Procter & Gamble: Compressed Air System Upgrade Saves Energy and Improves Production at a Paper Mill

Benefits

- Saves $309,000 annually
- Improves production
- Improves system performance
- Lowers maintenance costs
- Achieves a 1.75-year simple payback

Applications

Compressed air systems are found throughout industry and account for a significant amount of the electricity consumed by manufacturing plants. By applying a system-level strategy to optimize a compressed air system, a plant can improve system performance, save energy, and improve productivity.

Summary

In 2002, Procter & Gamble (P&G) improved the compressed air system at its paper products mill in Mehoopany, Pennsylvania. The project greatly improved the efficiency of the mill's compressed air system, yielded important compressed air energy savings, and increased production. Once the project was completed, the mill was able to shut down a 450-horsepower (hp) compressor and still maintain the minimum pressure level required to adequately supply its end-use applications. The project saved 7.6 million kilowatt-hours (kWh) and $304,000 per year in compressed air energy costs and $5,000 in annual maintenance costs for a total of $309,000. With a total project cost of $545,000, the simple payback was 1.75 years.

Plant/System Overview

P&G's headquarters have been in Cincinnati, Ohio, since 1837. The company is a major producer of consumer goods; it produces and sells a wide range of paper, laundry, cleaning, beauty care, health care, and food and beverage products to more than 5 billion consumers in more than 140 countries. P&G employs 102,000 people worldwide, and is present in more than 80 countries.

The Mehoopany mill is P&G's largest, covering about 1,200 acres with 91 acres under roof and employing about 2,700 workers. The mill has two basic product lines: tissues and towels, and diapers. Compressed air supports production processes in all of the mill's business units. The main compressed air applications include paper machines for diaper manufacturing and tissue towel/converting, conveyors, and cylinders. Many compressed air applications can operate reliably at 85 pounds per square inch gauge (psig). Before the project, the mill had six centrifugal compressors in four separate buildings that totaled 4,300 hp. All of these six compressors and a 450-hp steam-driven unit were operated to satisfy the mill's normal air demand. Together, they generated 17,000 standard cubic feet per minute (scfm) and provided a system pressure of 92 psig +/-3.5 psig.

Project Overview

Working with Air Science Engineering, Inc., a U.S. Department of Energy Allied Partner, mill engineers formed a project team to evaluate the system for efficiency gains and possible energy savings. The evaluation focused on the system's supply side because management planned to increase the mill's papermaking equipment.

The evaluation identified some reasons why the system was not operating efficiently. The main issues were related to the compressor control scheme. Each compressor was individually controlled and operated in a manual, fixed output mode. Also, many compressors were in different locations. Because of these conditions, it was impossible to determine how an

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Procter & Gamble's mill in Mehoopany, Pennsylvania

adjustment on one unit affected the operation of the others. As a result, all six units operated at full load to meet the estimated system demand of 16,000 scfm. Operating the compressors in this way led to constant blow-off of 1,000 scfm in excess air. In addition, pressure fluctuations prompted the operators to try to maintain a higher system pressure than necessary.

Furthermore, the simultaneous operation of all seven compressors did not allow for any backup compressor capacity if a unit was out for maintenance. To maintain output in such situations, the mill rented compressors at an annual cost of $30,000. The evaluation concluded that there was inadequate storage and that some of the piping between the compressors and the paper machines was improperly sized. Also, a check valve was installed at a backpressure control valve on the compressed air header going to the papermaking area. The control valves were installed to dedicate air for the papermaking machines by preventing air that was generated in the boiler room from flowing into the main header. The check valve was installed in case the control valve failed, but it prevented two-way flow, which isolated the other compressors in the mill so they could not supply the papermaking area. This caused the boiler room compressors to produce excess air, which was blown off and exacerbated the pressure fluctuations in the main header.

Project Implementation

The project team implemented the recommendations that would yield the greatest energy savings and kept several other recommendations under consideration. The recommendations implemented by the project team include:

- The installation and configuration of a Programmable Logic Control (PLC)-based network controls package with Management Information System (MIS) capability. The new control system was linked to additional airflow and dew point measuring devices that could provide it with real-time data to better help it determine when to bring compressors on or offline.

• Adding piping between the new converting area and the mill's north air supply header.

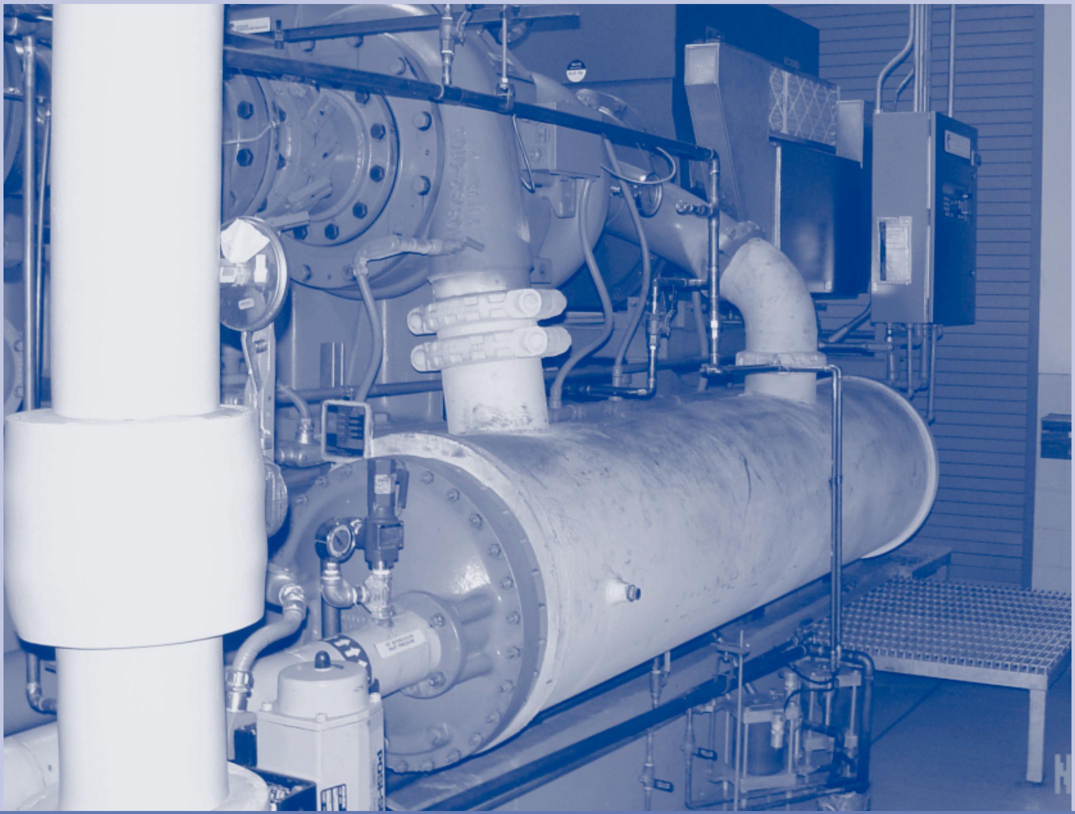
• Eliminating the backpressure control valve operation by adding a 6-inch header with a new 6-inch backpressure valve between a compressor room and the papermaking area. This eliminated the effect of the 4-inch check valve on the existing header.

• The purchase of a 1,500-hp centrifugal compressor that was integrated into the new controls package. This compressor was necessary because the anticipated mill expansion would increase air demand by 6,000 scfm at peak production.

Project Results

The changes have improved the compressed air system's performance, saved energy, and increased production. The new control system matches the air supply to the mill's air demand more accurately. Compressor blow off is 90% lower and unneeded compressors are taken offline sooner. Because the new control system can identify conditions such as peak demand and compressor response sooner, equipment failures due to low pressure have been eliminated. Another important benefit is that the system pressure is lower and more stable. Before the project, the mill operated at a pressure level of 92 psig, but experienced fluctuations of 3.5 psig. Currently, the pressure is 90 psig with fluctuations of less than +/- 2 psig.

The project has substantially reduced energy consumption by the original, seven-compressor system, yielding annual energy savings of 7.6 million kWh and $304,000. The mill saved an additional $5,000 on maintenance by taking a 450-hp unit offline. Together, these savings total $309,000. Because the project cost was $545,000, the simple payback is 1.75 years.



One of the 1,250-hp compressors in the Mehoopany mill

Lessons Learned

Proper compressor control is essential for efficient compressed air system operation and peak performance. At P&G's Mehoopany mill, multiple compressors are located throughout different buildings. Before the project, mill personnel had to operate all the units because they could not determine when to shut off unneeded compressors or when to delay bringing additional ones online. This configuration made it logical for the Mehoopany mill to acquire sophisticated controls that can orchestrate compressor operation and air delivery effectively within the context of a system-level strategy to improve system performance. Once the mill implemented additional measures, the system was able to match its air supply to its air demand more closely, which led to more efficient compressor operation and considerable energy savings. Moreover, the control system was able to stabilize the pressure level, thereby avoiding the purchase of additional capital equipment. This project and its results are being shared with other P&G sites that have similar motor systems.

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Project Partners

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