Techni-Cast: Foundry Saves Energy with Compressed Air System Retrofit

BENEFITS

- Saves $22,000 in annual energy costs
- Achieves simple payback of 14 months
- Lowers annual maintenance costs by $2,200
- Received $10,000 incentive award

APPLICATIONS

Compressed air systems are widely used to support industrial production processes and are often the largest electricity end use in a plant. By periodically reviewing its compressed air end uses, an industrial facility can determine whether its compressed air system is properly sized and configured. Proper configuration allows compressed air systems to support production processes effectively and efficiently. Many metal casting companies, and other industries, can potentially replicate the improvements and subsequent savings achieved by the Techni-Cast project.

Summary

In 2002, Techni-Cast implemented a project on its compressed air system at its foundry in Southgate, California. The project involved retrofitting the compressed air system with more appropriately sized compressors, upgrading the compressor controls, and other measures to increase the system's efficiency. The project's implementation allowed the foundry to reduce its compressor capacity by 50%, which greatly reduced the foundry's compressed air energy and maintenance costs. The annual energy and maintenance savings from the project's implementation are 242,000 kilowatt-hours (kWh) and $24,200; the project cost $38,000. Because the plant received a $10,000 incentive payment from the California Public Utilities Commission (CPUC), the total project cost was effectively reduced to $28,000, yielding a 14-month simple payback.

Plant/System Overview

Techni-Cast is a specialty foundry based in Southgate, California. The company has 100 employees and has been in business since 1954. The Southgate foundry is a 42,000-square-foot facility that specializes in centrifugal casting, and therefore produces industrial metal parts that have cylindrical and ringed configurations, such as landing gear for aircraft, ship shaft liners, automotive gaskets, cylinder liners, pump parts, and balls for ball valves. In addition to centrifugal casting, the foundry makes its own alloys and secondary metal-castings. Other plant operations include computer numerical controlled machining, conventional machining, heat treating, metallurgical testing, and nondestructive testing. The foundry's compressed air applications require between 200 and 400 standard cubic feet per minute (scfm) of compressed air at 90 pounds per square inch gauge (psig) to operate reliably.

Before the project, the foundry was served by two rotary screw compressors, one 100-horsepower (hp) unit and one 50-hp unit. Together, they generated 350 to 500 scfm. The larger compressor operated 16 hours a day, 6 days per week, while the 50-hp unit came online for 5 hours a day to support the plant's peak demand of 442 scfm. It was necessary for both compressors to generate air at a discharge pressure of 120 psig so that the end-use applications would receive air at no less than 90 psig. This clearly showed that the system had an excessive pressure drop. Because of pressure fluctuations, foundry personnel ran both compressors simultaneously to prevent the header pressure from falling below 90 psig during periods of peak demand. In response to high energy costs and potential incentives, Techni-Cast reviewed the compressed air system for potential energy-efficiency opportunities.

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Techni-Cast's plant in Southgate, California

Project Overview

Plant personnel worked with Accurate Air Engineering of Bakersfield, California, which is a U.S. Department of Energy Allied Partner, to perform a system-level review of the compressed air system. The first problem the review identified was the compressor control scheme. Both the 100- and 50-hp units were operating in standard modulation, meaning that they both operated at part load at the same time. When this happened, neither compressor operated at maximum efficiency. Staff controlled the 50-hp unit manually and only started it during peak demand when plant pressure fell below 90 psig. The 50-hp unit continued to run at part load even after peak demand ended. This caused more than 30 hp of compressor capacity to operate unnecessarily. In addition, by operating the compressors at part load, the bearings in the compressor air ends wore out more quickly, decreasing the compressor life.

Next, the evaluation identified the causes of the system's severe pressure drop. These included components such as point-of-use filters, regulators, and lubricators (FRLs), and additional air-treatment equipment. The FRLs caused a pressure drop of 10 to 20 psig because they were improperly configured, which resulted in poor performance by the applications. Therefore, production personnel adjusted the regulators for maximum pressure, causing a pressure gradient from the end-use application back to the point of supply. This in turn necessitated higher compressor discharge pressure to overcome the gradient. The other air treatment equipment increased pressure drop two ways. The coalescing filter on the dryer was undersized for the flow rate, causing a pressure drop. Condensate drains were manually operated, and operators were not able to open the valves often enough. This resulted in accumulation of condensate, which further exacerbated the pressure drop.

Finally, the evaluation found a large air leak and some inefficient uses of compressed air. The leak was in the grit blaster, which is one of the plant's most critical compressed air applications. The plant also used 10 diaphragm pumps. Accurate Air Engineering showed that the task the pumps were performing could be accomplished with electric pumps that use less energy.

Project Implementation

The project's implementation closely followed the recommendations made in Accurate Air Engineering's audit report. The report showed that a 50-hp compressor could satisfy the plant's normal demand of 200 scfm, so the plant installed a new, 50-hp rotary-screw compressor as the base compressor. Automatic start-stop controls were added to the existing 50-hp unit, which allow it to come offline as soon as it is no longer required. The company retained the 100-hp compressor as a back-up unit.

Next, the foundry staff sought to reduce the system's pressure drop and compressed air waste. Operators specified proper pressure levels for all end-use applications, and repaired the leak in the grit blaster. The foundry personnel then had the dryer's coalescing filter professionally cleaned and equipped with new elements. In addition, staff replaced the existing condensate drains with zero-loss condensate drains. Once these measures were implemented, the compressor discharge pressure was reduced from 120 psig to 100 psig; this lowered the system pressure to 95 +/- 5 psig.

Project Results

By installing a smaller compressor, along with optimal controls and the additional measures, Techni-Cast improved the compressed air system's performance and lowered energy costs. The system can now meet the plant's normal air demand during off-peak production, despite a 50% reduction in aggregate horsepower. The plant's normal air demand is now 200 scfm, and briefly reaches 400 scfm during peak demand. The leak repair and condensate drain replacement were the most significant factors in reducing air demand. In addition, the pressure drop in both the point-of-use and in the air treatment equipment has been significantly reduced.

Techni-Cast's new 50-hp compressor

Because the project reduced the compressed air capacity and output required to serve the end uses, the plant achieves annual compressed air energy savings of 242,000 kWh ($22,000). Furthermore, the foundry's maintenance costs have declined by $2,200 annually because the new compressor is less maintenance intensive than the 100-hp unit. The project's implementation cost was $28,000 after the CPUC contributed the $10,000 incentive payment. The annual energy and maintenance savings total $24,200, and the project's simple payback is 14 months.

Lessons Learned

Industrial compressed air systems can become oversized as production equipment becomes more efficient. A system-level evaluation of an industrial facility's compressed air system can determine whether that system is properly sized and configured to satisfy the plant's production requirements as efficiently as possible. In the case of Techni-Cast, a few systemic improvements to the compressed air system allowed less aggregate horsepower to meet the foundry's compressed air needs. By implementing such an approach towards equipment replacement, and configuring the system to have the lowest compressor capacity that meets production requirements, the Southgate foundry increased its compressed air system's efficiency and realized significant energy savings.

Point-of-Use Filters, Regulators, and Lubricators (FRLs)

Point-of-use FRLs are devices that ensure that a compressed air application receives a clean, lubricated supply of air at the appropriate pressure level. Filter elements trap contaminants, and those elements must be cleaned or replaced periodically. Regulators supply proper airflow with minimum pressure variations. Lubricators are intended to provide the required lubrication to maintain and prolong the life of a compressed air application. Often, companies purchase the least expensive FRLs, or install improperly sized FRLs. These actions lead to pressure drop, shorter end-use equipment life, and inconsistent product quality.

Generally, FRLs must satisfy the peak flow of air during operation of the compressed air applications they serve. Oversized filters may not develop the centrifugal action to separate liquids, while undersized filters may induce too large a pressure drop. FRLs should be positioned as close as possible to a compressed air application with as few elbows and bends between them and the application as possible. The combined total pressure drop in the filter and lubricator should not exceed 3 psi.

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