Reducing energy use at QX Inc.

QX Inc. made changes to equipment and maintenance practices, along with some simple and inexpensive process modifications, in order to realize significant energy and cost savings

QX Inc. is an aluminum die casting and finishing facility in Hamel, Minnesota. Die casting is one of several metal product producing processes that injects molten metal under pressure, typically aluminum, zinc, magnesium, into a die cavity to form one or several parts simultaneously.

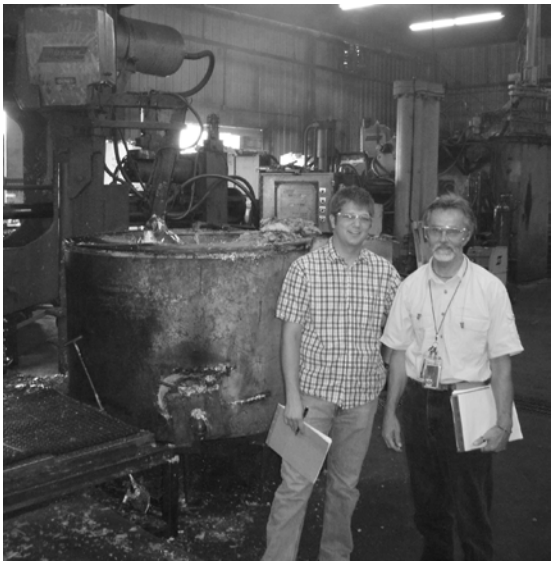
Die casting is a complicated manufacturing process that involves significant capital investment in metal melting and pressure forming equipment and supplies, large amounts of raw material resources, and substantial energy use. To better understand the natural gas use of the facility, QX worked with a MnTAP intern during the summer of 2006. The intern identified natural gas energy reduction opportunities in the gas-fired breakdown and holding furnaces.

Gas-fired breakdown furnaces

Redesign

Furnaces must be well maintained to be as energy efficient as possible. Furnaces sized and operated at capacity use available energy most effectively. Changes to production requirements need to take into account the energy demands of a furnace. The MnTAP intern recommended that QX re-engineer the capacity of the large 24,000 lb capacity natural gas breakdown furnace to better match melt production needs.

The capacity of the 24,000 lb furnace was physically reduced 50% by installing a dry hearth in the back half of the furnace. This allowed two of four gas-fired burners to be adjusted to low fire, saving a substantial amount of energy. Additionally, the reduced capacity of the furnace more closely matched production requirements. The construction of the dry hearth also provided a shelf in the back of the furnace where large amounts of aluminum were able to be preheated before entering the melt bath, reducing the impact of charging the bath with cold metal.



Intern Andrew Rosander and MnT'AP staff member Mick Jost in front of furnace at QX Inc.

A one-time cost savings of $13,200 resulted from eliminating the excess metal in inventory. The estimated energy consumption savings after the installation of the dry hearth is between 1.9 and 2.8 MMBTU/hr.

Regular maintenance

In gas-fired melting maintaining 10% excess air is important in order to maximize the flame temperature and heat transfer without creating excessive aluminum deterioration, air emission contaminants, or fuel loss. Different instruments can help maintenance staff track burner performance and service the burners as needed. QX purchased a flue gas analyzer to provide periodic readings of burner performance and added this to a routine maintenance program, allowing

Benefits Overview

Waste Reduction Option	Waste Reduced/ Materials Savings	Annual Cost Savings
Covering charge wells	4,240 therms/year	$2,970
Adding crucible furnace covers	2,170 therms/year	$1,520

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better monitoring of the combustion efficiency of the gas-fired aluminum breakdown furnaces. Proper combustion tuning could result in an 11% fuel savings.

Proper Insulation

Insulation on furnace doors gets easily damaged and should be routinely refurbished and refitted. Furnace insulation technologies have greatly improved, providing better heat retention performance and reducing radiation energy losses. Taking surface temperature readings at various locations on a furnace should indicate where excessive heat is radiating. High temperature readings would be a good indication of air gaps or failure of the refractory insulation. For QX, adding insulation to the large furnace would result in a $4,700 savings and potential annual energy savings of 671 MMBTU.

Properly insulated and well-fitted charge well covers should always be in place except when removing oxides and impurities or otherwise treating a melt bath. QX implemented use of charge well covers for an annual energy saving of 424 MMBTU and cost savings of over $2,900.

The intern also identified improvement opportunities for regular furnace maintenance. Thermocouples control the burners that regulate the temperature of the aluminum melting or melted metal holding process. In the metal casting industry melt energy use is estimated to be 55% of the total energy used. Real-time accuracy is important in order to adjust the energy use and avoid varying from target temperatures which can cause the melt bath to either overheat from excessive gas firing or to cool below required temperatures. Thermocouples need to be maintained and positioned carefully. They should not be too deep, too shallow, or exposed to the direct heat of combustion to accurately sense the melt temperature and optimize energy use. The general condition and proper placement of the furnace thermocouples was identified by the intern as very important. It was estimated that malfunctioning thermocouples or improper placement that would light burners on high-fire just two additional hours per day could potentially cost QX at least $10,000 annually.

Holding furnaces

Small capacity holding furnaces are typically placed at each die casting machine to have a supply of melted aluminum ready to cast. The holding furnaces at QX are supplied from the breakdown furnaces with a fork truck and a ladle. Crucible holding furnaces are the traditional holding furnace design. The main production advantage of the crucible holding furnaces is the capability to melt as well as hold metal and generally also to have a quick recovery time. During casting activities, melted metal is dipped out and poured into the die cast machine every few seconds to make the next cycle of parts. This process leaves the crucible furnace top exposed to radiant and convective heat loss during casting. QX realized approximately $1,520 in savings by using furnace covers on their four crucible holding furnaces. That cost savings translated to an energy saving of 217 MMBTU.

Different holding furnace designs that incorporate a smaller dip well opening, more efficient burners (or electric heaters), and insulation can be much more energy efficient. QX has three of these better designs and the MnTAP intern developed two recommendations to replace the existing crucibles with the better designs.

Summary

Following the intern's recommendations, QX was able to capitalize on changes to equipment and maintenance practices, along with some simple and inexpensive process modifications. The company realized significant energy and cost savings during this continuing time of energy cost escalation. Overall, QX is saving nearly $4,500 and reducing energy use by 6,410 therms annually.

For More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution, increase energy efficiency, and reduce costs. Our information resources are available online at <mntap.umn.edu>. Please call MnTAP at 612.624.1300 or 800.247.0015 for personal assistance or more information about MnTAP's Intern Program.