STEEL

BestPractices
Project Case Study

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OFFICE OF INDUSTRIAL TECHNOLOGIES

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

Compressed Air System Improvements Increase Production at a Tin Mill

Benefits

- Saves over $136,000 annually
- Reduces energy use
- Eliminates production rejects
- Improves productivity
- Improves product quality

Applications

Compressed air systems are found throughout industry and consume a significant portion of the electricity used in the manufacturing sector. Specifying and maintaining the proper air treatment equipment is critical to the performance of any industrial compressed air system. The requirements of the various end-use applications in a plant should determine the level to which air is treated.

Summary

In 1999, Weirton Steel completed a project in which the compressed air system at their tin mill in Weirton, West Virginia was completely overhauled. The installation of new compressors, the addition of air treatment equipment, and the repair of leaks significantly reduced compressor shutdowns, production downtime, and product rejects. In addition, the new system operates more efficiently, leading to lower energy and maintenance costs. The total cost of the project's implementation was $246,000. The total expected annual savings are $136,000, leading to a simple payback of 1.8 years.

Plant Background

Weirton Steel's plant in Weirton, West Virginia is one of North America's most advanced integrated steel production facilities. Compressed air is an integral part of the production process and compressed air systems are located in four main areas – the Steel Works and Utilities, the Tin Mill, the Strip Steel Mill, and

Weirton Plant

the Sheet Mill. Of these, the Tin Mill and the Strip Steel Mill utilize the greatest amount of compressed air. At the Tin Mill, the main applications of compressed air are for pneumatic cylinders, blowing operations, and spray guns. Prior to the project's implementation, the Tin Mill's compressed air system was a combination of six aging, water-cooled, manually controlled centrifugal and sliding vane compressors having a combined total of 2200 horsepower. With this system in place, the Mill was experiencing frequent production interruptions and a high degree of product rejects.

Project Overview

Weirton Steel's management commissioned a compressed air systems assessment by Ingersoll Rand. The assessment's main conclusion was that most of the system's problems were being caused by excessive oil and moisture in the compressed air being delivered by the system. The assessment also showed the plant had excessive leaks and that the aging compressors were not operating efficiently.

Oil was contaminating the compressed air because it was leaking from the bearings in the old compressors. The improperly treated, still-contaminated air was being used in a spray coating process that is part of the production of steel rings used in cans. The lubricant in the air resulted in an unacceptably high degree of cans with poor quality. These cans were not reusable and had to be destroyed.

The excessive moisture in the system was caused by a lack of compressed air dryers. The absence of dryers in a compressed air system causes water to carryover into the system's distribution system and end-use applications. Moisture in the system was impacting the operation of air cylinders by filling them with water. This situation had two consequences. First, it prevented the compressors from maintaining a stable system pressure because the water steadily increased the system's pressure drop. Second, it led to periodic stoppages in the production process because the cylinders had to be manually drained.

Compressed air leaks were found throughout the system, with large amounts of air leaking around valves and filters. Finally, the compressors in the plant were found to be old and worn such that they only produced 70% of the scfm that they were rated for, which caused the mill to bring extra compressors online.

Project Implementation

The mill proceeded by removing its old compressors and installing five 350 horsepower rotary screw compressors that supply approximately 8500 scfm at an optimum pressure level of 90 psig. In order to improve their efficiency, the compressors were sequenced to respond more appropriately to the dynamic system demand.

Each of the new compressors has its own dedicated thermal mass refrigerated dryer, which solved the moisture problem. In addition, the plant had to rebuild the air cylinders that had been damaged from years of water buildup.

In order to ensure the purity of the compressed air used in the coating process, the mill decided to have a separate source of compressed air for that process. They installed a dedicated, lubricant-free, rotary screw 100-horsepower compressor with a desiccant dryer, a conventional filter, and two charcoal filters to supply compressed air to this process.

The mill implemented a leak management program and replaced the filters and the old valves which were a significant source of compressed air leakage.

Results

The overhaul of the Tin Mill's compressed air system resulted in improved production and substantial savings. Prior to the project, the mill had to baseload four compressors (1600 total horsepower), including its two largest ones, 24 hours per day, and frequently had to start additional units to meet demand spikes. With the new system in place, the mill is able to operate more effectively with less total horsepower and energy consumption, since only three compressors (1050 horsepower) run all of the time, and one small 100 horsepower unit supplies compressed air for the coating process.

The mill estimates that it will save $60,000 (1,200,000 kWh) in energy costs annually. In addition, the mill should save $76,000 per year from less time and resources being spent on repair and maintenance costs. These savings will result in a payback of 1.8 years.

Lubricant-Free Air

Some compressed air end-uses require essentially lubricant-free air. Lubricant-free air can be generated with lubricant-free compressors, including types of reciprocating and rotary screw compressors, and all centrifugal units. Lubricant-free air can also be produced using standard reciprocating compressors and lubricant-injected rotary screw compressors, but additional separation and filtration equipment is required. Lubricant-free rotary screw and reciprocating compressors usually have higher first costs, lower efficiency, and higher maintenance costs than lubricant-injected compressors. However, the additional separation and filtration equipment required by lubricant-injected compressors adds to system cost and will cause some reduction in efficiency, especially if systems are not properly maintained. Careful consideration should be given to the specific end-use for the lubricant-free air, including the risk and cost associated with product contamination, before selecting a lubricant-free or lubricant-injected compressor.

The installation of the dryers has done away with the need to drain and perform maintenance on the air cylinders. Consequently, production downtime has been significantly reduced. Since there is less water build up, the resistance to the airflow has been reduced, which allows the compressors to maintain the system pressure more effectively.

The rate of can rejection has been dramatically reduced as a result of the lubricant-free air being supplied by the dedicated compressed air system. The overall production level and productivity of the Tin Mill has increased considerably.

Lessons Learned

Aging and improperly configured industrial compressed air systems can lead to unreliability, poor product quality, energy waste, lower productivity, higher than necessary operating costs, and poor system performance. Excessive moisture and lubricant carryover in compressed air systems are problems that can be solved by specifying the proper air treatment equipment. Training on these issues as well as optimal configuration of compressed air systems is available through the Compressed Air Challenge (www.knowpressure.org) and Best Practices (www.oit.doe.gov/bestpractices).

COMPRESSED AIR SYSTEM

INDUSTRY OF THE FUTURE—STEEL

Through OIT's Industries of the Future initiative, the Steel Association, on behalf of the steel industry, has partnered with the U.S. Department of Energy (DOE) to spur technological innovations that will reduce energy consumption, pollution, and production costs. In March 1996, the industry outlined its vision for maintaining and building its competitive position in the world market in the document, The Re-emergent Steel Industry: Industry/Government Partnerships for the Future.

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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 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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