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OFFICE OF INDUSTRIAL TECHNOLOGIES

ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Benefits

- Estimated annual savings of $1,974,300 for phase I
- Estimated payback of 1.2 years for phase I
- Additional savings measures identified for phase II

Applications

A systematic approach for a plant-wide energy efficiency assessment was employed at Lafayette Operations. Energy use for each manufacturing process was determined and processes with high annual savings potential were targeted for further evaluation. Targeted processes were then reviewed to quantify potential energy savings and estimate required capital costs for implementation of potential energy savings projects. The costs of power and fuel are the significant utility costs at the plant.

Alcoa Lafayette Operations Energy Efficiency Assessment

Summary

The energy efficiency assessment performed at Alcoa's Lafayette Operations aluminum extrusion plant identified potential annual savings of $1,974,300 in eight high-energy-use areas with an estimated initial capital requirement of $2,308,500.

Company Background

Alcoa Inc., is the world's leading producer of primary aluminum, fabricated aluminum, and alumina. Alcoa is active in all major segments of the aluminum industry, including mining, refining, smelting, fabricating, and recycling. Alcoa provides packaging, automotive, aerospace, construction, and other markets with a variety of fabricated and finished products. The company is composed of 24 business units, with 103,500 employees at 215 operating locations in 31 countries. Revenues in 1998 were $15.3 billion.

Lafayette Operations is an aluminum extrusion plant that is part of the Alcoa Engineered Products Business Group. Facility processes include ingot casting,

Lafayette Park

extrusion, and cold drawn tubing production. The facility operates numerous extrusion presses. Finishing operations associated with extrusion include stretching, sawing, heat treating, and annealing. Tube production involves the cold drawing of extruded tube. The drawing process produces flexible, thin-walled tubing that can be used in a variety of applications in various industries.

Assessment Overview

Encouraged by the Department of Energy's (DOE) Office of Industrial Technologies' (OIT) energy assessment project, Alcoa initiated a plant-wide energy efficiency study at its Lafayette, Indiana plant. The objectives of this study were to analyze departmental energy use, identify areas for more detailed analysis, provide a detailed analysis of several of the energy savings opportunities identified, and support the development of a comprehensive energy strategy for the facility. The assessment team consisted of Pace Global Energy Services, LLC, of Fairfax, Virginia, SSEEI, Inc., of Rockford, Illinois, and Veritech, of Sterling, Virginia. DOE OIT co-sponsored the assessment. OIT supports plant-wide energy efficiency assessments that will lead to improvements in industrial efficiency, waste reduction, productivity, and global competitiveness in OIT's Industries of the Future strategy.

Assessment Implementation

Pace Global Energy Services provided the analysis of departmental energy use, identification of areas for detailed analysis, and support for the development of an energy strategy for the facility. SSEEI analyzed the furnaces and combustion systems and identified opportunities for improved heat recovery methods and furnace operations. Veritech reviewed current energy monitoring methods and identified opportunities for savings from improved metering and development of process energy use targets.

The team selected eight areas for further analysis based on the results of the preliminary assessment, departmental energy use, and estimates of savings opportunities for major energy users. The areas selected for more detailed analysis were:

- *High pressure extrusion press pumps*
- *Extrusion Unit #2 billet heaters*
- *Ingot Plant cooling water recirculation system*
- *Compressed air system*
- *Plant lighting*
- *Plant steam boilers*
- *Melting furnaces and*
- *Energy monitoring.*

Overview of Specific Actions Identified in the Assessment

The comprehensive energy strategy designed to capture the identified savings opportunities identified in the energy assessment would be implemented in two-phases. The goal of Phase I is to reduce energy consumption at the facility by 5% in the current year (2000). Phase II targets longer term energy reductions and will include the larger projects that require significant capital expenditures.

The Phase I projects are:

Compressed air system improvements
Two measures being implemented: replacement of existing compressors with high-efficiency compressors and implementation of a leak detection and repair program.

Induction heating management
This project includes minimizing the amount of energy used at the presses to maintain billets at extrusion temperature. Press production schedules are to be modified to concentrate production on presses with induction billet heaters, minimizing start-up and shutdown losses on gas-fired billet furnaces.

Furnace tuning and repair
A program is being instituted to check burner air-fuel ratios and optimize controls for individual process areas. Furnace door and casing leaks would be monitored and repaired.

Ingot cooling water recirculation improvements
System operation is being optimized to reduce energy consumption. Pump size, system modification, and use of variable speed drives is to be investigated.

Extrusion pump improvements
A monitoring/maintenance program is being instituted to maintain pump efficiency.

Lighting management
Opportunities to reduce burn time is being evaluated.

Monitoring and targeting
The plant fuel and power monitoring system are being expanded and specific energy use targets would be identified.

Phase II projects will address the furnace and combustion systems and improved energy monitoring. Detailed project analyses will be completed to more accurately quantify energy savings opportunities associated with these projects. The analysis for the melting furnace heat recovery system will include verification of potential savings based on a rigorous review of individual melting furnaces' operating characteristics. It will also require a detailed cost estimate for equipment installation. Further analysis of the direct-fired heating system will include verification of the effect of the loss of dual fuel capability on the plant natural gas costs and a detailed cost estimate for the system.

The assessment showed that increases in furnace efficiency could be gained by:

- Instituting a maintenance/monitoring program to ensure optimal air/gas mixing
- Sealing furnace leaks
- Periodic examination of furnace linings
- Preheating scrap and fresh aluminum to lower overall energy consumption, and
- Linking two melting furnaces to one preheating furnace.

With regard to energy monitoring and targeting programs, specific recommendations were made to install additional utility meters. These include power meters for the ingot plant, tube mill, and units 1 and 2. Installation of new fuel meters for the ingot plant, units 1 and 2, and the tube mill was also recommended.

Results and Recommendations

Departmental Energy Use-Identification of Areas for Detailed Analysis

Implementation of energy conservation projects identified during the departmental energy use assessment could result in potential annual savings of $1,974,300 in the eight areas of interest with an estimated initial capital requirement of $2,308,500. Of the total savings, $1,309,300 is direct energy

savings and $665,000 is non-fuel operating and maintenance costs. The resulting payback period would be approximately 1.2 years. The areas that represent the greatest savings opportunities are summarized in Table 1. Estimated results from phase II projects are*:*

Table 1. Summary of Savings Potential by Area

Savings Opportunity	Annual Savings	Capital Cost
Extrusion press pump improvements	$70,000	$12,000
Just-in-time billet heating	$23,300	$9,000
Ingot cooling water recirculation systems	$18,000	$10,000
Compressed air system improvements	$25,000	Leased system
Direct-fired heating system	$1,253,000	$1,839,000
Melting furnace heat recovery	$378,000	$450,000
Furnace maintenance	$57,000	$36,000
Monitoring and targeting	$150,000	$42,500
Total	$1,974,300	$2,308,500

Furnace and Combustion Systems Analysis

The analysis of the ingot melting furnaces showed that the best method for heat recovery from exhaust gases is to use the exhaust gases to preheat the ingot. This approach would result in reduced duct cost and therefore reduced heat loss from duct surfaces. It is estimated that the ingot melting department could realize annual energy savings of $441,000 (1 year payback period) by implementing the heat recovery strategy. This method would also reduce air emissions.

Current Energy Monitoring Methods-Savings from Improved Metering and Process Energy Use Targets

An initial survey was performed to document current energy costs, estimated implementation costs, and potential savings from optimizing the plant energy monitoring and targeting program. The costs of power and fuel are the significant utility costs at the plant. Costs of other utilities (e.g., water, compressed air) were not included. Steam was not considered separately because the effective cost of steam was considered to be the cost of power and fuel at the boilerhouse. The study looked at capital specific costs and potential savings associated with installation of utility meters in each area of the facility.

Sixteen power consumption metering points were identified across the entire facility, representing a potential annual savings of $49,000. For this level of savings, installation of 17 to 46 new power meters would be justified. The optimum number of power meters is approximately 30.

Fuel metering points identified for the operating units represent a potential annual savings of $92,800. For this level of savings, installation of 25 new fuel meters would be justified.

Industry of The Future—Aluminum

Through OIT's Industries of the Future initiative, the Aluminum Association, Inc., on behalf of the aluminum industry, has partnered with the U.S. Department of Energy (DOE) to spur technological innovations that will reduce energy consumption, pollution, and production costs. In March 1996, the industry outlined its vision for maintaining and building its competitive position in the world market in the document, ***Aluminum Industry: Industry/GovernmentPartnerships for the Future****.*

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BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on 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.

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