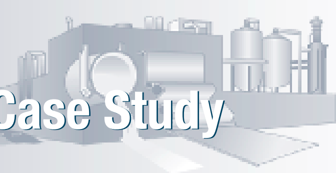

Pechiney Rolled Products: Plant-Wide Energy Assessment Identifies Opportunities to Optimize Aluminum Casting and Rolling Operations

Benefits

- Identified annual energy savings of 460,000 MMBtu and 9.6 million kWh
- Identified annual cost savings of $2.5 million
- Found opportunities to reduce annual CO_2 production by 69 million pounds

Application

Aluminum casting and rolling are energy-intensive processes. A comprehensive assessment of energy consumption, efficiency, and productivity improvement opportunities for an aluminum casting and rolling mill included baseline data acquisition and development of accounting procedures for tracking and analysis of plant equipment and operating practice improvements. Recommendations resulting from the assessment included several low-cost, best practices type solutions that are applicable to almost all industries; e.g., air compressor system improvements. The assessment illustrates that high tech solutions are not needed to effectively capture substantial energy savings.

Summary

Previous energy assessments at the Pechiney Rolled Products plant, in Ravenswood, West Virginia, had identified the melting/casting, ingot reheating, and rolling operations as the primary energy consumers in the plant. Using the results of these studies as a starting point, Pechiney conducted a plant-wide assessment (PWA) to analyze energy consumption and to identify opportunities to improve energy efficiency and productivity. The PWA identified potential annual natural gas savings of 460,000 million British thermal units (MMBtu) and 9.6 million kilowatt-hours (kWh) in annual electricity savings. If all the projects identified during the assessment were implemented, carbon dioxide (CO_2) production could be reduced by 69 million pounds and the plant could save $2.5 million annually. This assessment illustrates that application of well-known energy conservation best practices can yield significant, cost-effective energy savings.

Public-Private Partnership

The U.S. Department of Energy's (DOE) Industrial Technologies Program (ITP) cosponsored the assessment through a competitive process. DOE promotes plant-wide energy efficiency assessments that will lead to improvements in industrial energy efficiency, productivity, and global competitiveness, while reducing waste and environmental emissions. In this case, ITP contributed $83,000 of the total $224,000 assessment cost.

Plant Description

The Pechiney Group operates in two core businesses, the production of primary aluminum and fabricated aluminum products and the production of packaging materials. Pechiney operates 61 production facilities in the United States and has sales facilities in 50 countries, including Europe, the United States, Asia, and South America.

The Pechiney Rolled Products plant in Ravenswood comprises two major operations. In the casting operation, molten aluminum is refined and mixed with alloying agents and cast into ingots. Ingots are then cooled and transported to a rolling facility for surface machining, heating, and rolling into various types of sheet and plate products. The Ravenswood plant produces aluminum coils, sheets, plate, and ingots for a variety of markets, including aircraft and automotive industries.

Molten aluminum purchased offsite is combined with scrap and then refined, alloyed, and cast into ingots in the cast shop. The ingots are further finished in the fabrication shop, and finally rolled into plate or coils. Electric motors and lighting are primary users of electrical energy in the cast shop. The rolling mill's pumps, fan motors, air compressors, lighting, and the nitrogen plant are primary electric loads on the fabrication side of the plant. Melting and holding furnaces in the cast plant and ingot homogenizing furnaces, annealing furnaces, and heat-treating/aging furnaces are the primary users of natural gas. The plant also purchases steam for process heating and for vaporizing chlorine, used in the fluxing process.

Assessment Approach

Previous energy assessments at the Pechiney Ravenswood plant had identified the melting/casting, ingot reheating, and rolling operations as the primary energy consumers in the plant. Using the results of these studies as a starting point, Pechiney conducted a PWA to analyze energy consumption and to identify opportunities to improve energy efficiency and productivity.

The assessment team conducted interviews with engineers, managers, production supervisors, and maintenance personnel to collect detailed information about the operating procedures, processes, and equipment in each area of the plant. The team also gathered information regarding recently implemented or planned energy conservation measures, problems, and specific areas of concern that plant management deemed important. Baseline energy consumption data, including monthly utility bills for the past year was also accumulated. Where possible, utility data was separated by the various plant areas or by individual processes or machines. Production data was also collected and correlated against energy data where possible. Areas addressed during the assessment included the plant compressed air system, plant lighting, the nitrogen production system, annealing processes, process heating, melting furnaces, and the rolling mill lubricating oil system.

Data collected for the study included:

- Energy used for lighting in the finishing side of the plant
- Combustion efficiency of the burners on the annealing furnaces and soaking pits
- Process temperatures and process start and stop times
- Nitrogen leaks from furnaces, hot spots in insulation, and inconsistent temperatures in product coils and slabs.

The assessment team used their data and observations to evaluate operations and maintenance practices, system efficiencies, and process improvement opportunities. Based on their assessments, the team developed recommendations for improvements in operations, maintenance, and production processes, and identified ways to optimize nitrogen production. The team also used the data to estimate implementation costs and energy savings. Implementation costs were conservatively estimated to obtain worst-case estimates of simple payback periods. Only those opportunities with a payback period of less than 2 years were considered.

Results and Projects Identified

Table 1 summarizes the results of the Pechiney plant-wide energy assessment.

Following are brief descriptions of each project.

Project 1 – Maintain compressed air system

Establish a system for continuous inspection and repair of the compressed air system, including compressor maintenance improvements and elimination of compressed air leaks.

Project 2 – Upgrade air compressor controls

Upgrade and integrate the air compressor control system to allow more effective staging and operation. Consider using reciprocating compressors as part of a load-following strategy.

Table 1. Summary of Energy Conservation Opportunities								
Project No.	Project Description	Annual Energy Savings		Annual CO_2 Production Reduction (lb)	Annual Cost Savings ($)	Capital Cost ($)	Payback Period (yr)
		Electricity (kWh)	Natural Gas (MMBtu)				
1	Maintain compressed air system	2,850,000	NA	6,090,000	74,000	0	0
2	Upgrade air compressor controls	1,460,000	NA	3,120,000	38,000	50,000	1.3
3	Use HID* lighting technology	2,310,000	NA	4,930,000	60,000	120,000	2
4	Turn off idling equipment	615,000	NA	1,310,000	16,000	0	0
5	Eliminate nitrogen leaks	NA	NA	0	200,000	118,000	0.6
6	Reduce nitrogen used in annealing processes	962,000	NA	2,050,000	25,000	10,000	0.4
7	Reconfigure nitrogen plant	1,920,000	NA	4,100,000	50,000	98,000	2
8	Manage comfort heating system	-518,000	224,000	22,590,000	1,014,000	185,000	0.2
9	Establish burner testing and maintenance program	NA	153,000	16,200,000	692,000	360,000	0.5
10	Improve heat transfer from radiant tubes to annealing atmosphere in cold rolled annealing furnaces	NA	28,800	3,050,000	130,000	42,000	0.3
11	Replace missing melter port covers	NA	2,000	234,000	10,000	20,000	2
12	Upgrade lubricating oil systems	NA	50,900	5,400,000	230,000	90,000	0.4
13	Replace leaking steam trap	NA	1000	84,000	4,000	1000	0.3
	Total	**9,599,000**	**459,700**	**69,158,000**	**2,543,000**	**1,094,000**	**0.4** aggregate average

*High intensity discharge

Project 3 – Implement HID lighting technology

Consider implementing High Intensity Discharge (HID) dimming technology for industrial lighting to reduce power consumption. Dim lights to 50% power in areas of the plant when full power is not needed on a full-time basis.

Project 4 – Turn off idling equipment

Turn off equipment not in use for production processes. Candidate equipment includes conveyors, hydraulic pumps, personnel fans, computers, and compressed air chip blowers.

Project 5 – Eliminate nitrogen leaks

Identify and eliminate leaks in the nitrogen production system.

Project 6 – Reduce nitrogen used in annealing processes

Nitrogen is currently being wasted in annealing processes because of improper operator practices.

Nitrogen waste can be minimized by:

- Shutting off flow to the annealing furnaces during loading and unloading
- Adjusting flow rates to the furnaces
- Upgrading operations manuals for adjusting nitrogen flow controls.

Project 7 – Reconfigure nitrogen plant

Reconfigure the nitrogen plant to optimize liquid nitrogen production. Optimize nitrogen production to match actual process consumption. Coordinate annealing production schedule with nitrogen plant production to control production load swings. Use an automated control system to manage annealing furnace cycles to prevent large load fluctuations.

Project 8 – Manage comfort heating system

Disconnect unneeded space heaters and modify control systems and/or work practices so that heaters are not left on in unoccupied areas. Replace inefficient heaters in critical areas with radiant electric units that have timers or motion sensors.

Project 9 – Establish burner testing and maintenance program

Current operation of natural gas burners for process heating is characterized by inconsistent burner operation. For example, average combustion efficiency was measured at 58%, excess air levels range from 7% to 100%, and carbon monoxide concentrations range from 0 ppm to more than 6,000 ppm. To improve burner efficiency and consistency of operation, a burner testing and maintenance program will be established. The most heavily used burners will be repaired and tuned first.

Project 10 – Improve heat transfer from radiant tubes to annealing atmosphere in cold rolled annealing furnaces

Both the annealing furnaces and the pit furnaces for ingot heating are inefficient designs. Heat transfer from the burners to the furnace atmosphere is accomplished by radiant tubes arranged parallel to the primary airflow. The furnace design does not enhance convective heat transfer, and airflow patterns are inefficient. The plant could improve heat transfer by increasing the surface area to which the heat from the radiant tubes is transferred. By installing aluminum plates between the refractory wall and the burner tubes, Pechiney will double the available surface area for convective heat transfer.

Project 11 – Replace missing melter port covers

Molten metal from the crucibles is poured through ports into the melting furnaces in the casting area. Covers for the ports are missing on many furnaces, however. By replacing the missing covers, Pechiney will reduce the significant heat loss and the hot combustion gases and radiation that escape from hot furnace walls.

Project 12 – Upgrade lubricating oil systems

Install upgraded instrumentation for the temperature and flow control systems for lubricating oil in the rolling mill. By installing more accurate instrumentation, plant operators will more precisely control lubricating oil holding tank temperatures and eliminate overheating. Pechiney can reduce the rolling oil flow rate to 20% of full volume during idle periods in the rolling mills and thus reduce energy consumption, increase pump and filter life, and reduce treatment costs.

Project 13 – Replace leaking steam trap

Replace the leaking steam trap on the condensate return from the chlorine house heat exchanger.

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.

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DOE/GO-102004-1889
July 2004

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