has avoided coal-fired steam systems in general, due to environmental cleanup costs and plant problems connected with coal handling and firing. To change this trend, DOE co-funded the design, installation, and evaluation of an innovative, 4.1 MW high-back-pressure steam cogeneration system with Riegel Textile Corporation at one of the firm's textile plants. The new system uses a coal-fired boiler, modified to solve retrofitting space problems, to generate steam that powers a turbine to produce electricity. The turbine exhaust steam temperature is high enough to be used in existing mains for process heat requirements and for space heating. The system achieved net energy cost savings of $250,000 per year. Five such systems operated in 1987, saving approximately 2.15 trillion Btu per year.

Beck Dyeing Modifications

A large amount of textile material and carpet is batch dyed in a "beck", a large stainless-steel tub vented to the atmosphere. The conventional dyeing process is to load the beck with undyed textile or carpet, fill it with water, add the necessary chemicals and dyes, and bring the water to a boil by steam injection. Once the boiling cycle is satisfactorily completed, the used dye-bath solution is discharged as waste and the beck refilled with water to rinse the carpet or other textile. After the load is rinsed, the used water is discharged. As a result of a DOE program conducted in cooperation with Georgia Institute of Technology, Salem Carpets, Inc., and Adams-Millis, three types of modifications that reduce the amount of energy, water, and materials used in conventional dyeing have been tested. These modifications are bump-and-run, dye-bath reuse, and hot pull. The bump-and-run modification eliminates much of the conventional energy loss by reducing the demand for steam in the dyeing process. Dye-bath reuse involves recycling the spent dye bath after it is reconstituted. The spent dye bath is analyzed to determine the amount of dye remaining, and additional dye is added to obtain a desired color. Small amounts of auxiliary chemicals are also added to replace those lost in the dyeing process. Hot pull is a handling procedure that increases the attractiveness of dye-bath reuse by eliminating the final rinse step in conventional processing, thus minimizing handling of the spent dye bath and saving the water used by the final rinse. In 1987, 69 dye units used one or more of these innovations, saving 0.25 trillion Btu. Energy savings in 2010 are projected at 7.6 trillion Btu per year.

Energy-Efficient Fertilizer Production

Fertilizer production is energy intensive. A prototype reactor that substantially reduces energy use in producing many fertilizers was developed by the Tennessee Valley Authority with financial support from DOE. The prototype reactor has a pipe-cross configuration within which raw materials are processed to produce fertilizer. In this design the reactor process heat, in conjunction with increased air flow, causes the final product to have less than one percent moisture, reducing or eliminating the thermal drying function required for conventional fertilizers that contain 5 to 7 percent moisture before drying. Ten of these innovative reactors are now in operation in the fertilizer industry, saving about 0.17 trillion Btu per year. Projected annual savings in 2010 are 5.4 trillion Btu.

Foam Processing

Conventional wet processing of textiles (e.g., desizing, bleaching, dyeing, printing, and finishing) uses water to distribute pigments or other chemicals throughout the fabric. Wet processing is energy intensive since 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 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