December 2000

OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Boise Cascade Mill Energy Assessment

Benefits

- Estimated annual savings of $707,000
- Reduction in steam use of 28,100 lb/hr is estimated
- Estimated reduction of effluentflow of 2.2 million gallons/day

Applications

In the pulp and paper industry, water is the carrier of raw materials, byproducts, chemicals, and energy. Excessive water use, however, can lead to fiber losses and increased energy costs. Fiber is the greatest contributor to mill operating costs, while energy is second. It is therefore important to identify ways to conserve water while maintaining

Summary

An integrated effluent heat reduction and water conservation study was performed at the Boise Cascade plant in International Falls, Minnesota. The implementation of four projects and two process modifications are projected to remove 45.6 MM Btu/hr from the effluent.

Company Background

The Boise Cascade Mill in International Falls, Minnesota, is an integrated pulp and paper mill producing 1500 tons/day of finished paper from four paper machines using site-cooked pulp and purchased slurry and stock.

Boise Cascade Corporation has identified goals to develop and implement processes that reduce effluent, increase product yield, and consume less energy and water. The International Falls mill has traditionally implemented heat recovery projects and has been energy conscious. The mill has achieved favorable ratings in energy use benchmark comparisons, and has competitive

The Boise Cascade Mill, International Falls, MN

energy contracts in place for other energy resources. In an effort to identify additional energy savings opportunities, the mill chose to use water pinch technology as an analysis tool. Water pinch analysis is a method used to identify synergies between water and energy reduction associated with the pulping and paper making processes. The analysis identified several heat recovery projects and process modifications to help achieve the mill's energy reduction goals.

The Boise Cascade International Falls Mill conducted a thermal pinch study in 1997. Recommendations from the study included several projects that would increase the thermal energy efficiency of the mill. The mill wanted to adopt a similar site-wide approach to address water use issues and their association with fiber and energy costs and product quality issues.

Assessment Overview

The Boise Cascade International Falls Mill Water Closure Study project involved the application of water and energy consumption analysis techniques to identify opportunities for conservation in each of these resources. The mill uses approximately 35 million gallons/day of water for pulp production. In summer, the temperature of the plant's combined effluent stream requires the mill to operate effluent cooling towers. This causes increased electrical energy consumption, as well as the inherent possibility of volatilization of organic compounds prior to treatment in the effluent treatment plant and their release into the atmosphere. The mill is therefore forced into a sub-optimal operating scenario in which electrical energy is used to enable the rejection of thermal energy to the environment. By using selective effluent streams to reduce water consumption and eliminate the need for a cooling tower, the mill could decrease its steam usage. This decrease is possible since reuse/recycling of the hotter effluent within the process retains heat, reducing the need for steam and removing heat from the effluent. Successful implementation can decrease facility operating costs, reduce water consumption, and help prevent increases in environmental emissions.

Water pinch analysis, combined with an examination of energy use at the effluent treatment plant, provides insight into site-wide water and energy consumption. The approach is derived from the combination of water conservation efforts with input from specific field experiments that account for quality constraints and economics. A site-wide approach was adopted to prevent changes to one process from adversely affecting other processes. The approach can be applied to all paper machine sites.

The assessment team consisted of Boise Cascade International Falls Mill, American Process, Incorporated, and EPRI. The U.S. Department of Energy's (DOE) Office of Industrial Technologies (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

The scope of the assessment was to perform an effluent heat reduction and water conservation study. The objectives were to establish an effluent thermal reduction target and to find practicable projects to achieve the reduction target.

Steps in the study included:

- Identification and quantification of effluent sources and sinks in terms of flow and temperature
- Identification of process contaminants, topological location probability of reuse (for each source and sink identified in the study)
- Identification of potential candidate systems for water recycling

Inputs to the analysis include water chemistry data, regeneration treatment costs, process configuration changes, plant configuration, and interactions between thermal and electrical energy and water use.

Analysis tools used in the assessment included Water Close™ technology, which uses a systematic approach based on water pinch, but modified to suit the pulp and paper industry. Water pinch, also known as mass pinch, uses the principles of categorizing all water streams as sources or sinks and grading them by degree of contamination using a relevant list of contaminants. Water pinch curves are then created by matching sources to sinks, thereby maximizing internal recycle and minimizing fresh water use.

In the Boise Cascade Mill, the contaminant of concern is temperature and the objective of water conservation is to remove heat from the sewers through rational and structured steam reuse within the process. In these cases, temperature is also included in the contaminant list, and thermal pinch and water pinch techniques are then employed to identify water reuse opportunities.

Overview of Specific Actions Identified in the Assessment

The mill plans to implement two projects to conserve Base Mill water: one project to reroute turbine room steam trap condensate and a project to capture heat from the foul condensate stream and reuse it to heat demineralized water makeup to the hotwells. Process modifications planned for implementation include use of raw water for cooling in the oxygen plant followed by diversion of the cooling water to the noncontact sewer, and lowering the Base Mill white water operating temperature.

A detailed engineering analysis, including data confirmation, Hazard and Operability (HAZOP) studies, and system design verification must be performed prior to project implementation.

Summaries of selected projects and process modifications from this assessment are as follows:

Base Mill Water Conservation Project No. 1
Currently, the Base Mill overflows 2700 gallons/min of hot white water at 125°F to the sewer and cold demineralized water is heated in the paper machine blow-through condensers. The proposed project would preheat the demineralized water using the heat from the white water before it enters the condensers. The white water in the Base Mill would be collected in a new white water collection tank to maximize heat recovery from the Base Mill.

Base Mill Water Conservation Project No. 2
The Nos. 2, 3, and 4 paper machines use raw water for vacuum pump seal water that is subsequently drained to the sewer. Each machine also has a dryer section vacuum pump; the seal water from these pumps is approximately 140°F. The proposed project would recycle the vacuum pump seal water via a cooling tower to the vacuum pumps, reducing both effluent flow and raw water use. It would also remove heat from the sewer.

No. 1-5 TG Water Conservation Project No. 1
Most of the steam traps in the turbine room basement drain to the sewer. The proposed project would collect all the steam trap water in a new condensate collection tank and pump the condensate back to the original condensate collection tank. This project would help remove 4.1 MM Btu/hr from the sewer and would also assist in the reduction of steam consumption.

Evaporator Area Water Conservation Project No. 2
The mill plans to send 400 gallons/min of foul and combined condensate from the pulp mill to the UNOX treatment basin. Currently, the flow is approximately 160 gallons/min of hot foul condensate that should be cooled. The proposed project would use foul condensate heat to heat the demineralized water makeup to the hotwells. This project would help remove 12.2 MM Btu/hr from the sewer and would also help reduce steam consumption. The mill is already implementing this project.

Process Modification No. 18—Reduce I1 Paper Machine Summer Operating Temperature

The I1 paper machine has difficulty maintaining its desired white water temperature in the summer, resulting in additional burden on the effluent treatment plant. The oxygen plant cooling water is recycled into the water header feeding the paper machine, causing an elevated temperature. The proposed process modification would use raw water for cooling in the oxygen plant, then divert the cooling water to the noncontact sewer. This process modification would remove 1.5 MM Btu/hr from the process effluent.

Process Modification No. 19—Reduce Nos. 2, 3, and 4 Paper Machine Summer Operating Temperature

During summer, the Base Mill paper machines operate at high temperatures. The proposed process modification would lower the paper machine white water temperature during the summer months by adding less steam to the wire pits and by lowering the I1 paper machine white water temperature (which lowers the stock temperature to the Base Mill paper machines). This modification would remove 5.0 MM Btu/hr from the process effluent.

Results and Recommendations

A total of 17 potential projects were identified to assist in effluent reduction. Of these, four projects and two process modifications were selected as the most practicable to attain the reduction goal. These projects are estimated to cost $2.1 million (+/- 25%). Savings of $707,000 per year and a payback period of 3 years were estimated.

These projects and modifications in total would remove 45.6 MM Btu/hr from the effluent, exceeding the reduction target of 35 MM Btu/hr estimated from the study. In addition, the projects would reduce steam use by 28,100 lb/hr and effluent flow by 2.2 million gallons/day (an 8% reduction in total flow). Because the reduction target could be achieved with the selected projects, the remaining 13 water conservation and effluent heat reduction projects were deemed unnecessary for current goals but may be implemented in the future to further improve mill efficiency.

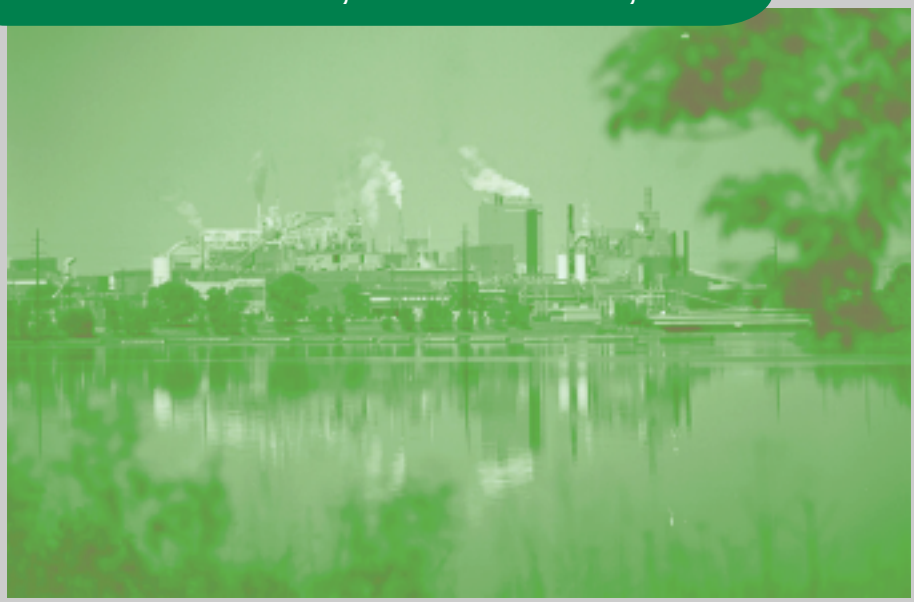
The effluent reduction target of 35 MM Btu/hr accounts for known future changes in process requirements. This target does not require operation of the existing effluent cooling tower. Therefore, the cooling tower can be held in reserve as added assurance to meet effluent limits (i.e., the cooling tower can be used as a production backup to remove an additional 22 MM Btu/hr if necessary). Additional benefits from implementation of selected projects and modifications include

reduced consumption of filtered water, raw water, and demineralized water, as well as effluent flow reduction and steam savings.

Additional testing performed on the No. 2 paper machine to identify practicable white water recycling projects and to study the impacts of white water recycling on process and product quality revealed that white water (with its present quality characteristics) cannot be reused on the No. 2 paper machine wet-end showers, since it has a direct effect on drainage time and paper properties.

It was also recommended that the mill use the simulation model developed for the study as a live process tool to assist with daily production management and employee training as well as to form the basis for future engineering studies. The model should be maintained to reflect changes in plant configuration.

The Boise Cascade Mill, International Falls, MN



Industry of the Future—Forest Products and Agenda 2020

*In November 1994, DOE's Secretary of Energy and the Chairman of the American Forest and Paper Association signed a compact, establishing a research partnership involving the forest products industry and DOE. A key feature of this partnership was a strategic technology plan-**Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood, and Paper Industry**. Agenda 2020 includes goals for the research partnership and a plan to address the industry's needs in six critical areas:*

- *Energy performance*
- *Environmental performance*
- *Capital effectiveness*
- *Recycling*
- *Sensors and controls*
- *Sustainable forestry*

OIT Forest Products Team Leader: Valri Robinson (202) 586-0937

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.

Project Partners

Boise Cascade Mill
International Falls, MN

American Process, Inc.
Atlanta, GA

U.S. Department of Energy
Washington, D.C.

For Additional Information, Please Contact:

OIT Clearinghouse
Phone: (800) 862-2086
Fax: (360) 586-8303
clearinghouse@ee.doe.gov

Visit our home page at
www.oit.doe.gov

Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy, EE-20
U.S. Department of Energy
Washington, D.C. 20585

DOE/ORNL-031
December 2000