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Technical Case Study

June 2001

OFFICE OF INDUSTRIAL TECHNOLOGIES

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

Motor Assembly Plant Saves $85,000 with Compressed Air System Improvements

Benefits

- Saves $85,000 annually
- Improves productivity

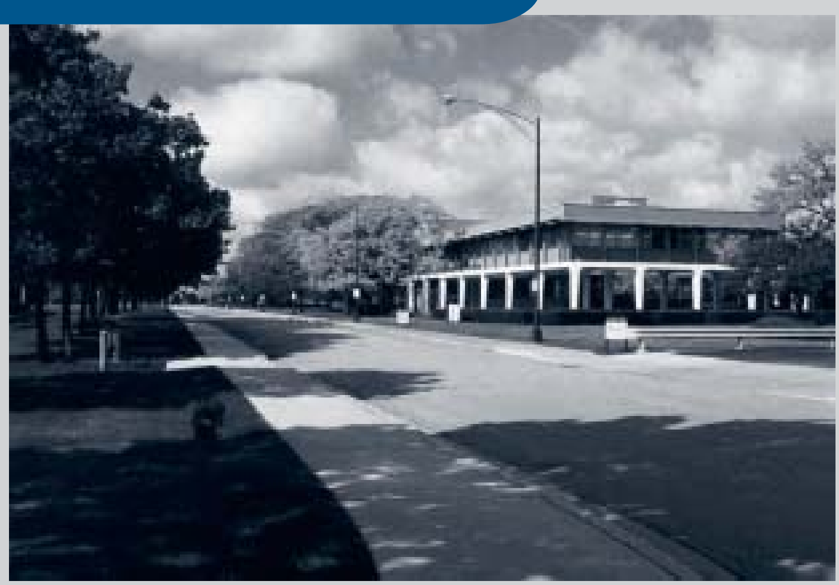
Applications

Compressed air systems are widely used in industrial production processes and are often the largest electricity end use in a plant. When an industrial plant's need for compressed air changes, the compressed air system needs to be re-evaluated to ensure that it is properly configured for the new processes.

Summary

In 1995, a compressed air improvement project was implemented following a system-level audit at the Chicago, Illinois, plant of the Bodine Electric company. The compressed air system was completely overhauled, with three new compressors, a pressure/flow controller, a receiver, and condensate traps. The project allowed the plant to reduce energy costs and production downtime. The annual energy savings from the project's implementation were $85,000, which represents about 10% of the plant's annual electricity costs. The project's total cost was $135,500, and the simple payback was 1.6 years.

Bodine Electric's Chicago Facility



Plant/Company Overview

Founded in 1905, Bodine Electric is headquartered in Chicago, Illinois, and manufactures fractional horsepower motors and devices that use motors for various commercial and consumer applications. Bodine's Chicago plant employs 280 people and uses compressed air for air guns and drivers, computerized lathes, vertical mills, winders, and soldering machines. The variety of the products requires different levels of air treatment depending on the product being made. Some assembly processes require very dry, clean air at 100 psig. At the time of the project, the plant's compressed air system was served by a 250-hp centrifugal compressor and several small booster compressors.

Project Overview

Bodine's management commissioned an outside survey of its compressed air system because their production requirements for compressed air had decreased from the time the system had originally been installed. This compressed air survey became the basis for a system-wide strategy to improve the system's efficiency and save energy costs.

The survey's first conclusion was that the centrifugal compressor was old and in such poor condition that it did not function effectively. It could only sustain a system pressure level of 85 psig and was difficult to restart after being shut off. Under these conditions, the plant needed several small booster compressors to achieve end-use pressures of 100 psig. The survey recommended that the system be upgraded with newer and smaller compressors that would use less power and adjust more appropriately to the changing demand patterns.

Next, the survey found that the control system did not function well. The centrifugal compressor had a load/unload control system that was only efficient during periods of highest demand. When the plant's demand for air decreased, the controls would not allow the centrifugal compressor to unload, so it continued to use almost the same amount of power that it required during peak demand.

For the new controls to work effectively, the survey advised that a pressure/flow controller and additional air storage be added. Doing so would help the new controls work effectively because it would create a steady demand pressure to which the controls could adjust.

The survey found that the plant's air treatment equipment was in good operating condition, had a low pressure drop, and required no changes to make the system more efficient. The survey also found that the plant's manually operated condensate traps were not effectively removing enough moisture from the system, which contaminated the air. To address the situation, the survey recommended replacing the manual condensate traps with electronic ones.

Project Implementation

The Bodine plant implemented the survey's recommendations. The project included replacing the old, 250-hp centrifugal compressor and controls with three 75-hp rotary screw compressors with automatic load/unload controls. They also installed a pressure flow/controller with a 1,500-gallon storage receiver. In addition, the plant replaced their manually operated condensate traps with mechanical ones, since these were deemed more cost-effective than the electronic ones recommended in the audit.

Results

The project resulted in solid energy savings and more efficient production. The three new rotary screw compressors—which total less horsepower than the original centrifugal compressor—deliver air to end-use equipment at 100 psig without assistance from booster compressors, which the plant removed from service. The stable air demand managed by the pressure/flow controller helped the new compressor controls adjust to the load patterns, allowing them to unload the compressors more frequently. This improved efficiency has resulted in annual energy savings of $85,000 (1,192,467 kWh), just under 10% of the plant's annual energy costs. The total project costs were $135,000, yielding a simple payback of 1.6 years. In addition, stable system pressure and drier air (mainly due to the new condensation traps) have resulted in more reliable production.

Three Rotary Screw Compressors

Lessons Learned

Before this project was implemented, Bodine was having problems maintaining end-use pressure levels, because of their aging centrifugal compressor. To compensate for this, a number of booster compressors were purchased to increase the pressure level. This further increased the costs of the compressed air system's operation.

As production requirements changed and the need for compressed air decreased, Bodine decided it was time to take a close look at the entire compressed air system because of the potential for energy savings and improvements in production. By using a systems approach, Bodine was able to identify and treat the problems in its system instead of the symptoms, resulting in a more reliable and cost-effective compressed air system.

Condensate Traps

Condensate traps collect and remove liquids from compressed air systems. Traps are located where moisture collects and at low points in the distribution system. Improperly functioning or ineffective condensate traps waste energy and compromise system performance. Manually operated condensate traps are the least efficient because they require continual diligence and adjustment for proper operation. Mechanical float-type and electronic solenoid-operated condensate traps are more efficient. These condensate traps also require periodic inspection to ensure that they do not fail. Condensate traps that fail open (have drain valves stuck in the open position) waste energy because they allow compressed air to escape into the atmosphere. Condensate traps that fail closed (have drain valves stuck in the closed position) cause condensate to back up in the system, which can damage components and lead to pressure drop.

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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Washington, DC 20585-0121

DOE/GO-102001-1324
June 2001