The California Energy Commission and the U.S. Department of Energy, Office of Industrial Technologies BestPractices present:

ENERGY SOLUTIONS FOR CALIFORNIA INDUSTRY:

WAYS TO IMPROVE OPERATIONS AND PROFITABILITY

MAY 2002

CASE STUDY

BENEFITS

- Saves $74,000 annually
- Saves 507,000 kWh annually
- Improves reliability
- Lowers maintenance costs

APPLICATIONS

Compressed air systems are widely used in industrial production processes and are frequently one of the largest electricity end use in a plant. Often, compressed air systems are oversized when industrial plants are built or a plant's needs for compressed air evolve over time. Re-evaluating a compressed air system's capacity in relation to a plant's production needs can save energy while ensuring that the system adequately meets a plant's requirements.

ABOUT THIS EVENT

The purpose of the Energy Solutions for California events is to provide a *professional, solutions-oriented* environment for industrial electricity users who face serious challenges to remaining operational and profitable during the current energy crisis. Industrial electricity users have the opportunity to receive unbiased information and analytical tools that can increase reliability and manage short and long-term production costs.

Compressed Air System Retrofit Reduces Energy Costs at a Newspaper Printing Facility

Summary

In 2000, a compressed air system optimization project was implemented at The Bakersfield Californian's printing facility in Bakersfield, California. The compressed air system was evaluated for potential energy efficiency improvement opportunities in response to rising energy costs. The resulting project involved retrofitting the existing system with smaller compressors and lowering the system's operating pressure, which resulted in important reductions in the facility's compressed air energy consumption, as well as in its production and maintenance costs. In addition, the project increased the efficiency and reliability of the compressed air system, making the facility's production process more reliable. The total cost of the project was $69,000, and annual compressed air energy savings were 507,000 kWh, or $46,000. In addition, compressed air consumption was reduced by 65%. Due to incentive payments from its utility Pacific Gas & Electric Company (PG&E) of $28,000, The Bakersfield Californian achieved a simple payback of just under 1 year on the project.

The Bakersfield Californian Printing Facility

Company/Plant Background

The Bakersfield Californian is an independent, family-owned newspaper serving the city of Bakersfield, California as well as Kern and Tulare counties since 1907. The paper has an average daily circulation of 72,000 and 84,000 on Sundays. In 1984, The Bakersfield Californian constructed a $21 million state-of-the-art publishing facility. When the new publishing facility was completed, The Californian became one of the most technologically advanced newspaper companies in the United States.

Included in the publishing facility is a compressed air system that is important to the facility's production process because it serves many air cylinders around the presses as well as various air hoses and packaging equipment. Prior to the project, the facility's compressed air system was served by one 125-hp and two 75-hp rotary screw compressors. The 125-hp compressor operated near full load and supplied over 400 scfm at a system pressure level of 145 psig. The 75-hp compressors were older units that were offline, but kept as back-up compressors. The system was also served by three aging refrigerated air dryers that operated together and were able to treat 1,200 scfm.

Project Overview

Rising energy costs led facility personnel to examine ways in which the facility's processes could become more energy efficient. A compressed air system evaluation performed by Accurate Air Engineering, an OIT Allied Partner, determined that the system could be optimized without large capital expenditures. The evaluation's main finding was that the true pressure requirements of the end-use applications were significantly lower than the existing system pressure of 145 psig. Another important conclusion was that the facility's air demand was considerably lower than the volume of air that the compressor was supplying. During the evaluation, recordings of the air demand patterns showed that the end-use applications only required up to 100 scfm for 70% of the time that the facility was in operation and needed more than 200 scfm for only 5% of the facility's daily operation.

Based on the air demand recordings, the evaluation showed that the facility's compressed air needs could adequately be met most of the time with one 50-hp compressor. In addition, the capacity of the system's air dryers was greater than the volume of air they needed to treat. The evaluation recommended downsizing the air drying capacity to a maximum of 400 scfm, which would be sufficient to treat air volume at peak demand.

Project Implementation

The Bakersfield Californian purchased and installed two 50-hp rotary screw compressors as well as two parallel refrigerated air dryers each rated for 400 scfm. Because one of the compressors could adequately serve the facility during its normal operations, facility personnel configured them so that one would be baseloaded 8,760 hours per year and the second one would operate 500 hours per year (the cumulative amount of annual peak load air demand). To prolong compressor life, each unit was sequenced to rotate the baseload demand every 24 hours. This way, the compressors would share the load equally because each unit would run for 4,630 hours per year (8,760+500)/2.

The two new dryers were not only more optimally sized for the volume of air to be treated, but were also fitted with Variable Speed Drives (VSDs) to help them respond more effectively to fluctuating demand patterns. As with the compressors, the dryers were rotated to prevent excessive wear on either dryer. In addition, the facility personnel lowered the system operating pressure from 145 psig to 105 psig. Lowering the system pressure allowed the compressor discharge pressure to be set at 110 psig whereas before, it had been as high as 150 psig. The 125-hp compressor was left offline to serve as a backup unit and the two 75-hp compressors were no longer in use.

The Cost of System Pressure

For systems in the 100 psig-range, for every 2-psig increase in discharge pressure, energy consumption will typically increase by approximately 1% at full output flow (check performance curves for centrifugal and two-stage lubricant injected rotary screw compressors).

There is also another penalty for higher-than-needed pressure. Raising the compressor discharge pressure increases the demand of every unregulated usage, including leaks, open blowing, etc. Although it varies by plant, unregulated usage is commonly as high as 30-50% of air demand. For systems in the 100 psig range with 30-50% unregulated usage, a 2 psig increase in header pressure will increase energy consumption by about another 0.6-1.0% because of the additional unregulated air being consumed (in the worst-case scenario, the extra flow could cause another compressor to start).

The combined effect results in a total increase in energy consumption of about 1.6-2% for every 2 psig increase in discharge pressure for a system in the 100 psig range with 30-50% unregulated usage.

Project Results

The retrofit of the facility's compressed air system and the reduction in system pressure has made The Bakersfield Californian's system more efficient and led to important energy savings. Prior to the project's implementation, the 125-hp compressor consumed over 747,000 kWh and the air dryers consumed an additional 67,000 kWh per year. With the newly configured system, the smaller, more efficient compressors consume 299,000 kWh annually and the dryers 8,000 kWh per year. The facility's total compressed air energy savings are 507,000 kWh per year or $46,000. This represents a 65% reduction in its compressed air power costs. Much of these energy savings were achieved by lowering the system pressure, which did not require any capital expenditure. By implementing the project, the Californian received total net incentive payments from its utility of over $28,000 including a $7,000 bonus for peak non-use in the summer of 2001. In addition, the Californian was able to sell one of its 75-hp units for $1,200. With total project costs of $69,000 and total savings of $74,000, the facility achieved a simple payback of less than 1 year.

Lessons Learned

High-pressure air is expensive to generate and should only be produced when necessary. In this case, inaccurate assumptions about the pressure level needed to achieve reliable production led to an excessive system pressure level and unnecessarily high compressed air energy costs. By simply lowering its system pressure from 145 psig to 105 psig, The Bakersfield Californian reduced its compressed air energy costs by around 20%. In addition, the compressed air system was greatly oversized for the facility's compressed air needs. Once an optimally sized system was installed that provided an adequate volume of air at a lower system pressure level that achieved production requirements, The Bakersfield Californian was able to reduce its compressed air energy costs by 65%.

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PROJECT PARTNERS

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