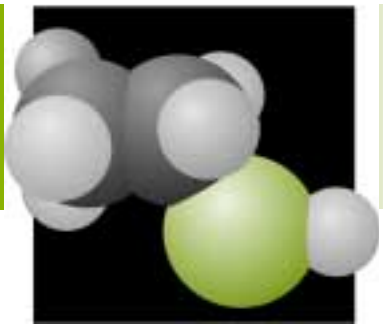
CHEMICALS

A Steam System Technical Case Study



INDUSTRIES OF THE FUTURE
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Energy Smart Technology for Today

Benefits

- Saved over $80,000 annually
- Saved 27,308 million Btu annually
- Reduced annual CO_2 emissions by 2,400 tons
- Reduced annual consumption of treatment chemicals by 1,000 pounds, saving over $20,000 per year
- Decreased worker exposure to treatment chemicals
- Reduced make-up water use by 56%

Applications

Improving steam trap maintenance practices can increase the performance of almost any steam system. Steam systems are found throughout industry and consume a significant portion of the energy used at manufacturing plants.

Improved Steam Trap Maintenance Increases System Performance And Decreases Operating Costs

Summary

Environmental responsibility and competitive operating performance are important goals of Velsicol Chemical Corporation. As many other companies have learned, these goals can be concurrently achieved by seeking out avoidable energy losses and taking reasonable steps to minimize them. Velsicol's Chestertown, Maryland, facility implemented an improved preventive maintenance (PM) program that identified energy losses in their steam system. Implementing this PM program cost $22,000, reduced energy consumption on a per production unit basis by 28%, and had a payback of just over 2.5 months. The plant received a 1997 Chemical Manufacturers Association Energy Efficiency Award for the project.

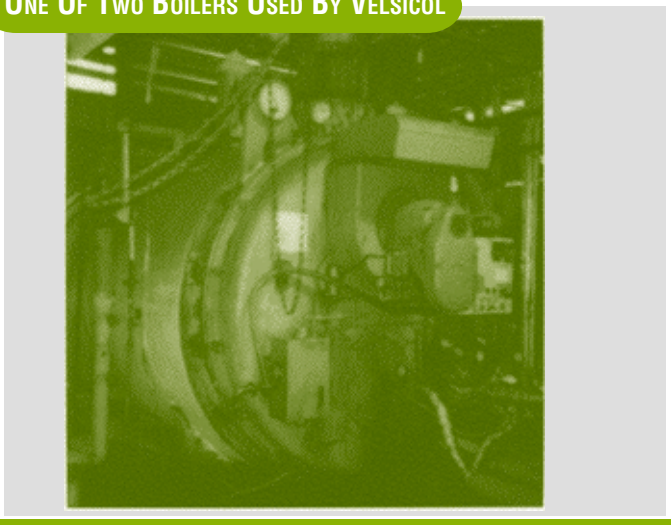
Company Background

Velsicol Chemical Corporation is a mid-size specialty chemical company. Velsicol's four U.S. facilities produce around 200,000 tons of specialty chemicals annually. The Chestertown facility produces about 25,000 tons, or 12.5%, of Velsicol's total U.S. production.

Project Overview

Velsicol's participation in the Responsible Care Program of the Chemical Manufacturing Association has motivated their search for opportunities to improve employee safety and increase environmental performance.

One Of Two Boilers Used By Velsicol



After Chemtreat, Velsicol's chemical treatment supplier, suggested the facility's chemical use was high, plant personnel evaluated steam system performance and realized there was room for improvement. The steam system energy efficiency was somewhat low due to steam trap failures that created system performance problems and resulted in the loss of condensate. The loss of condensate required the addition of make-up water, which increased system energy consumption.

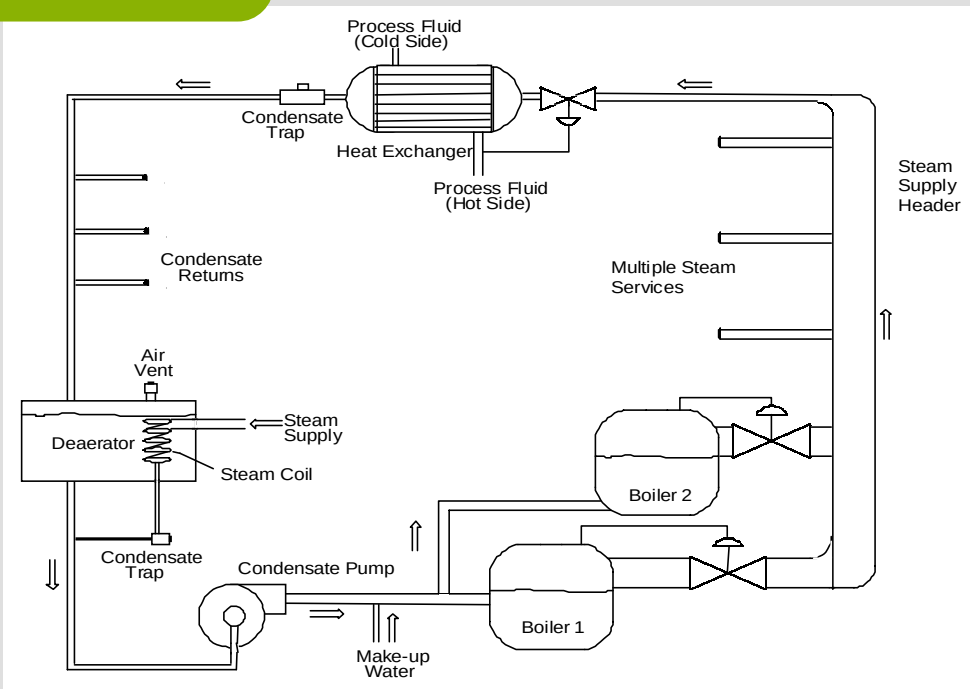
Velsicol implemented a program that inventoried the plant's steam traps, trained system operators to identify failed traps, and improved communication between maintenance and production personnel so that failed traps were quickly repaired or replaced. This program also identified traps that were improperly sized or were of the wrong type, and planned their replacement.

The results of this program were impressive. By improving heat transfer within the system heat exchangers and by reducing condensate loss, Velsicol lowered their energy use and reduced their use of treatment chemicals. This reduced material costs, labor requirements, and reduced worker exposure to treatment chemicals.

Project Team

The Project Team included operations, process, maintenance and engineering staff from Velsicol, as well as staff from Chemtreat and Velsicol's steam trap supplier, Spirax Sarco.

Steam System Diagram



The Old System

The steam system at the Chestertown facility is powered by 2 boilers and has over 300 traps, most of which are thermostatic types. The previous preventive maintenance program allowed many steam trap failures to go undetected. Depending on whether a steam trap failed shut or open, the steam system suffered two principal consequences. Steam traps that failed shut caused condensate to backup and flood the upstream heat exchanger, reducing heat transfer within the heat exchanger and increasing cycle time. To correct this condition, operators manually opened bypass lines to dump condensate into the drainage system.

Steam traps that failed open allowed steam to directly enter the condensate return system, increasing the pressure in the condensate lines. As line pressure increased, less condensate was able to enter the condensate return system, which further aggravated drainage problems from some heat exchangers. Eventually, condensate line pressure increased, forcing a relief valve to lift, dumping more condensate into the drainage system. In both cases, lost condensate required the addition of make-up water to the system.

In most steam systems, returning condensate contains a large amount of energy. At Velsicol, the condensate contains about 21% more energy than the make-up water. Consequently, the loss of condensate significantly increased system fuel consumption. Additionally, since make-up water must be treated with chemicals to maintain the necessary corrosion protection and anti-scaling properties, the loss of condensate increased the use of costly treatment chemicals and added a burden on the plant's in-house wastewater treatment facility.

The New System

Recognizing the large energy loss associated with make-up water use and the impact of heat transfer problems on production, Velsicol implemented a formalized steam trap preventive maintenance program that used ultrasonic instruments to inspect steam traps at regular intervals. Velsicol trained maintenance and production operators to help them identify failed steam traps. Operators, now aware of the costs associated with improper steam trap operation, respond to indications of trap failure. In doing so, Velsicol has also improved internal communication between production and maintenance personnel, facilitating quick correction of steam trap problems once they are found.

As part of Velsicol's plan to increase steam system performance, a process engineer inventoried over 300 of the system's steam traps. During this effort, many of the traps were found to be improperly sized or were of the wrong type. Trap replacement was planned and performed so that it did not interfere with plant operation. A key objective of this approach was to improve system performance while concurrently reducing energy and treatment chemical consumption.

Results

By formalizing steam trap inspections, training production personnel to identify poor steam trap operation, and increasing awareness of steam trap failure costs, Velsicol reduced annual energy consumption by 27,308 million Btu—a 17% decrease. These energy savings are even higher when adjusted for changes in production. On a Btu per pound of production basis, Velsicol reduced their energy consumption by 28%. Annual fuel costs were reduced $80,000. Energy savings translated to an annual 2,400-ton reduction in CO_2 emissions. Additional benefits included a 56% reduction in the use of make-up water. This reduced annual consumption of treatment chemicals by 1,000 pounds, saving over $20,000 per year. Furthermore, this reduced the burden on the wastewater treatment plant and reduced worker exposure to the treatment chemicals. Also, by eliminating 37 fuel truck shipments, Velsicol improved plant safety and reduced the risk of spills.

Lessons Learned

Steam systems are often overlooked as a source of operating cost improvements. However, steam systems are inherently energy intensive, and energy assessments can often find operating and maintenance practices that lead to avoidable energy losses. In most steam systems, returning condensate contains a significant amount of energy (up to 13% of the steam's total energy). Therefore, replacing lost condensate with ambient temperature make-up water has a large impact on boiler energy consumption.

Improving steam system energy efficiency frequently results in other benefits, such as pollution prevention and improved worker safety. At Velsicol, the project reduced worker exposure to the treatment chemicals during material handling. Reducing the number of fuel truck deliveries also decreased safety concerns associated with these deliveries.

Steam Trap

Industries of the Future

The chemicals industry is one of several energy- and waste-intensive industries that participate in OIT's Industries of the Future initiative. In December 1996, the chemicals industry published a report, entitled Technology Vision 2020: The U.S. Chemicals Industry, that helps establish technical priorities for improving the industry's competitiveness and develops recommendations to strengthen cooperation among industry, government, and academia. It also provides direction for continuous improvement through step-change technology in new chemical science and engineering technology, supply chain management, information systems, and manufacturing and operations.

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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 competitiveness over the next 20 years. 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. Another component is the Industrial Assessments Centers, which provide comprehensive industrial assessments to small and medium-size manufacturers.

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