Metal and Glass Manufacturers Reduce Costs by Increasing Energy Efficiency in Process Heating Systems

Introduction

Process heating plays a key role in the production of basic materials such as steel, aluminum, and glass and in the manufacture of value-added products made from these materials. Faced with regulatory and competitive pressures to control emissions and reduce operating costs, metal and glass manufacturers are considering a variety of options for reducing overall energy consumption. As 38% of the energy used in U.S. industrial plants is consumed for process heating applications, metal and glass manufacturers are discovering that process heating technologies provide significant opportunities for improving industrial productivity, energy efficiency, and global competitiveness.

The plant-wide assessment (PWA) is a valuable tool that helps manufacturers identify energy- and cost-saving opportunities in industrial facilities. When a company conducts a PWA, it uses a system-level approach to investigate plant energy use and identifies opportunities to implement energy efficiency technologies, along with other best energy management practices. The U.S. Department of Energy's (DOE) Industrial Technologies Program (ITP) cosponsors PWAs through a solicitation process. This fact sheet provides a brief overview of energy efficiency improvement opportunities in process heating systems, and gives examples of how PWAs identified such opportunities in metal and glass manufacturing facilities.

Opportunities in Process Heating for Metal and Glass Manufacturers

With wide and varied industrial use, process heating operations are generally characterized as fluid heating, calcining, drying, smelting, agglomeration, sintering, heat treating, metal heating, metal and nonmetal melting, curing and forming, incineration, thermal oxidation, or other heating processes. Process heating systems are made up of different components including:

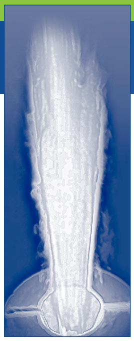
- Heating devices that generate and supply heat
- Heat transfer devices to move heat from the source to the product
- Heat containment devices, such as furnaces, heaters, ovens, and kilns
- Heat recovery devices.

The system can also include a number of other support systems, such as sensors and controls, material handling, process atmosphere supply and control, emissions control, safety, and other auxiliary systems. Process heating equipment operates over a broad range of temperatures. Low-temperature process heating applications such as food preparation, chemical processing, and drying operations are generally limited to 600°F or less. Processes requiring temperatures greater than 600°F represent the greatest potential for energy savings, because the margin for improvement is large and the returns are greater. Performance and efficiency improvement opportunities can be grouped into the following categories:

- Heat generation
- Heat containment
- Heat transfer
- Waste heat recovery
- Enabling technologies, including application of advanced sensors and controls and use of advanced materials.

Some of these opportunities can be implemented at little or no cost. For example, tuning burners to reduce excess air is a cost-effective technique to reduce the amount of heat lost in the exhaust. Closing oven doors when operations permit and turning off pumps and

This large-diameter gear was heat-treated at the Metlab facility in Wyndmoor, Pennsylvania.



fans when not needed are other no-cost energy saving options. Installing thermal insulation and maintaining refractory linings are effective ways to reduce heat loss with simple paybacks of 1 year or less. Significant energy savings can be realized by installing equipment for capturing and using waste heat and by using advanced sensors, controls, and materials. However, application of enabling technologies is often capital intensive and may require changes in the process or operating procedures.

Case Studies

ITP has cosponsored PWAs at a number of metal and glass manufacturing facilities. These energy assessments have successfully identified opportunities to improve industrial energy efficiency, productivity, and global competitiveness, and to reduce waste and environmental emissions. These opportunities may be grouped into the following general categories:

- Improve controls systems
- Preheat combustion air
- Recover furnace waste heat
- Improve maintenance on furnaces to reduce heat losses
- Install variable speed drives when appropriate
- Optimize air-to-fuel ratios
- Optimize cycle length and furnace loading
- Preheat process materials and equipment
- Upgrade equipment to more efficient technologies.

Examples of Process Heating Energy Efficiency Improvement Projects

AMCAST Industrial Corporation recently conducted a PWA at its aluminum casting plant in Wapakoneta, Ohio. The assessment team made several recommendations to improve the energy efficiency of the reverberatory (remelt) furnaces. The reverberatory furnaces melt prime ingots and reheat liquid aluminum from the jet melter. Heat is lost from the burners through the flue gases and furnace walls and openings. The assessment team recommended three measures to increase the furnaces' thermal efficiency. First, the team recommended that flue gases be used to preheat the charge material. This could be accomplished by installing a separate heater box close to the furnaces. Another recommendation to install furnace door seals of an improved design and to perform preventive maintenance on the seals on a regular basis would reduce the air leakage into the furnaces. A third recommendation to monitor and adjust the burner air-fuel ratio to maintain optimum combustion would save fuel and reduce carbon monoxide emissions.

A different type of process heating opportunity was identified at Metlab's heat treating facility in Wyndmoor, Pennsylvania. The PWA team recommended a project to optimize the loading and scheduling of the heat treating furnaces by reducing furnace holding times and optimizing soak times for long cycles.

Another process heating efficiency improvement opportunity was identified at Corning's automotive headlight lens glass manufacturing plant in Greenville, Ohio. This project involved a modification to the zoned furnace to use oxy-fuel firing with 30% electric boost and preheating of the glass batch with the waste heat from the furnace flue gases. The retrofit cost for the system would include installing the oxy-fuel system, modifying the electric system, rebuilding the tank using a higher-grade refractory, and adding a batch preheating system.

Learn how your company can take advantage of energy- and cost-saving opportunities in process heating systems. To find out more about process heating best practices and PWAs, you can read the case studies by logging on to the ITP BestPractices Web site at **http://www.oit.doe.gov/bestpractices**.

BestPractices is part of the Industrial Technologies Program, and it supports the Industries of the Future strategy. This strategy helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together emerging technologies and energy-management best 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.

For Additional Information, Please Contact:

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DOE/GO-102004-1891
May 2004