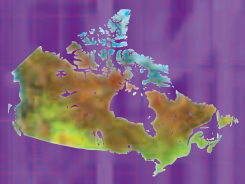

Canadian Industry Program for Energy Conservation

CIPEC

Case Study:
Kruger LaSalle

Energy Efficiency in the Production of Corrugated Cardboard Packaging

Highlights

- Electricity consumption for compressed air system reduced by 25 percent
- Cost of operating the compressed air system reduced by 42 percent
- Water consumption reduced by 38 000 m^3 annually
- Production increased due to better quality of compressed air

Introduction

Through the Canadian Industry Program for Energy Conservation, Natural Resources Canada's (NRCan's) Office of Energy Efficiency offers a financial incentive to help industrial companies increase energy efficiency, improve production processes and cut costs. Program funding is available for up to 50 percent of the cost of an energy audit performed by a professional energy auditor, to a maximum of $5,000.

With funding from NRCan's Industrial Energy Audit Incentive program, Kruger Inc., a pulp and paper manufacturer specializing in the fabrication and multi-colour printing of corrugated cardboard packaging, had an energy audit conducted at its plant in LaSalle, Quebec, in 2003. By implementing measures identified in the audit, which included plugging leaks in the compressed air distribution lines and replacing air compressors, Kruger was able to reduce the annual operating costs of its compressed air system by 42 percent. It was also able to reduce its space heating costs by recovering heat from the system and to eliminate its use of municipal water for system cooling.

Plant profile

Kruger is a major pulp and paper manufacturer with operations in British Columbia, Alberta, Ontario, Quebec, Newfoundland and Labrador, the United States and the United Kingdom. It employs more than 10 500 people worldwide.

Kruger's LaSalle plant produces 100 percent recyclable corrugated cardboard packaging for companies in the food and beverage, chemical, textiles, clothing and agricultural sectors. It has an annual production capacity of 1.2 billion square feet of corrugated cardboard.

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The corrugated cardboard is manufactured from rolls of paper produced in other factories and shipped to the LaSalle plant. The packaging is produced by printing, cutting, folding and gluing the cardboard. The LaSalle plant specializes in four-colour flexographic printing – a printing process that uses a flexible, relief-type printing plate.

The manufacturing process uses electricity and natural gas. Natural gas is also used for space heating. In 2001–2002, the plant used more than 7 gigawatt hours of electricity, at an approximate cost of $425,000, and approximately 1.4 million m^3 of natural gas, at a cost of about $580,000.

Energy audit

The LaSalle plant audit, conducted by R.O. Poirier Inc., examined the air compressors and the compressed air distribution lines and identified energy efficiency measures that would reduce the amount of electricity used by the compressed air system. Kruger received financial support from NRCan's Office of Energy Efficiency equal to 50 percent of the professional fees for the audit.

Kruger's LaSalle plant uses compressed air to operate its production equipment including the printing presses, conveyors and splicers on the corrugated cardboard machine. Compressed air is also used for cleaning some equipment.

At the time of the energy audit, the compressed air system comprised two single-speed, water-cooled compressors, rated at 112 kilowatts (kW) and 149.2 kW (150 horsepower [hp] and 200 hp), respectively, and a compressed air reservoir to which both compressors were connected. In 2001–2002, it cost the company about $131,000 to operate the compressed air system, including the cost of electricity and water used for cooling the compressors.

The audit found a very high rate of leaks – 45 percent of the compressed air was lost. The leaks meant that the compressors had to operate for longer periods with consequent increases in electricity consumption. The annual cost of producing compressed air was calculated to be $215 per SCFM (cubic foot per minute under standard conditions of temperature and pressure – 15°C (59°F) and atmospheric pressure). This is considerably higher than the $110 per SCFM cost usually associated with screw compressors. As well, the leaks reduced the system's capacity to provide compressed air at the volume and pressure required by the plant's equipment.

The proposed energy efficiency measures included plugging the leaks and improving the current system by replacing the two compressors with a new variable-speed, air-cooled unit. The ability to control the air pressure was also improved by adding a new air reservoir.

The amount of the leaks was determined by measuring the flow of compressed air produced by the system on a weekend when there was no activity at the plant. The audit found that there were leaks throughout the plant, with the biggest ones in the roller conveyers. The plant's staff worked to correct the loss, and the demand for compressed air dropped by over 300 SCFM, or about 40 percent of the compressed air produced by the system.

To improve the performance of the compressed air system, the auditors proposed measures applicable to both the individual components of the system and the system as a whole. However, because the compressors had been in service for many years and because their performance had dropped to below 70 percent of their rated volume, the plant decided to replace the entire compressed air system. This option also had the advantage of a shorter payback period.

The plant's compressed air system was replaced with a single variable-speed, air-cooled compressor rated at 112 kW (150 hp). Unlike a single-speed compressor that runs at the same speed whenever it is on, a variable-speed compressor adjusts the speed of its drive motor so that the production of compressed air matches the demand placed on the system, thus reducing energy costs. Given its increased efficiency, the new compressor is sufficiently powerful to meet the plant's reduced demand for compressed air, which resulted from eliminating leaks.

Since the new system is air-cooled, water is no longer used for cooling as it was with the old system. Air compressors give off a lot of heat – generally 80 to 90 percent of the electrical energy supplied to the compressor is converted to heat. At Kruger's LaSalle plant, the heat given off by the air compressor is now recovered and used as a supplementary source of space heating during the winter. It is vented outside during the summer when space heating is not required.

A new compressed air reservoir, larger in volume than the existing reservoir, was also installed. This reservoir receives the compressed air as it is produced and acts as a buffer downstream from the compressors, cushioning fluctuations in the airflow and allowing for a better control of system pressure.

Installation of the new compressor, which was done by a team of subcontractors working under the direction of the plant's engineers, did not affect production since the old compressed air system was kept in operation until the new one was up and running. Purchase and installation costs of $170,000 were partially offset by $67,000 in financial assistance from Hydro-Québec, through its Industrial Initiatives Program.

Results

By implementing the measures proposed in the energy audit, Kruger's LaSalle plant was able to reduce its production of compressed air by more than 40 percent and the annual operating costs of the compressed air system by 42 percent. Blocking the leaks alone generated savings of over $60,000 annually.

Reducing the demand for compressed air and installing a new variable-speed, air-cooled compressor helped the plant to reduce the annual electricity consumption of its compressed air system by approximately 25 percent and reduce the plant's water consumption by 38 000 m^3, generating savings of $55,000 annually. By recovering energy from the air used to cool the system, the plant has reduced its natural gas consumption by 21 000 m^3 annually, resulting in savings of $5,000 on space heating costs.

Considering the net cost of $103,000, and savings of $60,000, the installation of a new compressed air system represented a financially attractive investment with a payback period of approximately 20 months. In addition to the significant energy savings, the new compressor ensured better regulation of the air pressure in the network. This in turn eliminated breaks in production at the plant due to the drops in network pressure that occurred with the former compressed air system.

Kruger's commitment to fostering the environmentally friendly use of natural resources, and their LaSalle plant's determination to increase the energy efficiency of its operations by improving the performance of its compressed air system, ensured the successful outcome of their energy audit.

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Cat. No. ??
ISBN ??

Aussi disponible en français sous le titre :
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