PETROLEUM

BestPractices
Project Case Study

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OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Benefits

- Reduces compressed air energy costs by 25 percent
- Annual energy consumption reduced by 517,000 kWh
- Improves productivity and reliability
- Lowers maintenance costs
- Similar improvements implemented at additional Mobil plants

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 is retooled or converted to a new production process, the plant's compressed air system needs to be re-evaluated to ensure that it is properly configured for the new process.

Compressed Air System Retrofit Increases Productivity at a Petroleum Packaging Facility

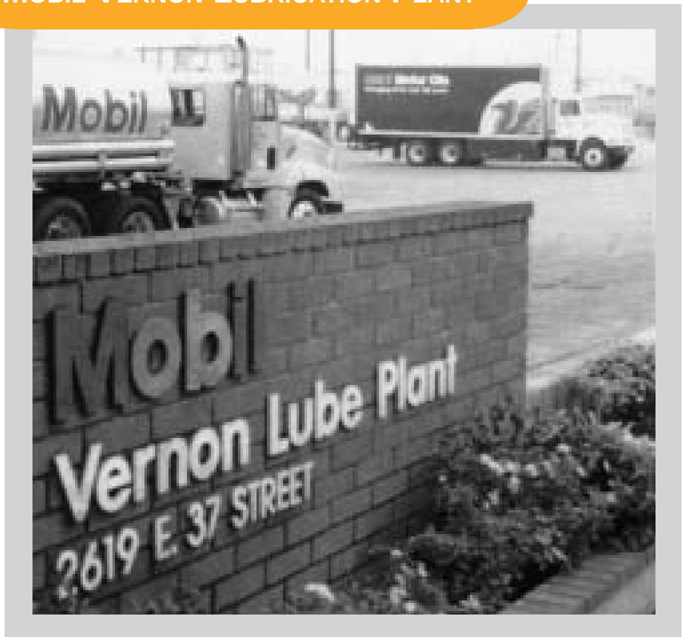
Summary

In 1998, a compressed air system improvement project was implemented at the Mobil lubrication plant in Vernon, California. The compressed air system was modified because the plant was retooled into a distribution facility that uses comparatively less energy. The project reduced the plant's compressed air energy costs by 25 percent, as well as reducing production and maintenance costs. This was accomplished by substituting a new 50-horsepower (hp) rotary-screw compressor with load/unload controls for two 200-hp compressors and two aging 50-hp compressors. The increased efficiency and reliability of the compressed air system made the plant's production process more reliable. The total cost of the project was $23,000, and the annual savings were $20,700, leading to a simple payback of approximately one year. The plant also avoided $52,000 in costs by implementing this cost-effective, internally-developed project instead of one that a local engineering company recommended.

Plant Overview

The Mobil lubrication plant in Vernon, California was originally a small lubricant-blending plant that employed nineteen people. The plant was converted into a

MOBIL VERNON LUBRICATION PLANT

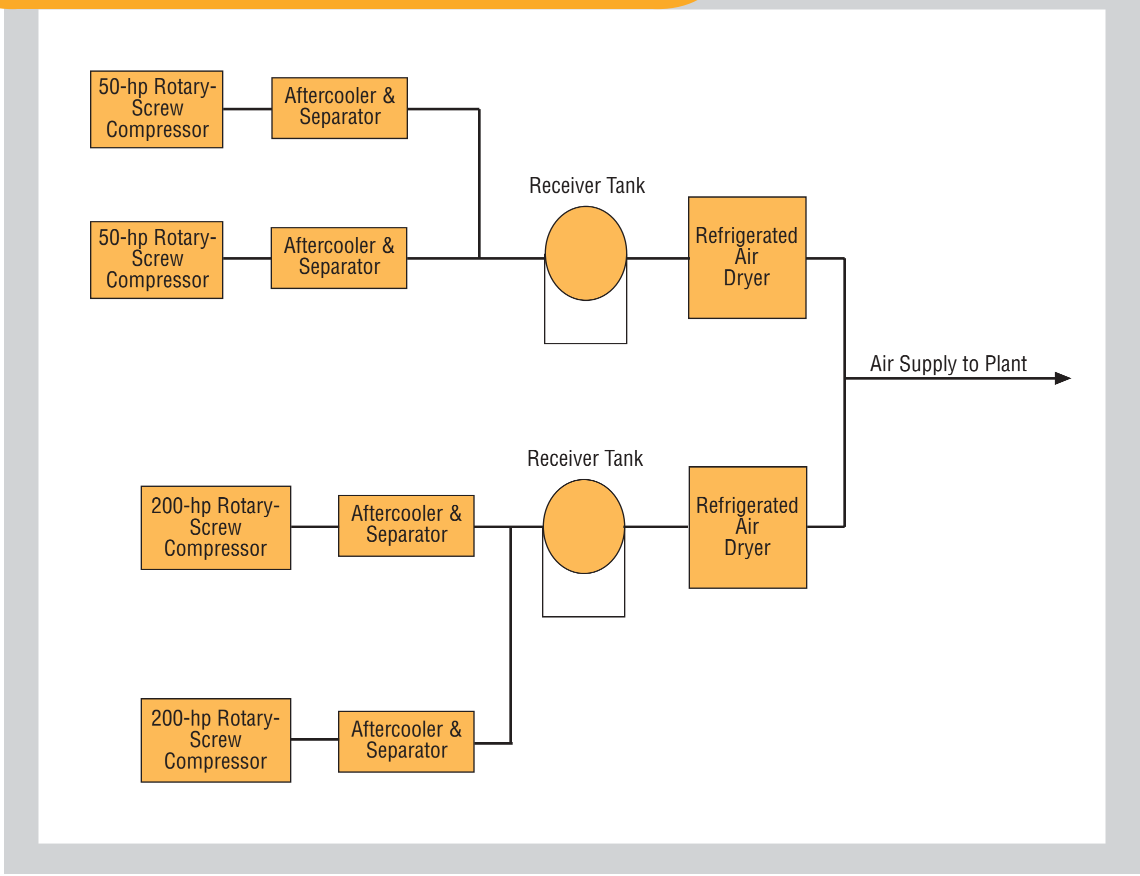


lubricant and grease distribution facility, which uses less energy than a blending plant. The facility is equipped with a steam system for heating, and a compressed air system that supports lubricant bulk loading and storing. Compressed air is needed in both the lubrication plant and the fuels terminal to operate pumps, valves, pneumatic tools, and instrumentation. Prior to the project's implementation, the plant used two 200-hp compressors and two aging 50-hp compressors that were at the end of their useful lives. Since the converted plant's compressed air applications were less energy-intensive, the system was oversized for the plant's new requirements.

Project Overview

The impending need to replace the aging compressors, coupled with the change in the plant's operation, led to an evaluation of the plant's utility needs. One evaluation performed by a local engineering company recommended replacing the compressors with two 75-hp compressors and adding dedicated dryers and a pressure flow controller. Due to the cost of the proposed plan, a separate evaluation was performed. Since the plant's compressed air requirements were expected to decrease, the second study determined that the compressed air needs could be adequately met with one 50-hp compressor. The plant decided to replace the two old 50-hp compressors with a 50-hp rotary-screw compressor with load/unload controls that generates 240 scfm at 80 psig. In addition, plant personnel decided to take one of the two 200-hp compressors offline and use the other one as a back-up.

Diagram of Original Compressed Air System



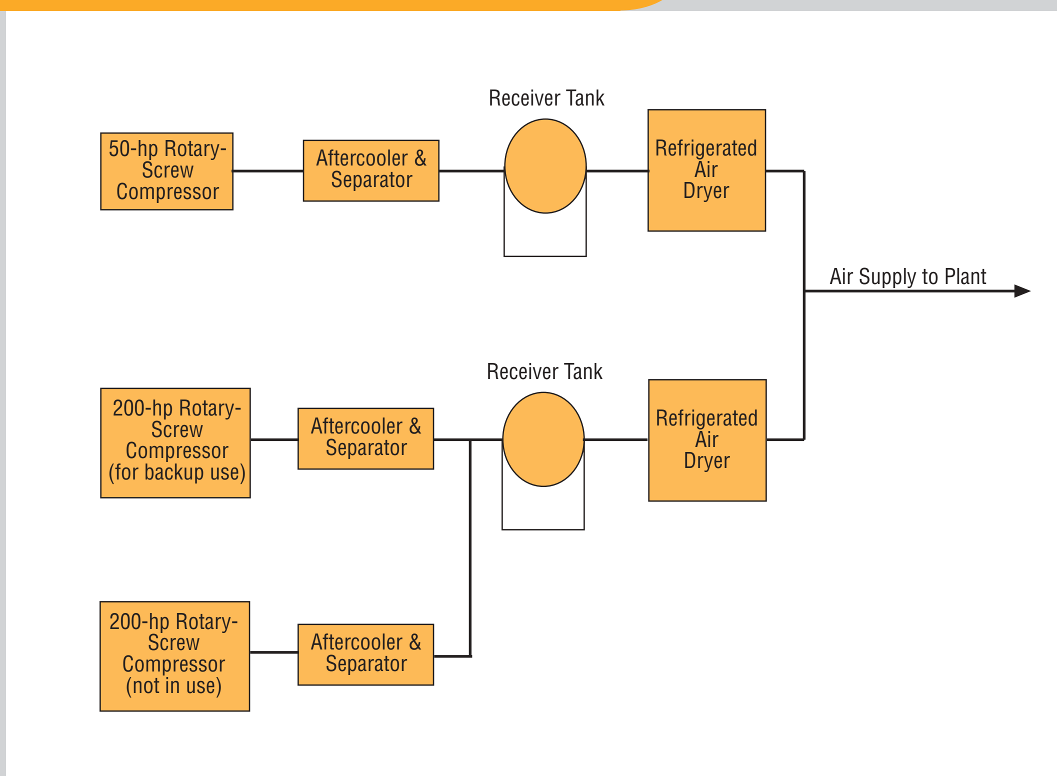
Project Implementation

The plant purchased and installed the 50-hp compressor as well as a refrigerated air dryer at a total cost of $23,000. However, after installation, the new compressor did not load and unload properly. It not only had to operate at higher loads than anticipated to meet system demand, but the 200-hp backup compressor had to run more often, as well. Due to the high run-time of the 200-hp compressor and the high loading of the new compressor, the anticipated energy savings were not realized. Plant personnel then conducted an investigation of the entire compressed air system and discovered two large leaks in the underground section of the distribution piping system. Once the leaks were fixed, the new compressor was able to load and unload properly, and the plant was able to take the 200-hp compressor offline.

Load/Unload Controls

Load/unload controls, also known as constant speed controls, allow the compressor motor to run continuously, but unload the compressor when the discharge pressure is adequate. Compressor manufacturers use different strategies for unloading the compressor, but in most cases an unloaded rotary-screw compressor will consume 15 to 35 percent of its full-load horsepower.

Diagram of Revised Compressed Air System



Results

The system reconfiguration and leak repair provided significant improvements to the Vernon plant's compressed air system. Since the plant was able to operate with one compressor instead of four, the new system's configuration reduced the plant's annual energy consumption by 517,000 kWh, saving $20,700, or almost 25 percent of the plant's compressed air electricity costs. If the plant had purchased the two 75-hp compressors as recommended by the outside company, it would have spent more and saved less. Since the proposed plan would have cost $75,000 to implement, the plant avoided approximately $52,000 in potential costs.

Fixing the leaks allowed the compressors to operate more effectively and to deliver compressed air more consistently. The consistent supply of air not only reduced interruptions in the bulk loading rack, but lowered the number of boiler shutdowns caused by the previously unstable supply of compressed air. Therefore, the compressed air system's increased reliability improved production by reducing production downtime. The leak detection/repair experience increased plant awareness of leaks and their cost, and led to the implementation of a leak management program. In addition, plant personnel now spend less time and resources on compressor maintenance.

Due to the success that the Vernon plant experienced from optimizing its compressed air system, several other Mobil lubrication plants have assessed their compressed air systems and are implementing similar improvement projects.

Lessons Learned

A compressed air system assessment that forms the basis for an optimization project should include both the demand and supply sides of the system because a change made in one area will affect the rest of the system. If only one side of a compressed air system is improved, the whole system may not operate as anticipated, and any energy savings or production improvements may not be realized.

In this case, leaks in the system caused the new 50-hp compressor to run loaded more often than necessary and the 200-hp compressor to be operated solely to support leaks. Once the leaks were fixed, the system was able to operate as intended, using only the new 50-hp compressor.

Industry of the Future—Petroleum

Petroleum is one of nine energy- and waste-intensive industries that is participating with the U.S. Department of Energy's (DOE) Office of Industrial Technologies' Industries of the Future initiative. Using an industry-defined vision of the petroleum industry in the year 2020, the industry and DOE are using this strategy to build collaborations to develop and deploy technologies crucial to the industry's 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 emphasizes 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.

Project Partners

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