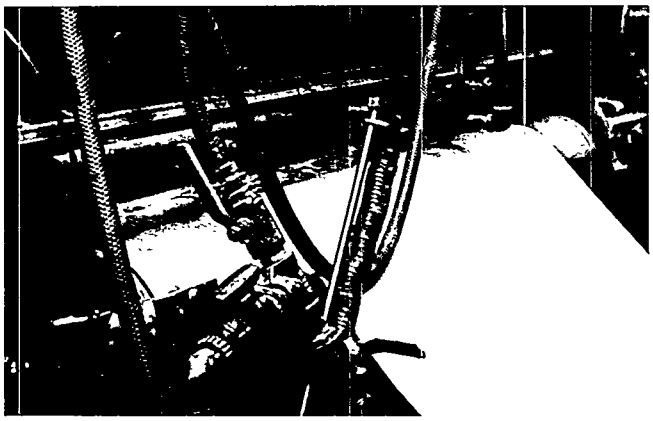

*Foam processing prompted the development of other technologies that reduce energy consumption in textile sizing, dyeing, printing, and finishing processes.*

In 1989, 69 dye units used one or more of these innovations, saving 0.25 trillion Btus. Energy savings in 2010 are projected to be 7.6 trillion Btus.

## Solid-on-Solid Processing

Eliminating liquids in applying finishes and colorants to textiles can drastically reduce the drying requirement, which currently accounts for half of all energy consumption in the textile industry. Three new electrostatic powder concepts could help bring this about. The new processes, successfully demonstrated at bench scale, allow the dry application of chemicals to textile materials. DOE funded the research conducted by Electrostatic Technologies of Connecticut and Nordson of Ohio in cooperation with the Georgia Institute of Technology.

The solid-on-solid processing technique uses powdered chemicals containing a thermoplastic polymer. The chemicals are deposited on the textiles through electrostatic attraction. The low heat capacities of the dry polymeric powders allow rapid heat transfer in the curing ovens. This process avoids the use of extraneous liquids in the chemical application process, thus reducing energy consumption and increasing process speeds. Researchers at the Georgia Institute of Technology estimate that if half the textile industry were to convert to solid-on-solid processing (where appropriate), energy savings would amount to about 10 trillion Btus per year.

## Foam Processing

In conventional wet processing of textiles (e.g., desizing, bleaching, dyeing, printing, and finishing), water is used to distribute pigments or other chemicals throughout the fabric. Wet processing is energy intensive because the fabric is repeatedly wetted and dried, and drying requires large amounts of thermal energy.

Working with United Merchants & Manufacturers, DOE developed a more energy-efficient process and has seen it through laboratory investigations, pilot plant trials, and commercial production. The process replaces some of the water with foam in the dyeing, printing, and finishing of a variety of fabrics, thereby reducing the energy required for drying, reducing water consumption and pollution control requirements, and increasing plant productivity.

Foam processing has led the way for the development of several low- and medium-wet pick-up processes (e.g., squeeze roll, spraying, and kiss roll coaters) that have been successfully implemented by the textile industry. In 1989, more than 550 million square yards of carpet and more than 2 billion linear yards of broad woven and knit fabrics were processed using these technologies, saving 1.37 trillion Btus. Low- and medium-wet pick-up processing could save about 33.6 trillion Btus per year by 2010.

## Hyperfiltration in the Textile Industry

Textile industry scouring, bleaching, and dyeing processes produce hot water waste streams containing dyes and other chemicals. The heat content and chemical content of this contaminated wastewater is usually lost when it enters the plant's wastewater cleanup system.

With support from DOE, EPA, and the U.S. Department of the Interior, Carre, Inc. developed a hyperfiltration technique that uses a pressure-driven membrane to separate the hot water, dyes, and other chemicals for direct reuse in textile processes. The hyperfiltration unit consists of zirconium oxide polyacrylate membranes dynamically formed on the interior of sintered stainless steel support tubes. The unit was designed to recycle 90% of the dye wash water in a continuous dye range at a process temperature of 185°F and remove 97% of the color.