, 3
source of, 1
testing of incoming, 122
tow, 1
filters
proper maintenance of, 87-88
finishing, 1
atmospheric emissions from, pollution prevention for, 201
chemical alternatives for, 201-204
chemically imported characteristics, types of, 7, 11
chemical specialties for, use of, 140
cotton, cellulose; synthetic fibers, pollution prevention
for, 201-205
equipment to minimize pollution, 204
fabric design to minimize, 202
fabric handling to minimize, 202
liquid wastes, pollution prevention for, 200-201
with low add-on methods, 114-116, 204, 205
mechanical alternatives for, 74, 202, 204-205
optimization of processes for, 202
physical methods, types of, 7
pollutants and waste streams associated with, 199, 200
pollution prevention ideas for, 199, 200-208
solid wastes, pollution prevention for, 200
wool, pollution prevention for, 206-208
FOG. See fats, oil, and grease
globalization of pollution prevention, 105-106, 124, 134-135, 247
barriers to, 212
communication in, role of, 105-106, 212-214, 240-241
customer involvement for, 81, 82, 105-106
for dyeing operations, 176, 178
to minimize chemical processing, 212
need for, 211
participants in, 212
pollution prevention teams incorporate, 222, 223-229
for preparation processing operations, 212
for sizing and desizing operations, 146, 165
vendor involvement for, 105-106, 149
greige (or gray goods), 1, 128, 171

hard-to-treat wastes, 32
examples of, 32
pollution prevention strategies for, 32-33
from printing, 193
problems that arise from, 50-52
risk assessment methods, role in, 244-245
sources of, 32
treatability of, improving, 50
hazardous air pollutants (HAPs), 27
CAA, identified by, 44-46
design products to avoid, 48-49
specific to textiles, 46
hazardous wastes, 24
disposal of, 25
examples of, 33
generation and storage of, 24-25
handling and recordkeeping of, 26
policies for, 24
prevalence of, 24
from printing, 193
regulations for, 25, 26
risk assessment methods, role in, 244-245
from solvent coating operations, 25-26
sources of, 25-26
heat recovery, 110, 259, 264. See also energy savings
heatsetting in fabric preparation, 173
high-extraction, low-carryover processes
in afterwashing of prints, 196
devices used in, 96
offensive materials, recovery of, 96
process step separations, 95-96
wet-on-wet processing, 95
wet pickup, minimizing, 94-95
high-volume wastes, 33
examples of, 33
from printing, 193
risk assessment methods, role in, 244-245
incentives to practice pollution prevention
for companies, 239-241
for employees, 230, 235, 246
indoor air quality (IAQ) problems, 15
from drapery linings, 15
from drapery materials, 15
from finishing chemicals, 15, 16
OSHA rule for, 16
prevention of, 16, 210-211, 261
integration of producers
backward, 3
forward, 3
need for, 239
vertical, 172
ISO 14000 environmental standards, 239

knitting, 5-6
pollution prevention in, 169
warp, 1, 6
weft, 1, 6

looms
air-jet, 5
components of, 5
projectile, 5
rapier, 5
shuttle, 5
shuttleless, 5
water-jet, 5

machinery, 3-11. See also equipment for pollution prevention
management systems
for control, automation and scheduling, 109-110, 111
for real-time process monitoring and control, 116-118

manmade fibers. See also synthetic fibers; cellulose fibers
companies responsible for production of, 3
manufacture of, 4
types of, 11
markets for wastes. See also waste exchanges
as business opportunities, 241
development of, 97-98
from finishing operations, 200
from printing process, 196
for silver, 198

Material Safety Data Sheets (MSDS)
chemicals from typical finishes as listed in, 15, 16
chemical specialties, role in purchasing, 138-139
metal content, use in determining, 53
prescreening, use in, 26, 27, 49, 103
problem solving, use in, 147
toxicity of chemicals, use in determining, 59, 64
mechanical substitutions for chemical processing
compacting, 112-113
in finishing operations, 74, 201-202, 204-205
for knit designs, 82-83
to prevent hard-to-treat wastes, 32
in sizing operations, 166-167
types of, 81, 147

melt spinning
described, 4
fibers formed by, 4

mercerizing, 173
dye fixation, to improve, 186
fabric preparation, role in, 173
vat dyes, role when used with, 134
waterless, 74

metals in effluent
chemical sources of, 55-56
from cotton, 123-124
dyeing process sources of, 53-54, 179
dye source of, 62 63, 64, 180-183
from fabric preparation, 175
plumbing sources of, 55
pollution prevention strategies for, 56-57, 175
from printing, 194
synthetic and regenerated fibers, from processing of, 125-126

MSDS. See Material Safety Data Sheets

National Pollutant Discharge Elimination Standards (NPDES)
chloride limits of, 40
general discharge limits of, 17
pH limits of, 174
natural fibers. See also cotton; wool contaminants in, 122 preparation of, 3-4 sources of, 122 types of, 11
NPDES. See National Pollutant Discharge Elimination Standards

Occupational Safety and Health Administration IAQ rule, 15 openers in cleaning natural fibers, use of, 4 OSHA IAQ rule, 15 overmixing, 206

packaging bulk systems for chemical commodities, use of, 83, 100, 151-152 for chemical specialties, 100, 149-150 for salts, 42 for size, 16/
pad-batch processes as alternative for fiber reactive dyeing, 183 for combined single-stage processing, 176 vs conventional dyeing processes, 187 costs of vs. batch and continuous processes, 187-188 dye and equipment requirements of, 187 with fiber reactives, 70, 113 as pollution prevention measure, 186-188 salt needs for, 41 substituting for another process, 32 pentachlorophenol (PCP) levels in carpets, 124 levels in wool, 124-125 pesticide residues from cotton, 122-124 from wool, 124-125 plied yarns, formation of, 5 Pollution Prevention Information Clearinghouse, 220 pollution prevention of air pollution air emissions from printing operations, by minimizing, 196, 197 air pollutants from finishing operations, by minimizing, 201 audit information for, 235-236 boiler operations for, optimizing, 49 by chemical auxiliary elimination, 49 chemical prescreening for, 49, 102-104 chemical and process alternatives, by using, 256 emerging technologies, by investigating, 50 fiber prescreening for, 49 hydrocarbon release from printing operations, by minimizing, 193 by product design examination, 48-49 by quality control assurance of incoming fibers, 126-127 solvent processing operations, by improving, 49-50 by source identification and emissions quantification, 49 by spill prevention, 50 solvent recycling for, 257, 265 strategies for, 15-16 trapping bulk storage tanks for, 49 pollution prevention of hard-to-treat wastes by chemical or process substitution, 32 employee work practices, by improving, 33 process control and optimization, by improved, 33 treatability, by improving, 50-52 by waste segregation, capture, and reuse/recycle, 33 pollution prevention of hazardous waste barriers to, 243-244 chemical and process alternatives, by using, 256 prescreening chemicals for, 26, 102-104 rationale for, 24 by recycling solvent, 265 screening and reviewing processes in, 27 strategies for, 26-27 testing raw materials for, 27 pollution prevention of indoor air pollution considerations for, 210 consumer issues for, 211 strategies for, 16, 105-106, 261 pollution prevention for salt reduction by batch dye bath reuse, 44 low bath ratios, by using, 40-41 by optimizing salt use, 41-42, 43 by process design, 42, 43 by product design, 42 by proper handling, 42 pollution prevention of solid wastes for ash and sludge, 21 for bags, 21, 24 by cost factor evaluation, 22, 23 by disposal, 22 for drums, 21, 24, 200, 252-253 for fibers and fabric, 200 general focus of, 20 by marketing of wastes, 260 for miscellaneous items, 24 for packaging materials, 21, 149, 252-253, 262 for pallets, 23, 252-253 for paper and cardboard, 21, 23 for processing wastes, 21-22 by recycling, 22, 252-253 by reuse, 22, 197 by source reduction, 22 waste management practices in, use of, 22-23 pollution prevention of water pollution by aquatic toxicity reductions, 61, 64, 261 barriers to, 243-244 bulking and poor settleability, by reducing, 51 by chemical prescreening, 102-104, 139, 146, 251, 266, 270, 271 chemical and process alternatives, by implementing, 256, 263 by chemical recovery and reuse, 100, 109, 257, 265, 269 color in wastewater from batch dyeing, by reducing, 38 color in wastewater from continuous dyeing, by reducing, 38 drum washing, by eliminating, 201 dyebath exhaustion, by maximizing, 35, 251 dyebath reuse, by implementing, 72, 107-108, 189-191, 250, 254

296
by dye handling, equipment cleaning, and housekeeping techniques, 36
fixation and washoff, by maximizing, 35
metals in effluent, by reducing, 56-57, 124, 271
pass-through of nondegradable materials, by reducing, 52
priority areas for, 20
by process water reuse, 70-72, 191, 252-253, 255, 268
by quality control assurance of incoming fibers, 126-127, 251
respiratory inhibition, by reducing, 51
salts in wastewater, by reducing, 40-44, 113
shock loading, by reducing, 52
sludge contamination, by reducing, 51
targets for, 17, 19
treatability, by improving, 50-52
permit limits, role of, 17-19
by waste stream segregation, 106
water conservation techniques, by implementing, 67-74, 258, 263, 264, 266, 268
work practices/scheduling, by using sound, 38, 267
pollution prevention programs, characteristics of coordinator, 220
employee commitment, 77, 219-220
long-term commitment, 78
management commitment, 77, 219-220, 241-242
standardization, 105
team to lead, 220-221
pollution prevention programs, responsibilities of action plans, developing, 222, 230-231
costs of specific techniques, evaluating, 235
documenting accomplishments, 78
employee input, encouraging, 88, 230
general strategies, 78
high-technology approaches, 78
implementing strategies, 219
low-technology approaches, 77-78
pollution prevention plan, development of, 221
process mapping, 221-222, 223-229
proper scheduling, 104
right-first-time production, 79
risks/liabilities of managing waste streams, evaluating, 235, 244-246
setting goals for, 222
technical feasibility of specific techniques, evaluating, 234-235
waste auditing, 231-238
waste minimization techniques, monitoring, 235
waste reduction techniques, choosing, 233-235
POTW. See publicly owned treatment works
printing, 6.
color in wastewater from, 38
direct, 6
discharge, 6, 192, 194
dispersable wastes from, 31, 193
heat-transfer, 6
ink jet, 118, 195
jet, 6
laser engraving of screens for, 114
pollutants associated with, 47-48, 191, 192-193
pollution prevention by minimizing oil/hydrocarbon discharge, 193-194
pollution prevention practices for, 191, 195-199
pollution prevention strategies for, 193-195
resist, 6
silver in, use of, 198
techniques, 191-192
toxic air emissions from, 47-48
transfer, 113, 115, 194-195
warp, 6
process alternatives
cold batch processes, 99-100, 176, 186-188
design stage planning, 79-81
examples that can reduce pollution, 99, 147
to improve control, 106-107, 109-110, 111
mechanical substitutions for chemical processes, 81, 112-113, 147
to minimize pollution from sizing operations, 100-107
to minimize WPU, 94-96, 205
powder coatings to replace solvent-based coatings, 98-99
to prevent hard-to-treat wastes, 32
process flow diagram. See process mapping for pollution prevention
process mapping for pollution prevention, 221-222, 223-229
publicly owned treatment works (POTW)
limits imposed on, 38-39
pH limits imposed by, 174
surcharges imposed by, 19, 20, 93, 242-243
wastewater directed to, 17
quality control. See also raw material quality control of chemical commodities, 151
chemical prescreening for, 102-104
of chemical specialties, 149
of fibers for contaminants, 122, 124, 126-127
with formal evaluation structures, 104
of raw materials, 27, 96-97, 173-174
of sizing operations, 146, 167
standardization of, 105, 213
testing as key to purchasing procedures for, 100
of warp size and yarn, 167
of wool, 124-125
raw material quality control
as a pollution prevention strategy, 96-97, 173-174
prescreening chemicals for, 100, 102-104
with formal evaluation structures, 104
for warp size, 167
regenerated fibers
pollution concerns for, 125-126
types of, 125
research and development, 3, 237
risk assessment methods, 244-246
roving
in natural fiber preparation, 4
salts, 38-39
dyeing processes, use in, 39-40
from fiber reactive dyes, 133
pollution prevention practices for reduction of, 40-44
quantities used in textile operations, 38, 39
regulatory status of, 40
requirements for various dye classes, 41-42
sources in wastewater, 39
types used in textile operations, 39
scheduling
with automated systems, 106-107
of dyeing operations for pollution prevention, 38, 104
of finishing operations for pollution prevention, 206
of sizing operations for pollution prevention, 167
scouring
fabric preparation, role in, 172
pollution concerns with, 172
singeing, pollution potential, 173
sizing. See also desizing
application of, 5
auxiliary chemicals used for, 140, 163
chemical recovery from, 108, 109, 165-166
described, 160-161
equipment used in, 161
pollutants and waste streams associated with, 159-160
pollution prevention measures for, 146, 159-161, 165-168
primary components of chemicals used for, 161-163
recycling/recovery of size, 165-166
semisynthetic products for, use of, 140
starch for, use of, 140, 162
synthetic products for, use of, 140
warp sizes used in, 140-141, 161-163
wastes generated by materials used in, 164-165
slashing. See sizing
silver
described, 4
role in combing, 4
sludge
contamination of, 51-52
hard-to-treat wastes that pass through treatment systems, 193
metals from natural fibers in, 122
solid waste, as component of, 20, 21
solid wastes, 20
cutting room waste, 208-209
pollution prevention of, 159
pollution prevention practices to reduce cutting room waste, 209-210
from spinning operations, 156-157
sources of, 20-22
types of, 20, 21
solvent
chemical substitutions involving, 93-94
pollution prevention for cleaning agents, 97
pollution prevention for solvent-based coating systems, 98-99
processing operations for, improving, 49-50
spinning operations. See also dry spinning; melt spinning; wet spinning
additives from, 157, 159
toothable-cause waste from, 156
fiber waste from, 156
long staple system in, 155
in manmade fiber manufacture, 4
in natural fiber preparation, 4
pollutants and waste streams associated with, 153
pollution prevention ideas for, 153
pollution prevention in short staple system, 157-159
pollution prevention of solid waste from, 159
process waste from, 156
short staple system, 155-156
solid waste from, 156, 159
waste reclamation from, 116, 157, 159
Standard Industrial Classification (SIC). See categorization of textile industry
standardization of pollution prevention efforts
by incorporating ISO 14000 standards, 239-240
need for, 105
for tests, methods, definitions, 105
staple
cutting of filament yarns into, 154
role in yarn spinning, 1, 5, 155
surfactants
amphoteric, 143
anionic, 142-143
aquatic toxicity of, 145-146, 174-175
biodegradability of, 144
BOD and COD of, 144-145, 174
cationic, 143
chemical specialty formulations, use in, 141
nonionic, 142
pollutant properties of, 143-146
pollution prevention ideas for, 64, 146-147, 175, 195-196
scouring, use in, 172
as toxic compounds, 61-64
uses of, 141, 143
synthetic fibers
contaminants in, 126
manufacture of, 4
pollution concerns for, 125-126
types of, 125
technology transfer of pollution prevention activities, 237
textile facilities
gеographic distribution of, 2
types of, 2
textile products
types of, 11, 12-14
value of shipments for, 1, 14
texturizing
of manmade fibers, 4
of spun yarns, 5
throwing in the production of filament yarns, 5
total quality management, 219, 239
total suspended solids (TSS)
calculating sewer fees, role in, 242-243
handbooks, levels from, 141
raw textile dyeing wastewater, levels in, 17
training
for chemical handling, 33, 101, 214-215
formalized employee education, use of, 85-86, 236-237, 246-247
for slashing operations, 167
as key to pollution prevention program success, 84-85, 230, 236-237, 246-247
as tool to involve employees, 84-85, 219-220, 236-237
TSS. See total suspended solids
tufting, 6

ULLR. See ultra low liquor ratio dyeing systems
ultra low liquor ratio (ULLR) dyeing systems
bath ratio with, 111-112
conserving salt by, 40-41
costs of, 185
pollution prevention with, 183-185

volatile organic compounds (VOCs)
eliminating emissions from solvent-based coating systems, 98-99
from heatsetting, 173
from installation and aftermarket treatments, 210
from solvents, 93
sources of, 46-48

warp yarns
role in weaving, 5
sizes applied to, 140-141, 160

waste audits. See also audit
approach to, 231
background information for, collecting, 232
forms and lists in, use of, 236
information gathered by, 233, 234
need for, 231
plant survey for, conducting, 232, 233
of sizing operations, 167
of solid waste, 22
waste stream sampling for, 232
for water, 64-65

waste exchange. See also markets for wastes
advertising for, 23
benefits of, 97-98
examples of materials for, 98

wastewater
aquatic toxicity of, 57, 125-126
audit of, 17
BOD and COD of, 125-126
characteristics of, 16-17
color residues in, 34-37
hard-to-treat wastes in, problems from, 50-52
mothproofing in, pollution prevention for, 207-208
metals in, 52-56, 125-126
multiple water handling systems for, 84, 106
permitted discharges of, 17, 19
Priority Pollutants list for, 57, 58-59
quantities of, 16, 17-19
recovery and reuse of, 116, 174
segregation and capture of, 84, 106
sources of, 66
surcharges applied to, 19, 20, 147, 242-243
water conservation possibilities for, 65-67
waste conservation
calculating sewer fees, role in, 242-243
in continuous dyeing operations, 186
countercurrent washing for, 67-68, 110
dye equipment for, 107-108
in dyeing operations through water reuse, 191
in fabric preparation procedures, 174
low carryover washing for, 68
in printing operations, 196, 199
rationale for, 64-65
recovery of water for, 116
reuse for cleaning, 68-69
strategies for, 67-74
types of wastewater offering possibilities for, 65-67
water pollution, 16-20. See also wastewater
wet pickup (WPU)
low add-on finishing to reduce, 205
reason to minimize, 94, 95
saturation/expression process to reduce, 94
wet spinning
described, 4
fibers formed by, 4
weaving
of warp yarns, 5
pollution prevention in, 168-169
wool
cardiing of, 4
combing of, 4
chrome dyeing for, 180-183
mothproofing of, 96, 207-208
opening/blending bales of, 3-4
PCP levels in, 124-125
pollutants in, 124-125, 206
pollution prevention practices in finishing of, 207-208
roving of, 4
sorting and cleaning of, 4
spinning of, 4

yarn production
filament yarns, 1, 5, 153-154
pollutants and waste streams associated with, 152-153
pollution prevention ideas for, 152-153
spun yarns, 5, 154-155