Best Practices

BestPractices
Technical Case Study

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OFFICE OF INDUSTRIAL TECHNOLOGIES

ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Benefits

- Saved more than $165,000 annually
- Increased throughput by 37%
- Reduced energy consumption per unit of production by 38%

Applications

Adding heat recovery from "waste" streams can improve the performance of many industrial thermal processes. Applications like these are found throughout the manufacturing sector, particularly in the process industries.

Plant Utility Improvements Increase Profits and Productivity at a Clothing Manufacturing Complex

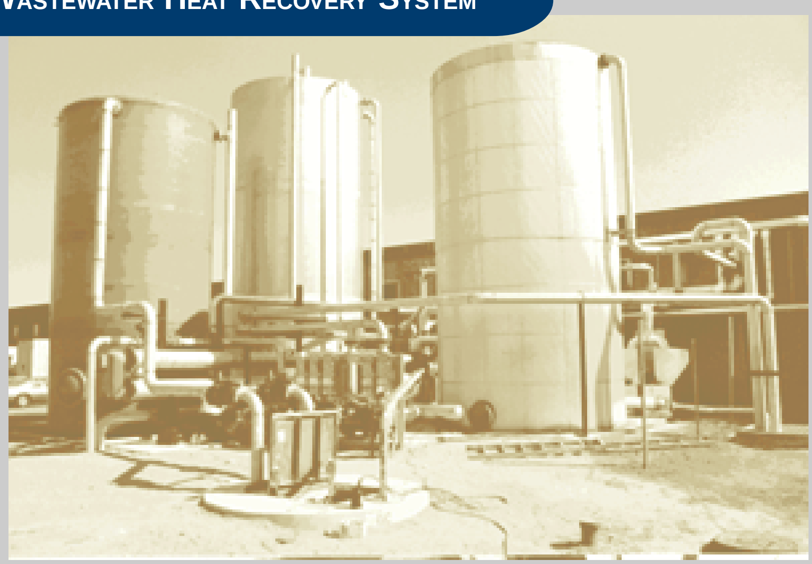
Summary

In response to increased marketplace competition and the need for expanded production capacity, MJ Soffe's manufacturing facility in Fayetteville, North Carolina implemented several energy improvement projects, including:

- Improving its steam system by increasing the amount of heat recovered and lowering the system pressure
- Implementing a steam trap maintenance program
- Establishing a motor purchase and replacement program
- Improving the compressed air system

As a result, MJ Soffe reduced its energy consumption per unit of production by 38% and increased its throughput capacity by 37%. Altogether, the improvements to the plant led to $165,000 in annual energy savings.

Wastewater Heat Recovery System



Company Background

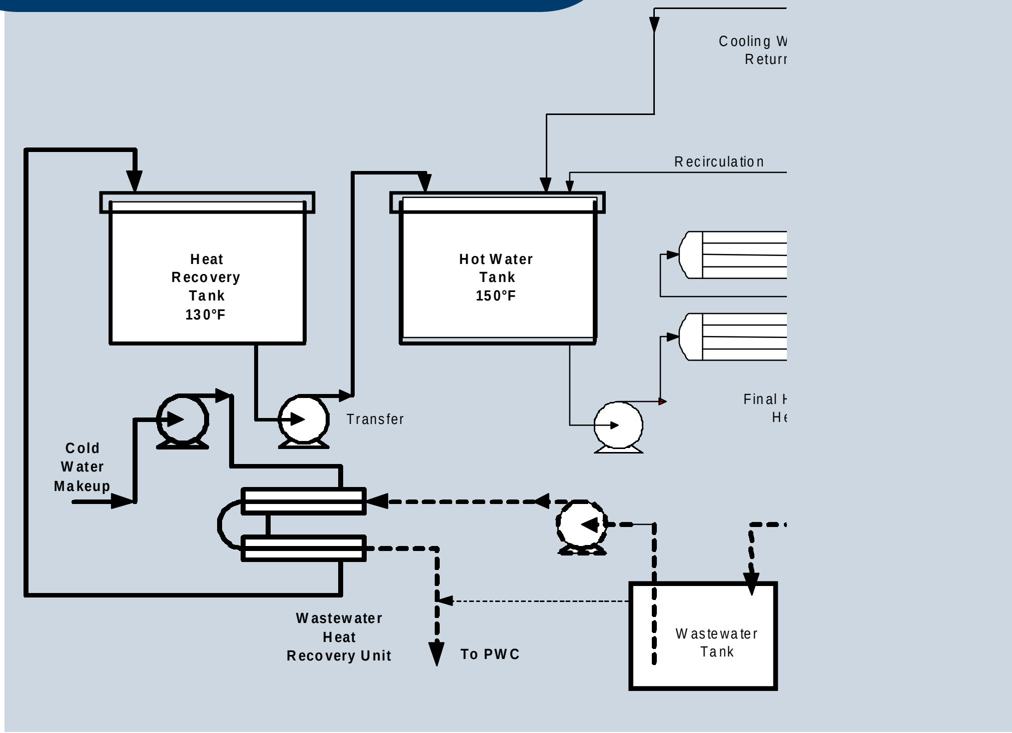
MJ Soffe produces a variety of athletic clothing and furnishings. The company distributes its products in retail and wholesale markets as well as directly to sports teams and athletic organizations around the country. Although MJ Soffe has several sewing and warehouse facilities around the country, the Fayetteville facility is its largest and most integrated manufacturing plant. Despite increased marketplace competition, the company has had to expand production capacity to keep up with the demand for its products.

Plant Overview

The Fayetteville manufacturing facility is highly vertically integrated, performing most of the tasks that make finished apparel out of basic textile materials. This level of integration affords control over throughput and quality, but requires production flexibility due to differences in the types of goods produced. For example, switching fabric types requires changing production temperatures, which affects the demand on the steam system as the operating conditions ramp up or down to the proper settings.

Fabric dyeing is an important part of MJ Soffe's manufacturing processes. Consequently, steam system performance has a large impact on plant productivity. Important operating characteristics of the steam system include adequate heat delivery, reliability, and responsiveness. Motor and compressed air systems are also essential to several production processes. As

Wastewater Heat Recovery System



part of an effort to achieve competitive advantages through lower costs and higher productivity, MJ Soffe assessed its steam, motor, and compressed air systems for improvement opportunities.

Project Overview

The apparel industry is highly competitive, motivating MJ Soffe to search for ways to reduce operating costs. After attending energy efficiency workshops, staff at MJ Soffe decided to target energy as a potential area for cost reduction. Because energy is a large portion of their operating costs, MJ Soffe assessed its energy use and identified opportunities to improve energy conservation and plant productivity. Following the energy assessment, MJ Soffe found cost improvement opportunities in three principal systems: steam, motors, and compressed air.

Steam and Wastewater Heat Recovery System

Upon review of steam system performance, MJ Soffe staff realized that the water heating system could not keep up with many of the production surges. During these surges, the facility was forced to dump large amounts of used hot water (up to 90,000 gallons per day at a cost of $3.85 for each thousand gallons, including wastewater treatment). This energy loss forced the steam system to work hard to meet process heating needs, requiring a steam pressure of 125 psig. At this pressure, steam and condensate losses were high due to leaks, steam trap failures, and relief valve releases, and the boiler operated around 100% of its rated capacity. In fact, to accommodate expanded production capacity, MJ Soffe installed an additional 700-hp boiler (the same capacity as the original boiler).

The loss of steam, hot wastewater and condensate is costly in terms of both chemicals and energy. The chemical costs result from having to use additional makeup water, which must be treated to protect the boiler and steam piping. Additionally, because makeup water is typically cooler than returning condensate, it requires more energy to convert to steam. Large amounts of cool makeup water can significantly lower the temperature of the feedwater reaching the boiler, which increases thermal stresses in the boiler, shortening its life. The combination of high operating loads and cold feedwater caused cracks in the boiler tubesheet.

MJ Soffe made several heat and condensate recovery improvements. A new wastewater heat recovery system was installed, reducing the amount of waste heat lost during production. The systems that supported heat recovery heat exchangers included new pumps, piping, instruments, and controls. The facility also made several improvements to the condensate recovery system. By replacing corroded pipe and reconfiguring certain portions of the system, more condensate was returned to the boiler rather than discharged to the wastewater treatment system.

MJ Soffe also performed a steam trap audit, identified several failed traps, and implemented a formalized steam trap maintenance program. Depending on the mode of failure, failed traps can significantly increase energy losses and condensate line pressure, causing water hammer, relief valve release, and stress on the condensate system. To minimize the risk of an undetected trap failure, MJ Soffe established a program that tagged and recorded all the steam traps and scheduled their inspection and testing.

The combined effects of these improvements reduced the load on the boiler. Because less steam was required to maintain the necessary process temperatures, one boiler could operate at 85% of rated capacity and the steam header pressure was lowered to 91 psig. High steam pressure increases the stresses on the steam and condensate piping. High condensate system pressures can increase condensate losses through leaks and relief valve releases. Reducing the system pressure extended system operating life and trimmed plant operating costs.

Motor System

MJ Soffe also implemented a formalized motor purchase and replacement policy that used a motor management software program, *MotorMaster+*, to evaluate the feasibility of purchasing energy-efficient motors. This policy increased the number of energy-efficient motors in service, which improved the average power factor from 85.9% to 86.6%.

Compressed Air System

An audit of the compressed air system identified air leaks and unused capacity between two separate compressed air systems. Previously, two compressors, one 75-hp and the other 50-hp, served the knitting process, although the 50-hp unit was only being used as a backup. A single 50-hp compressor served the dyeing process. By joining the systems, Soffe was able to shut off the 75-hp compressor and use the backup 50-hp unit, resulting in more efficient operation.

Project Results

MJ Soffe achieved lower operating costs and better performance from its energy improvement projects. Total annual savings from the projects exceed $165,000, and other benefits include increased reliability and throughput. Results from each system are detailed below.

Steam and Wastewater Heat Recovery System

The new system requires 38% less energy, resulting in annual fuel cost savings of more than $140,000. The investment in the heat recovery system was $381,000, making the payback period 2.7 years. The new wastewater heat recovery system also increased dyeing capacity by 37%. This productivity increase allows more rapid order turnaround, providing an important competitive advantage.

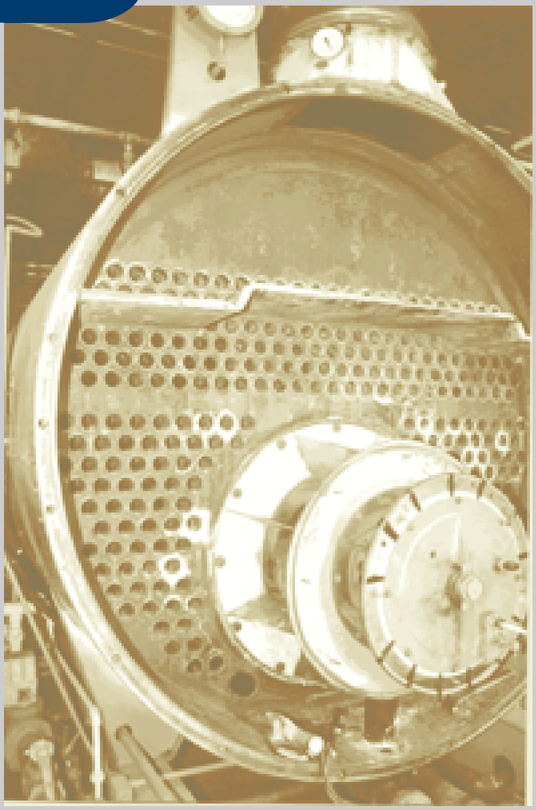
System improvements reduced the steam demand such that one boiler can handle the steam requirements. This boiler operates at 85% capacity instead of at 100% capacity. The second boiler provides redundancy, which is particularly important considering the stress endured by the original boiler. Although the original boiler was installed in 1992, operating it at high capacity with low feedwater temperatures caused it to crack (see photo below).

Reducing the system pressure from 125 psig to 91 psig reduced stress on components such as the boiler, the piping, and the feedwater pumps and decreased the loss of steam and condensate. Additionally, the combination of a steam trap maintenance program, leak repairs, and lower system operating pressure reduced makeup water use. As a result, treatment chemical use decreased by 50%.

Motor Systems

After implementing the energy-efficient motor purchase and replacement policy, the average power factor for the plant increased from 85.9% to 86.6%. Because the electric utility assesses a penalty when this power factor is below 85%, the program has reduced the risk of incurring this charge. Energy savings associated with the energy-efficient motors was not measured.

BOILER



The boiler failed after 6 years even though its normal life expectancy is 20 to 30 years. Because the repair costs $23,800, preventing early failures decreased yearly repair costs by 70% (from $3,967 per year to $1,190 per year).

Compressed Air

The increased efficiency of the compressed air system resulted in annual energy savings of $10,800 (180,000 kWh). The air system is also more reliable because the 75-hp air compressor is available for backup use. Because of its new configuration, the compressed air system requires less maintenance.

Lessons Learned

As with many energy efficiency projects, MJ Soffe realized benefits that are not limited to cost savings, but also include improved performance and reliability. By recovering heat from its process heating services, MJ Soffe reduced the load and the stress on its steam system. Since the steam system was a constraint to the dyeing tasks, improving steam system performance increased the capacity of the dyehouse, which increased the overall capacity of the plant. MJ Soffe used a similar approach to improve its compressed air and motor systems, achieving better efficiency, lower maintenance, and greater reliability.

BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small and medium-size manufacturers.

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