Aluminum BestPractices Plant-Wide Assessment Case Study

Industrial Technologies Program

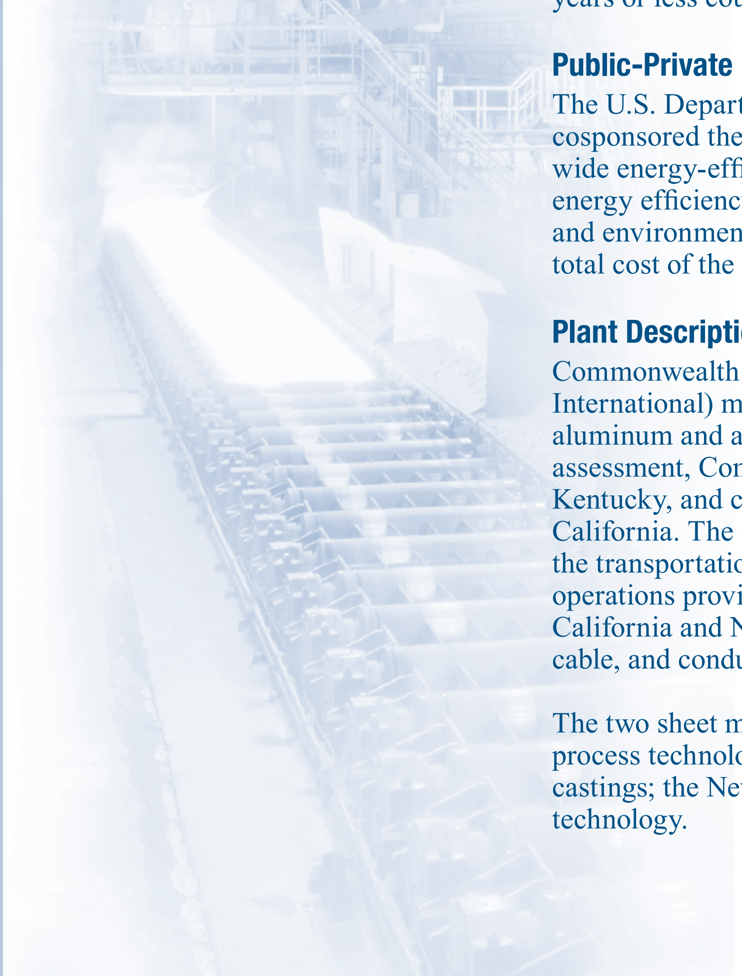
Commonwealth Aluminum: Manufacturer Conducts Plant-Wide Energy Assessments at Two Aluminum Sheet Production Operations

Benefits

- Cost savings of more than $11 million per year
- Fuel savings of about 1 million MMBtu annually
- Electricity savings of about 38 million kWh annually

Application

Analysis methodologies and resulting energy efficiency improvement projects are applicable to facilities employing both continuous-casting and direct-chill aluminum sheet production processes.



Summary

To improve process and energy efficiency, Commonwealth Industries (now Aleris Rolled Products) conducted plant-wide energy assessments at its aluminum sheet rolling mills in Lewisport, Kentucky, and Uhrichsville, Ohio. To assess current and historical energy consumption rates and theoretical minimum energy limits, the assessments focused on analyzing the processing procedures involved in converting aluminum scrap feed material to finished coiled sheet products. The assessment team recommended 10 potential projects to improve the efficiency of processes at the two rolling mills. Estimates indicate that implementing all 10 projects could result in annual cost savings of more than $11 million. Corresponding energy savings would be about 1 million MMBtu and 38 million kWh annually. The total capital costs required to implement all the projects would be about $31 million. Implementing just those projects with payback periods of 2 years or less could yield more than $2.4 million in annual cost 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, DOE contributed $100,000 toward the total cost of the assessment.

Plant Description

Commonwealth Industries (now Aleris Rolled Products, a division of Aleris International) manufactures common alloy aluminum sheet from recycled aluminum and aluminum and nonmetallic wiring products. At the time of the assessment, Commonwealth had direct-chill casting facilities in Lewisport, Kentucky, and continuous-casting mini-mills in Uhrichsville, Ohio, and in California. The company manufactured aluminum sheet for distributors and for the transportation, construction, and consumer durables end-use markets. These operations provided a direct supply link to Commonwealth's Alflex operations in California and North Carolina, which produce a wide range of electrical raceway, cable, and conduit products.

The two sheet manufacturing plants employ fundamentally different production process technologies. The Lewisport Rolling Mill utilizes direct-chill ingot castings; the Newport Rolling Mill in Uhrichsville employs continuous-casting technology.

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The direct-chill process makes use of reversing hot mills to homogenize, scalp, and break down large cast ingots. Additional processing includes hot reduction using multistand mills, coiling, annealing, cold reduction, and finishing. In the continuous-casting operation, molten metal is fed from an adjacent scrap casting operation and from melted in-house scrap to the continuous-casting unit, which produces aluminum strip. The as-cast strip is fed directly to a multistand hot mill and then goes through coiling, annealing, cold reduction, and finishing operations. The continuous-casting process eliminates the scalping, homogenization, and reversing hot mill operations that are part of the direct-chill process.

Assessment Approach

Commonwealth conducted plant-wide energy assessments at the Lewisport and Newport (in Uhrichsville) aluminum sheet production mills. To assess current and historical energy consumption rates and theoretical minimum energy limits, the assessments focused on analyzing the processing procedures involved in converting aluminum scrap feed material to finished coiled-sheet products. Specifically, the assessments involved looking at the role of process technologies, the impact of operating procedures, and the effects of alloy composition, temper, sheet width, sheet thickness, and coil weight and size in determining energy requirements. The assessment goals were as follows:

- Identify levels of energy consumption inherent in the direct-chill and continuous-casting processes
- Identify best practices at each plant and recommend potential methods to transfer those practices
- Define opportunities for improving future energy consumption by investing in new equipment, changing operating practices, and optimizing production strategies.

The assessment team reviewed the following:

- Process heating, with an emphasis on melting, homogenization, annealing, and painting processes
- Motors and pumps, including those used for hot and cold rolling operations, saws and shears, material-handling equipment, and environmental control systems
- Compressed air systems, which included locating and repairing air leaks
- Steam systems, with an emphasis on steam usage for process and plant heating and cooling
- Application of new processes and equipment, including energy contracting and scheduling, waste heat recovery, lighting, and heating, ventilating, and air-conditioning equipment.

Results and Projects Identified

Table 1 lists the 10 potential projects that the assessment team recommended to improve process and energy efficiency, based on their assessments of energy use at the two rolling mills. Implementing all 10 projects could result in an estimated annual cost savings of more than $11 million. Corresponding annual energy savings would be about 1 million MMBtu and 38 million kWh. The total capital costs required to implement all the projects would be about $31 million. Implementing only those projects with payback periods of 2 years or less could still yield more than $2.4 million in annual costs savings. Descriptions of each project follow.

Convert the Lewisport mill to the continuous-casting process. The assessment team recommended converting the Lewisport mill from direct-chill casting to continuous casting integrated with the existing multistand hot mill. The team calculated that the continuous-casting process employed at the Newport mill required only 44% of the energy used for casting at Lewisport. Process conversion at Lewisport would allow the mill to achieve significant reductions in energy consumption, improve the sheet recovery from cast material, and reduce working capital by eliminating the need for the scalping operation and ingot homogenization using the soaking pits and tunnel furnaces.

Table 1. Projects Identified During Commonwealth Aluminum's Plant-Wide Assessment					
Annual Projected Savings					
Project	Fuel savings (MMBtu/year)	Electricity savings (kWh/year)	Cost savings ($/year)	Capital cost ($)	Payback period (years)
Convert the Lewisport mill to the continuous-casting process	546,000	30,900,000	8,000,000	25,000,000	3.1
Upgrade melter/holder furnaces at the Newport mill	153,000	NA	918,000	5,000,000	5.4
Modify production strategy to accommodate market demands	83,000	NA	500,000	None	Immediate
Implement best practices for melting operations	46,000	NA	273,000	None	Immediate
Improve melt stirring processes at Newport mill	33,000	NA	200,000	400,000	2
Upgrade soaking pits at Lewisport mill	128,000	NA	770,000	500,000	0.6
Improve annealing operations	22,000	NA	130,000	None	Immediate
Optimize compressed air system	NA	6,800,000	238,000	248,000	1.0
Use infrared imaging technology for process diagnostics	50,000	NA	300,000	None	Immediate
Improve waste heat recovery	Unknown	Unknown	Unknown	Unknown	Unknown
Total	**1,061,000**	**37,700,000**	**11,329,000**	**31,148,000**	**2.7 (avg.)**

Upgrade melter/holder furnaces at the Newport mill. The Newport melter/holder furnaces have the dual functions of receiving and holding molten metal delivered from the adjacent IMCO plant and melting heavy gage and primary metal. The assessment team recommended replacing three of four existing melter/holders with two furnaces in which melting and holding functions are optimized. The third melter/holder would be retained as a spare.

Modify production strategy to accommodate market demands. The team recommended that the mills minimize or eliminate less-than-capacity operations and optimize operations for which multiple processing devices exist. Examples include melting, melter/holder and holding furnaces, homogenization furnaces, annealing furnaces, and finishing processes.

Implement best practices for melting operations. The assessment team recommended that the mills define and implement best practices for melting operations, including minimizing the amount of time that furnace doors are open, improving burner firing, improving skimming, controlling exhaust gas temperature, improving maintenance of furnace sensors and controls, and improving staff communications.

Improve melt stirring processes at Newport mill. The team suggested that the Newport mill upgrade its melt stirrer units to consume less energy and generate less dross.

Upgrade soaking pits at Lewisport mill. The efficiency of soaking furnaces could be improved by implementing the following upgrades:

- Replacing dry ceramic seals with more thermally efficient water seals
- Upgrading the programmable logic controllers (PLCs) for the furnace
- Using variable-speed recirculation fans and reverse air flow to mimic tunnel furnaces.

Improve annealing operations. The team recommended the following measures to improve annealing practices:

- The Lewisport mill should evaluate methods employed at Newport for controlling annealing operations by using thermocouples on each coil interfaced with a PLC. The system permits focusing on the slowest heating coil while preventing overheating in other coils. Advantages include energy savings and improved quality control.
- Door seals should be improved to minimize heat losses at both mills.
- The Lewisport mill should consider implementing the Newport mill's practice of pulling coils from the furnaces at higher temperatures to reduce annealing time and energy consumption.

Optimize the compressed air system. The assessment team suggested that both mills employ measures to upgrade and optimize their compressed air systems to improve system efficiency and maintenance practices, to eliminate leaks, and wherever possible, to substitute other energy sources for compressed air.

Use infrared imaging technology for process diagnostics. The team noted that infrared imaging techniques are a powerful tool for detecting heat losses and maintenance problems associated with thermal processes and electrical operations. The team recommended that staff at both mills use infrared detection devices to identify thermal and electrical problems.

Improve waste heat recovery. The team noted that opportunities exist to improve waste heat recovery at both mills, primarily from melting, homogenization, and annealing operations and from paint line exhausts. They recommended additional detailed engineering studies to identify specific opportunities for waste heat recovery in each of these areas. Uses for recovered heat could include furnace air preheating, regenerative burners, steam generation, and hot water generation for applications within the plants or at nearby sites. The team was unable to make meaningful estimates of costs or savings associated with waste heat recovery because specific data were not available. They noted, however, that they believe those opportunities could be significant.

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.

Project Partners

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