SHOWCASE PROJECT: HOLISTIC COMPRESSED AIR OPTIMIZATION

SOLUTION OVERVIEW

TE Connectivity has a goal of reducing the energy intensity of their corporate manufacturing footprint by 25 percent in 10 years. Compressed air systems account for a significant amount of the company's energy footprint, so energy performance improvements in compressed air systems at TE's plants are a high priority. At TE Connectivity's facility in Lickdale, Pennsylvania, the manufacturing process is heavily reliant on compressed air for production. This particular plant, which employs around 650 people, is a 250,000-square-foot manufacturing plant that makes electrical connectors and contacts for use in a wide range of applications. The plant's compressed air system serves multiple pneumatic processes including plastic parts molding, electroplating, metal stamping, and part assembly.

Most operations in this plant run on a continuous basis. Therefore, maintaining adequate pressure and volume is vital to plant operations. In the past, the plant had difficulty maintaining consistent system pressure due to intermittent compressed air demands. At times, the plant had to rely on supplemental diesel compressors to adequately serve all the compressed air demands.

**Actual 2018 energy use figure below has been adjusted for production changes and other energy efficiency projects implemented in the plant.*

SECTOR TYPE
Industrial

LOCATION
Lickdale, Pennsylvania

PROJECT SIZE
250,000 square feet

FINANCIAL OVERVIEW
$165,000

SOLUTIONS

In 2011, TE Connectivity partnered with their compressor vendor to evaluate the plant's compressed air system and identify opportunities for energy savings and improved system reliability. Prior to the assessment and subsequent improvements, the plant's compressed air system was served by eight 200-horsepower (hp) compressors that operated all the time at full capacity. Occasionally, the plant needed to outsource additional compressors to meet peak compressed air demands. As part of the holistic system assessment, multiple improvements were identified that would be implemented in five phases over several years. By the end of the five-phase project, the plant was able to reduce the system pressure by 22 psig, which lowered compressed air energy costs by 11 percent. In addition, the compressed air system was able to adequately serve the plant with four to five units operating instead of all eight. The five phases included:

Phase 1: Upgrade compressor controls package and strategy and install primary storage with a pressure/flow controller.

Phase 2: Replace worn compressors with units having variable speed control.

Phase 3: Reduce excess compressed air demand

Phase 4: Replace additional compressors at the end of their useful lives with 350-hp compressors to provide redundancy and capacity for plant expansions

Phase 5: Continuous improvement through metering

Phase 1: Upgrading Compressor Controls Package, Install Primary Storage with Pressure/Flow Controller

Phase 1 of the project involved upgrading the compressor controls and control strategy along with installing two 2,200-Cubic Feet per Minute (CFM) primary storage tanks and a pressure/flow controller to stabilize and reduce the system pressure. The new controls package uses programmable logic and can establish lead and lag compressors and rotate their sequence for maximum efficiency. The pressure/flow controller provides demand signals to the compressor controls to determine when to activate compressors and maximize the volume of air in the two storage tanks. This created a buffer between the supply and demand sides of the compressed air system, allowing for more effective use of air storage and a continuous dynamic response to demand fluctuations. This also served to stabilize system pressure. Once the pressure stabilization was accomplished, the plant was able to gradually reduce system pressure from 110 to 100 pounds per square inch gauged (psig) without any adverse impact to production.

Phase 2: Replace Worn Compressor with Compressor having Variable Speed Control

Phase 2 of the project involved replacing a worn, 200-hp compressor that had been rebuilt and was at the end of its useful life. TE decided to replace it with a similarly-sized compressor with a Variable Frequency Drive (VFD). The decision to use a compressor with variable speed control was highly strategic. Previously, all their compressors were fixed speed units, so having one with variable speed control enabled the plant to have a compressor that could truly act as a trim compressor. This along with the storage capacity enabled the plant’s compressed air system to more effectively meet peak air demands.

Phase 3: Compressed Air Demand Side Improvements

Phase 3 of the project involved addressing the demand side of the compressed air system. Several measures were implemented including:

- installing solenoid valves on the stamping machines,
- repairing leaks, and
- fitting open blowing applications with engineered nozzles.

The stamping machines are one of the plant's larger compressed air end users. Before the solenoid valves were added, compressed air was blown onto an entire strip of metal to blow off lubricant and any debris. The compressed air would blow on the stamped part, where it was needed, but would then also blow onto the space between the parts, where it was not needed, causing excess air consumption. The solenoid valves allow for pulse-blowing, so air is blown on the stamped part, but air is shut air off before the next stamped part is brought into position. The valve then turns the air back on and rapidly alternates the pulse blowing depending on the position of the strip. The solenoid valves avoid unnecessary air consumption by delivering air only where it is needed.

Next, the plant's personnel performed a comprehensive compressed air leak detection and repair campaign. Major air leaks were identified and fixed and a policy was implemented to check for leaks at the start of each plant shutdown. The plant then eliminated some unneeded open blowing applications and converted some blow-offs to engineered valves. Not only did this reduce the volume of air going to the applications, it also enabled the plant to prevent pressure loss if multiple applications were operated at once. Finally, the plant decided to reconfigure some of the demand-side piping by installing additional piping to balance the airflow and isolation valves on piping leading to non-operational portions of the plant. These measures enabled the plant to lower the system pressure even further from 100 to 92 psig. Since then the plant's employees have been evaluating the pressure needs of their compressed air applications on an annual basis.

Phase 4: Upgrading Compressor Efficiency

Phase 4 involved replacing two aging 200-hp compressors with two 350-hp compressors. This allowed the facility to use the 350-hp compressors for baseload demand, enabling the controls to use only the variable speed compressor as the trim compressor in the plant. This also allowed the plant to keep the remaining 200-hp compressors as back-up units and in case of future output expansions.

Phase 5: Continuous Improvement of the Compressed Air System

The final phase of the project involved installing flow meters on various types of assembly equipment to both monitor compressed air consumption and detect air leaks. The use of flow meters allowed the plant to understand whether air keeps flowing during periods when no production is occurring. When this happens, the equipment gets tagged and a repair order is generated to address the situation. With the implementation of these additional changes the plant has been able to reduce its compressed air pressure even further to 88 psig with no adverse impacts. This represents a significant decrease in operating pressure to the minimum level that ensures reliable production. In addition, by reducing the system pressure by 22 psig, the plant was able to reduce compressed air energy costs by 11 percent. The plant used to try to maintain the system pressure at a higher than necessary level to avoid pressure decay when large demands would activate. Now the plant can safely discharge air into storage at 100 psig and the pressure/flow controller sends air consistently into the plant at 88 psig.

Through this systematic approach to compressed air optimization TE Connectivity was able to stabilize the system air pressure in its plant and reduce compressed air waste.

OTHER BENEFITS

The system's engineered nozzles proved to be safer for plant operators than the open blow-offs originally in place. Additionally, the plant was less subject to compressor failures, which resulted in significant savings. In the past if a compressor failed and had to be taken offline for repairs, the plant would have to rent a replacement compressor at a cost of $10,000/month.

The size and complexity of the system necessitated a sophisticated compressor control strategy. The PLC-based controls package in conjunction with the primary storage tanks made it possible to activate only the compressors that are needed. This enables the plant to keep several compressors as back-up units and varies their use enough that maintenance costs went down by approximately $1,200/year.

As a result of the increased focus on generation and use of compressed air, plant culture experienced a change as well. Whereas in the past plant operators had ignored compressor costs or treated them as sunk costs, plant operators began to consider those costs as variable with production. This led to increased awareness of compressed air system operation and efficiency and greater participation by plant employees in energy treasure hunts and compressed air system leak detection/repair campaigns. Another notable cultural change is that there is greater emphasis on upkeep and repairs to the compressed air system. Now, the plant's employees routinely follow up with maintenance if a repair is overlooked or a leak is not fixed.

Annual Energy Use

Baseline(2012)

123,680 MMBTU (entire facility)

Actual(2018)

113,884* MMBTU (entire facility)

Energy Savings

9,796 MMBTU

Annual Energy Cost

Baseline(2012)

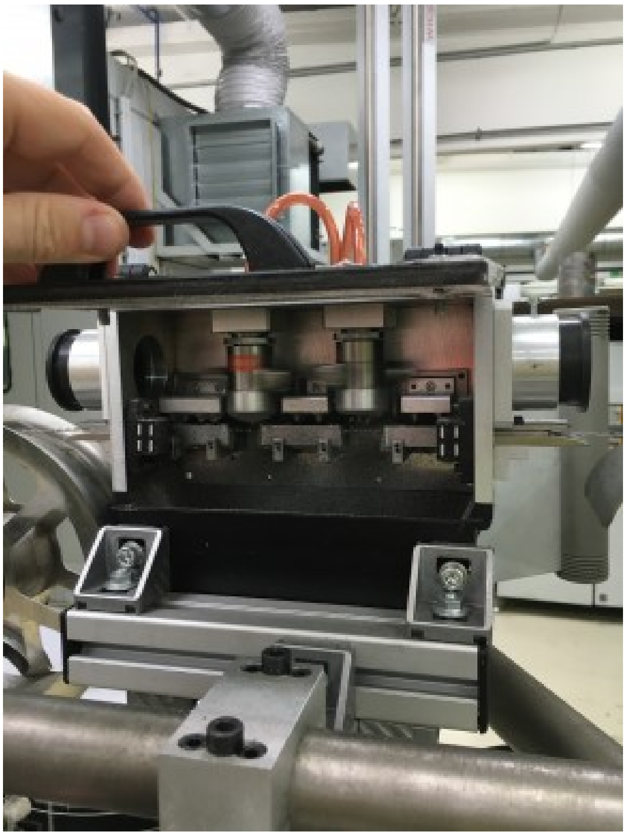
2,276,608 Dollars (entire facility)

Actual(2018)

2,053,608 Dollars (entire facility)

Cost Savings

$223,000



Compressed air blow off nozzles for stamping press