



ENERGY EFFICIENCY CASE STUDY

INDUSTRIAL

Variable-frequency drive produces savings for manufacturing plant

Summary

A rubber manufacturer recently installed a variable-frequency drive on a 1,500 horsepower motor used to power an extruder. The drive saves the customer more than \$40,000 per year in utility bills and improves extruder operations and the power factor for the entire plant.

Customer Background

The customer is a major industrial manufacturer that has been in business in MidAmerican Energy Company's service territory for more than 60 years. This facility serves national and international markets using just-in-time manufacturing methodologies.

The plant's electrical engineer sees energy efficiency as key to maintaining competitiveness. "In the global market of the rubber industry, a great deal of attention is given to efficiency improvements to maintain the local plants' profitability compared to similar plants and the competition. Cost-saving ideas and innovative process improvement always are paramount in contributing to a healthy bottom line. The variable-frequency drive showcased in this project is an example of an effective cost-saving improvement," the plant's electrical engineer said.

How the Program Works

The customer relies on the motor to power an extruder used to blend various solids, oils, carbon and other chemicals. Prior to installing the variable-frequency drive, the customer used an electromagnetic, eddy-current clutch to control motor output. The clutch was replaced with a Robicon 24-pulse frequency drive. The variable-frequency drive alters the voltage frequency to the motor allowing for precise speed control and maximum energy savings. Robicon drives are IEEE 1100-1999 compliant at the termination lugs. Installation was completed during a maintenance shutdown period. Preparation of a clean room and initial installation of the drive took several months.

Because the variable-frequency drive could be placed away from the extruder in a separate climate-controlled clean room, space became available that had been occupied by the eddy-current clutch near the extruder allowing for easier maintenance. There also were coupling inefficiencies using the eddy-current clutch that resulted in wasted energy, and by sizing the drive properly the motor now provides a 150 percent torque capability at very low revolutions per minute.

What were the benefits?

- More than \$40,000 per year in electricity bill savings
- Additional \$15,000 per year in power factor bill savings
- 1.3 million kilowatt-hours in annual electricity savings
- \$7,500 rebate from MidAmerican Energy
- 240 man-hours per year in reduced cleanup requirements
- Higher extruder availability, lower product waste and product contamination
- Improved power factor for the entire plant



This project utilized MidAmerican Energy's prescriptive Nonresidential Equipment program. After preapproval from MidAmerican Energy, the variable-frequency drive was ordered and installed. Copies of the invoices along with the one-page application form were sent in, and a rebate check was promptly processed. At the time of this project, the incentive was \$5-\$20 per horsepower of the driven motor, based on a stepped schedule. Rebate levels have since increased to \$30 per horsepower for all sizes. The program also requires that motors operate a minimum of 3,000 hours annually.

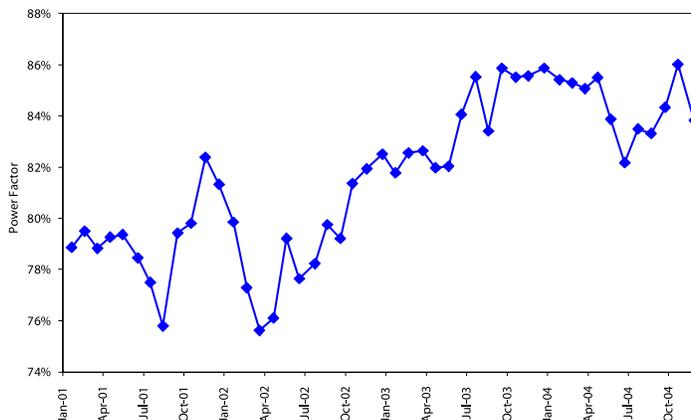
Benefits

The customer saves 1.3 million kilowatt-hours per year with the variable-frequency drive producing electricity bills savings of more than \$40,000. An analysis of extruder operation with the variable-frequency drive shows that more than 40 percent of the extruder's electricity consumption was wasted through the clutch controller. The customer received a \$7,500 rebate from MidAmerican Energy, lowering the capital cost of the variable-frequency drive from almost \$239,000 to less than \$231,000. Based on the electricity savings alone, the variable-frequency drive, after MidAmerican Energy's rebate, provided the customer with a 5.75-year simple payback on its investment. Additional labor, product quality and power-factor benefits further reduced the project's payback time.

The drive also improves extruder operation. With the variable-frequency drive, the unit can be brought online at very low revolutions per minute and ramped up, eliminating the need to shut down and clean out the unit after long idle periods. This procedure saves the customer more than 240 man-hours per year in labor costs. Product consistency also improves because the variable-frequency drive can adjust batch speed to continuously maintain desired temperatures. The variable-frequency drive also provides a soft start capability that will prolong the life of the motor and ease mechanical stress on the extruder.

The extruder and other variable-frequency drives installed in the plant also have increased the plant's power factor and lowered the plant's volt-ampere-reactive bill. As shown in the chart below, the power factor increased from under 80 percent to almost 86 percent after the extruder's variable-frequency drive installation in June 2001. The power factor improvement produced annual utility bill savings of approximately \$15,000.

Plant Power Factor



(Note: The initial decline in late 2001 was caused by a failed capacitor at the plant unrelated to variable-frequency drive operation.)

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Who else can benefit?

- Manufacturing customers with variable loads on motors driving extruders, mixers, pumps, fans and other process loads
- Commercial customers with variable loads on heating and/or cooling pumps and fans

What are customers saying?

"The variable-frequency drive showcased in this project is an example of an effective cost-saving improvement."

– Plant Electrical Engineer

Who can answer questions?

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