Forest Products

BestPractices Plant-Wide Assessment Case Study

Industrial Technologies Program—Boosting the productivity and competitiveness of U.S. industry through improvements in energy and environmental performance

Georgia-Pacific: Crossett Mill Identifies Heat Recovery Projects and Operational Improvements that May Save $9.6 Million Annually

Benefits

- Identified $9.6 million in potential annual cost savings
- Found 3,345,000 MMBtu in potential annual natural gas savings
- Identified 900 kWh in potential annual electricity savings
- Can yield a payback period of less than 1 year for heat recovery projects

Application

Georgia-Pacific Corporation and American Process, Inc., used pinch and S.T.E.P.™ methodologies to examine a paper mill's electrical and thermal energy usage, generation, and purchasing. The assessment team examined equipment and departmental efficiencies, electrical and thermal benchmarking, housekeeping, process modifications, cogeneration, and process controls in a systematic and integrated approach. This approach and the improvements identified from it can be replicated in other paper mills.

Summary

An assessment team conducted a mill-wide energy survey at Georgia-Pacific's Crossett, Arkansas, mill as an update to a previous pinch analysis. The team wanted to identify energy conservation measures and operating practice improvements that would increase the mill's overall energy efficiency. Three heat recovery projects were identified that could reduce annual costs by about $4.8 million and annual natural gas use by 1,845,000 million British thermal units (MMBtu). The overall payback period for the heat recovery projects would be less than 1 year. The team also addressed operational improvements during the assessment. Implementation of operational improvements could yield an additional $4.8 million in annual savings, along with 1,500,000 MMBtu in natural gas savings.

DOE-Industry 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 of the total $290,000 assessment cost.

Company Background

Founded in 1927 as a wholesaler of hardwood lumber, Georgia-Pacific Corporation has become one of the world's leading manufacturers and distributors of tissue, packaging, paper, building products, pulp, and related chemicals. Georgia-Pacific is a worldwide company with approximately $30 billion in sales, employing 85,000 people in more than 600 North American locations and in 11 European locations.

Georgia-Pacific Corporation purchased the Crossett Lumber Companies in 1962, spending more than $124 million for the companies' operations and land holdings in southeast Arkansas. The first paper machines were installed in Georgia-Pacific Crossett Paper Operations in 1937. Georgia-Pacific employs a total of 2,700 people in the Crossett area, while Crossett Paper Operations employs 1,650 people. The plant produces more than 650,000 tons of printing paper, board, and tissue products each year. The mill generates 75% of its own power and also has its own treatment system for both incoming and outgoing water. The Crossett complex consists of the paper mill, plywood mill, and chemical plant.

The Crossett mill cooks wood chips in two parallel batch digester lines to produce hardwood and softwood pulp. Each pulp production line includes its own washing plant. Two parallel bleach plants complete the hardwood bleaching; the softwood bleaching is done in a single line. The bleached pulp is mixed prior to entering the paper machines as required for each grade. The mill consists of two paper machines that make lightweight papers such as those used in copy machines, one board machine that makes paper used in lightweight boxes, and five tissue-paper machines.

Georgia-Pacific's Mill in Crossett, Arkansas

The pulping liquor is processed through an integrated pre-evaporator and stripper system, followed by an evaporator train, concentrators, and super concentrators. The concentrated black liquor is fed to the single recovery boiler, then to a recausticizing system that produces white liquor for the pulping process. Steam from the recovery boiler is supplemented by steam produced in the power boilers. Two power boilers primarily use wood waste as fuel. Two natural-gas-fired boilers back up the power boilers. Three backpressure turbines generate the majority of the mill power and supply process steam.

Assessment Approach

The assessment team performed a plant-wide energy assessment as an update to a 1996 pinch study that the mill had previously conducted. The assessment's primary objective was to define energy conservation measures and to recommend operating practice improvements to increase the mill's overall energy efficiency. Elements of the assessment included:

- Formulating heat and material balances
- Modeling the mill's energy profile and constraints affecting the profile
- Evaluating the efficiency of generation, purchase, and use of energy
- Characterizing the minimum thermal energy requirement for operation
- Formulating heat recovery projects that could reduce the mill's total thermal energy consumption
- Performing a cost/benefit analysis for proposed projects
- Targeting cogeneration analysis.

The assessment team applied pinch technology and the Showcasing True Energy Potential (S.T.E.P.™) methodology developed by American Process Inc. (API) to examine electrical and thermal energy usage, generation, and purchasing. Pinch analysis provides a systematic approach for analyzing energy networks to improve the energy performance of industrial processes. It uses graphical representations of the energy flows in the process and utility streams to determine the minimum energy consumption that a process should use to meet its specific production requirements.

Georgia Pacific's assessment team used the S.T.E.P.™ methodology to evaluate the efficiency of in-house steam generation and production processes and to review the mill's energy purchasing policies. For example, the team identified maximum sustainable capacities and production bottlenecks. Data representing seasonal fuel use and steam production were used to create an energy profile. Use of alternative fuels was explored. The team also conducted walk-downs to identify potential cost and energy savings through improvements in housekeeping (e.g., repairing leaks in the steam delivery and compressed air systems; insulation upgrades). The team then made a series of recommendations for operational improvements and low- or non-capital projects that the mill will continue to evaluate for potential implementation.

The energy-efficiency study focused on reducing the amount of fuel used to make steam[1]. Overall, the team examined equipment and departmental efficiencies, electrical and thermal benchmarking, housekeeping, process modifications, cogeneration, and process controls in a systematic and integrated approach.

[1] Steam is the primary form of energy used in the mill; it is used to evaporate water from the paper, to heat water for cleaning showers, and to generate electricity. The mill can conserve energy by utilizing the secondary heat from the various process streams instead of using fresh steam for heating.

Results and Projects Identified

If Georgia-Pacific implemented three proposed heat recovery projects at the Crossett mill, it would reduce natural gas use year-round and reduce purchased wood waste in the summer. Furthermore, during the winter, two power boilers would only operate at a minimum capacity to respond to fluctuations in steam demand. Implementing these projects would yield an annual cost reduction of about $4.8 million and annual natural gas savings of 1,845,000 MMBtu. The overall payback period would be less than 1 year.

Projects involving operational improvements and cogeneration were also addressed during the S.T.E.P.™ study. Operational changes could save an additional $4.8 million annually if natural gas use were reduced. These S.T.E.P.™ projects' savings are more subjective than those from the heat recovery projects. Benchmarking targets and detailed assessments are required before project implementation. Savings and capital costs depend on operational and maintenance policies, and were not calculated as part of the assessment.

Additional cogeneration is not currently considered to be economically attractive, and implementing the heat recovery projects would reduce the opportunities for cogeneration.

Table 1 summarizes the heat recovery and operational improvement projects identified during the assessment.

Table 1. Projects Identified During the Georgia-Pacific Crossett Mill Plant-Wide Assessment

Project	Annual Projected Savings: Fuel (MMBtu)	Annual Projected Savings: Steam (MMBtu)	Annual Projected Savings: Electricity (kWh)	Annual Projected Economic Impact: Annual Savings ($)	Annual Projected Economic Impact: Capital Cost ($)	Annual Projected Economic Impact: Payback Period (year)
Heating Recovery Projects						
Heat recovery from bleach plant D effluents	890,000	665,000		2,400,000	1,600,000[1]	0.7[1]
Improved blow heat recovery and demineralized water heating	940,000	705,000		2,350,000	2.250.000[1]	1.0[1]
Bleach plant prechiller	15,000	11,000	900	61,400	124,200[1]	2.0[1]
Total	**1,845,000**	**1,381,000**	**900**	**4,811,400**	**3,974,200[1]**	**0.8[1]**
Operational Improvement Projects						
S.T.E.P.™ Projects	1,500,000	900,000		4,800,000	Not evaluated[2]	Not evaluated[2]

[1] Heat recovery projects will require a detailed cost and engineering analysis before implementation; capital costs are estimates only.
[2] The study did not evaluate detailed implementation strategies and costs; therefore, the payback period has not been determined.

Project 1—Heat recovery from bleach plant D effluents

In the current mill configuration, effluents from the bleach plant D-stage washers are directed to the sewer. The effluent streams contain a large amount of heat that is being wasted. This project proposes to install a new heat exchanger to capture this heat and generate warm water for the paper machines. Using this warm water on the machines will reduce the amount of steam required to heat the white water.

Project 2—Improved blow heat recovery and demineralized water heating

The blow heat recovery system captures the heat from the flash steam generated when a digester is emptied from approximately 100 pounds per square inch gauge (psig) to an atmospheric storage tank. The flash steam is condensed, and an accumulator stores the condensate. From the accumulator, the condensate is routed through a series of heat exchangers, where it is cooled and returned to the bottom of the accumulator.

With the current configuration, a cooling tower removes excess heat from the accumulator and a steam heater generates hot water for the bleach plant. This project's purpose is to improve the heat recovery in the blow-heat area of the pulp mill and E-stage bleaching effluent for demineralized water heating. By installing new heat exchangers and rerouting some water lines, the cooling tower can be shut down and the steam heater removed. Steam reduction would lead to cost savings.

Project 3—Bleach plant prechiller

The mill continuously operates two chillers to provide cold water for the chlorine dioxide (ClO_2) plant. The chillers take well water that is a constant 70°F all year and chill it to around 45°F. The proposed prechiller would utilize 50°F ClO_2 solution from the ClO_2 plant to cool the incoming well water. This will not only reduce electrical energy demand from the chillers, but will also preheat the ClO_2 solution going to the bleach plant and reduce the amount of steam needed for heating.

The assessment team also addressed operational improvements and cogeneration opportunities. The mill would save on operating costs by improving mill operational parameters, housekeeping, and purchasing strategies. Cogeneration opportunities include those resulting from noncapital operational changes and a possible turbine upgrade. Because they are currently considered to be economically infeasible, the team did not estimate capital costs for cogeneration projects. Implementing all the heat recovery projects would also decrease the opportunities for cogeneration capacity. Implementing all heat recovery projects and operational improvements together may not be feasible and may require additional expenditures and analysis.

Operational improvements (S.T.E.P.™)

The assessment team studied various operational improvements to increase energy efficiency and energy conservation. The quantified items included improved boiler oxygen control, tank insulation, condensate recovery, steam and compressed air leak repair, and a more efficient black liquor evaporation scheme.

Process changes include increasing the high-pressure steam header pressure and reducing low- and medium-pressure header pressures. The savings would be obtained by reduced natural gas and steam usage.

Specific projects and their potential annual savings included:

- Reduce and control power boiler excess oxygen to save 66,000 cubic feet per hour (ft^3/hr) of natural gas ($2 million)
- Insulate five large storage tanks to save 25,000 pounds per hour (lb/h) of steam ($661,500)
- Repair steam leaks that had existed more than 1 year to save 7,700 lb/h ($263,000)
- Shift more black liquor evaporation to the 6-effect train to save 30,000 lb/h ($793,000)
- Improve condensate collection by repairing leaks and improving collection coverage to 65% to save 40,000 lb/h ($1,058,400)
- Clean heat exchangers (the savings have not been evaluated but are believed to be significant).

Cogeneration opportunities

Additional cogeneration opportunities include optimizing turbine pressure levels, improving steam turbine efficiency, and lowering steam level for the users. The savings would come from incremental electricity cogeneration; however, there would be a penalty for additional fuel required.

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.

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