ESA-153-2 Badger Paper Mill – Peshtigo Plant
Public Report

Introduction:

The Badger Paper Mill manufactures a wide variety of light-weight specialty paper grades from purchased recycled and virgin fiber. BPM's products are used in retail, commercial and office environments, and printed for various applications. The flexible packaging products are used primarily in the confectionary, fast food, grocery and drug/pharmaceutical industries. BPM's manufacturing capabilities are complimented with expertise in printing, waxing, roll and sheet converting, and packaging. The plant uses natural gas for process heating and space heating.

Objective of ESA:

The goal of the ESA was to apply the PSAT program, associated screening, measurement, and analysis methodologies to several pumping systems in order to:

a) Train plant personnel on the use of the DOE tools and methods
b) Identify savings potential in the selected systems and perform a preliminary evaluation of the cost-effectiveness of implementing projects to reduce energy consumption.

Focus of Assessment:

Before starting the assessment, the Pump Specialist reviewed facility pump systems for Line #1 with staff to determine which pumps would be the best candidates for improvement. Unfortunately, Line #2 was down for repairs. Pump systems reviewed included:

a) Line #1 Fan Pump
b) River Water Pump
c) Line #1 Machine Chest Pump
d) Line #1 Dump Chest Pump
e) Line #1 Broke Chest Pump
f) Well #4 Pump

We also did a very preliminary review of Fan Pump #2 (450 hp) and the wastewater lift station pumps (125 hp) but could not take measurements on the fan pump since Line #2 was down and did not have time to collect data on the wastewater lift pumps. The facility operates each line 3 weeks a month, 5 days/week, 24 hours/day but anticipates operating 24/7 in the near future which will improve the cost effectiveness of all projects.

Approach for ESA:

<u>General</u>

The Plant Manager, Jim Koronkiewicz coordinated the Pump ESA effort. ESA participants included Steve Vande Laacerschot and Jim Grabowski. Steve Bradford with Wisconsin Public Service attended part of the first day, and Jerry Aue with the Wisconsin Focus on Energy Program attended the wrap-up meeting.

<u>Specific Approach</u>

Line #1 Fan Pump

Line #1 Fan Pump transfers stock from the silo to the headbox. Flow from the pump discharge passes through a screen, attenuator and control valve. The control valve is adjusted to maintain a consistent level in the headbox. The pump is rated to provide 5300 gpm @ 57' TDH. However, based on the plant control system data, the pump was only delivering 1100 gpm.

Pump and suction discharge pressures were determined using existing pressure instrumentation at various locations on the pump suction and discharge piping. Power measurements were taken at the pump panel using a Fluke 43 B power quality analyzer. Flow was determined based on the plant control system that calculates flow based on the position of the

control valve. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

River Water Pump System

The river water pump supplies water for pump seals, general wash water, and boiler make-up water. The pump is rated to provide 1000 gpm @ 100' TDH.

Pump discharge pressures were determined using existing and portable pressure instrumentation. Power measurements were taken at the pump panel using a Fluke 43 B power quality analyzer. A clamp-on Panametrics transit-time flow meter was used to obtain a flow reading on the discharge of the pump. This reading was compared to an existing flow meter on the pump discharge. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

Line #1 Machine, Dump, & Broke Chest Pumps

The machine, dump and broke chest pumps for Line #1 transfer stock throughout the process. Flow from each of the pumps is controlled with discharge control valves.

Pump TDH was determined based on suction tank level and discharge pressure readings using portable pressure instrumentation. Power measurements were taken at the pump panel using a Fluke 43 B power quality analyzer. Flow readings were obtained from existing magnetic flow meters. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

Well Pump #4

The facility uses two deep wells (over 350 ft deep) to supply clean water to the process systems. Well Pump #4 (125 hp) is operated when Line #1 Paper Machine is operating and Well Pump #5 (150 hp) operates when Line #2 Paper Machine is operating. Both well pumps are multi-stage vertical turbine type pumps equipped with variable speed drives.

Since it was not possible to determine the true well depth, pump TDH was estimated based on original design head. Amperage measurements were taken from the control system panel readout, and flow was determined from the existing permanent flow meter. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

General Observations of Potential Opportunities:

2006 Plant annual operating energy data and costs

	kWhs	MMBtu	Cost
Natural Gas		764,328	$5,350,294
Electricity	64,457,389		$3,570,939
Total	**64,457,389**	**764,328**	**$8,921,233**

Electrical cost rate used for analysis purposes: 5.5 cents/kWh

General comments and observations

The plant staff was very knowledgeable and helpful during the ESA. We believe the facility would benefit if pump efficiency could be reviewed on a regular basis and that all operations staff should attend general "energy awareness" training to have a better understanding of the cost impact of operating large hp equipment.

Specific opportunities observed

Line #1 Fan Pump

Based on the data collected, the pump appears to be operating far below its design flow rate. The PSAT software calculated existing annual energy use of $19,000. Using the valve tool, we estimated that $14,000 of this cost was from the pressure losses across the control valve. Facility staff indicated that although existing pump flow was 1100 gpm, a more typical flow rate for Fan Pump #1 would be 2500 gpm. To determine potential savings at this flow rate, we used the PSAT tool to determine energy use for a properly sized pump equipped with a variable speed drive so the control valve could be fully opened. Based on these improvements, we estimated annual savings of $15,000.

River Water Pump

During our field visit, the pump flow rate was determined to be approximately 300 gpm. With the lower flow, and more closed valves in the distribution system, the pump head was approximately 131'. Based on discussions with facility staff, it was determined that flow would be higher when Line #2 was in operation, but would also be lower during the weekends when both lines were off. We also discussed the opportunity to reduce water system flow (and energy use) by reviewing all uses throughout the plant and finding ways to reduce excessive flow. This could include seal water solenoid valves, and eliminating open valves that dump river water directly to the drains. Reducing excessive river water flow would also reduce wastewater pumping and treatment costs.

To estimate potential energy savings of improving the river water pumps after "tightening up" the system, we assumed an average flow of 300 gpm at the original design head of 100' and compared this with the measured head of 131'. Using the pump equation, we determined annual savings of $4,480 if a constant head pressure of 100' could be maintained using a variable speed drive.

Line #1 Machine, Dump, & Broke Chest Pumps

A summary of original design and measured pump data, and potential energy savings based on the PSAT software for all three pumps is as follows:

Pump	Rated Flow & Head	Measured Flow & Head	PSAT Rating	Annual Potential Savings
Dump Chest	400 gpm @ 150'TDH	250 gpm @136' TDH	57	$1,700
Machine Chest	1600 gpm @ 60' TDH	563 gpm @ 89' TDH	75	$1,100
Broke Chest	Unknown	42 gpm @ 43' TDH	6	$5,500

As noted above, there was some savings for improving the efficiency of the dump and machine chest pumps based on only improving pump efficiency at the measured flow and head conditions. However, we were unable to calculate the potential higher savings of replacing the existing control valves with variable speed drives without additional system pressure measurements. At this time we have not recommended improvements for these pump systems until additional data can be collected. However, based on the extreme low flow of the broke chest pump, we recommend replacing this pump immediately. Although installing a variable speed drive in place of the control valve would increase savings for this pump, the total operating cost would be so low that the improvement over using the existing control valve would not be cost effective.

Well Pump #4

The variable speed drive of Well Pump #4 constantly modulates to achieve a 60 psi set point. While the paper machine is on line, the pump is operated at a reasonable efficiency (70 to 80%). However, during the weekends when the paper machine is off-line, the well continues to provide a small amount of water for air compressors and A/C units at low efficiencies (below 60%). We recommend supplying this equipment with an alternate water source such as the river water pump system (which does not require water to be pumped up 350 ft) to allow the high energy well pumps to be shut-off. Savings for reducing Well #4 operating hours would be approximately $7,000 annually. As noted for the river water pump system, facility staff should also review all well water uses throughout the plant to find ways to reduce unnecessary flow.

In addition to minimizing well pump hours, it appears that pump efficiency is approximately 15% less than the original curve efficiency. Since the pump motor is a hollow shaft, it may be possible to improve pump efficiency simply by adjusting the nut on top of the motor. However, this can only be done with semi-open impellers. We recommend discussing this option with the manufacturer. Prior to pursuing pump efficiency improvements, additional research should be done to confirm well depth elevation and field measurements.

Other Opportunities

Although this ESA focused on facility pump systems, we observed a 300 hp wastewater aeration blower that was oversized for its intended application. We recommend working with the blower manufacturer to determine the cost of changing/removing impellers to maintain head, but reduce flow by 50%. Improvements should also include reviewing the cost effectiveness of installing smaller motor. This project is expected to have a simple payback of less than 1 year.

We also did a very preliminary review of Fan Pump #2 (450 hp) and the wastewater lift station pumps (125 hp) but could not take measurements on the fan pump since Line #2 was down and did not have time to collect data on the wastewater lift pumps. Both of these pump systems appear to be good candidates for potential energy saving improvements.

Management Support and Comments:

The staff was very supportive of the effort and provided the assistance needed to conduct the assessment.

DOE Contact at Plant/Company:
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