At Badger Paper Mills, Peshtigo, Wis., new progressive cavity pumps eliminate coating leakage and production losses in the coating kitchen

BY MICHAEL J. OULETTE

# Progressive Cavity Pumps Improve Badger Paper's Coating Kitchen

BY INSTALLING A SINGLE TYPE OF progressive cavity pump in 1997, Badge Paper Mills Inc., Peshtigo, Wis., has solved a costly pumping problem in its basement-level coating kitchen. The solution employs four new progressive cavity units to eliminate maintenance and quality assurance issues created by the facility's previous four centrifugal pumps, which were being used in the transfer of coatings from the kitchen to the mill's ground-level 50 tpd Yankee paper machine.

Badger operates two paper machines and continuous converting facilities at its Peshtigo facility. The company also owns a flexographic printing and converting plant in nearby Oconto Falls, Wis. Since the closure of its sulfite mill in 1996, Badger has purchased all its raw materials—pre- and post-consumer recycled pulp, northern and southern softwood and hardwood pulps, and hard white rolls—on the open market.

Finished products off the mill's Fourdrinier machine, at 250 tpd, include fine paper grades such as multi-purpose business papers, offset, opaque, a wide range of colored papers, and water-oil-grease resistant papers.

Process engineer M.J. Ouellete monitors the coating kitchen control panel at Badger Paperís Peshtigo, Wis., mill. Three progressive cavity pumps (below) transfer each batch from the three-tank system to the paper machine, while a fourth (not shown) transfer solutions from mix tanks to the first coating tank.

## CONSISTENT PUMPING A NECESSITY.

Accounting for the balance of the mill's production, the Yankee machine produces converted plain or printed waxed papers, laminating grades, machine-glazed, colors, specialty-coated base papers, twisting papers, and various specialty papers. Twenty-percent of the machine's volume is coated, about one-half of which gets waxed--primarily for use in flexible packaging grades for food products. Badger expects to increase this percentage as the company moves away from commodity-type grades to specialty grades.

Most of these machine-finished coated (MFC) paper grades are made on a batch basis to customer specifications using proprietary recipes that require variable amounts of binder and pigments per order. Consistent, reliable pumping of coating from the kitchen to the computer-controlled Yankee machine is critical in meeting customer quality requirements and avoiding production losses.

*Coating process.* In the past, Badger's four centrifugal pumps were used to transfer pigments, such as kaolin clay and titanium dioxide. They were also used for transferring adhesive binders, such as starches, as well as synthetic binders like latex and polyvinyl alcohol. These binders and pigments were transferred from discrete hot and cold mixing tanks through a series of three coating tanks and a filter, before reaching the paper machine's continuous process inline coating system.

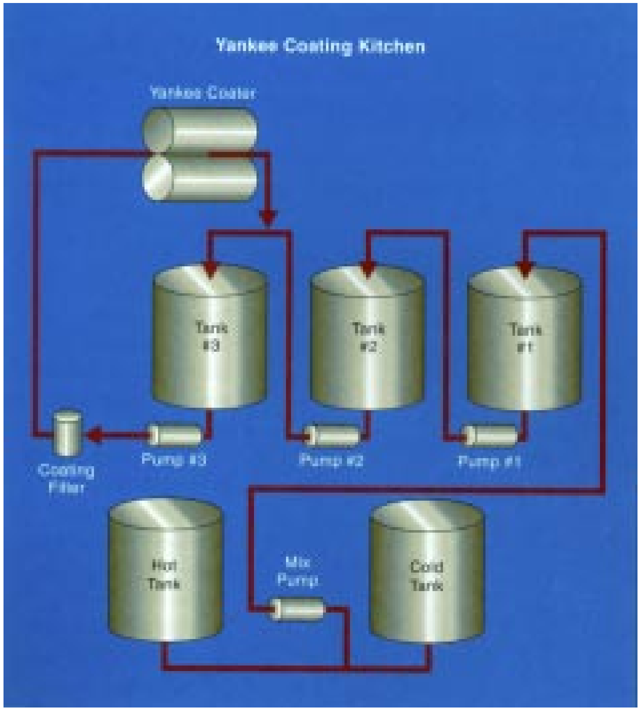


**FIGURE 1:** *Flow diagram of Badger Paperís coating kitchen transfer system, which pumps solutions from mix tanks to the Yankee paper machine.*

The coating system's applicator roll transfers the coating to the paper sheet after it has passed through the Yankee steam dryer and prior to additional drying and subsequent calendering. A metering element scrapes off excess coating, which is returned to the kitchen, where it is re-circulated until used up in the process. Basis weights of Badger's coated grades range from 20 lb/3,000 $ft^2$ to 60 lb/3,000 $ft^2$.

*Centrifugal pump problems.* The centrifugal pumps used to transfer pigments and binders were constantly costing the company extra time and money to operate. The units were always losing large quantities of coating because they lacked mechanical seals, resulting in leakage. The pumps would also experience mechanical breakdowns, causing excessive downtime and the periodic rescheduling of entire batches. In addition, the units tended to entrain air in the coatings, leading to air bubbles and foam that yielded inconsistent films that were not up to mill standards.

### PROGRESSIVE CAVITY PUMP SOLUTION.

Looking for a solution to its pumping problem, Badger turned to a regional fluids handling firm, R.W. Baron & Assoc. Inc. This firm supplied the mill with four Type 17-6LBN progressive cavity pumps manufactured by **seepex** Inc. Each pump, which is constructed with a grey cast iron housing, a hard chrome plated stainless steel rotor, and a molded-to-size NBR Perbunan stator, has a capacity of 50 gpm. The company also purchased one complete set of spare parts for the pumps.

In operation, the positive displacement pump's single external helix rotor turns within a molded double internal helix stator to form progressively moving cavities that create the pumping action. The pump's output is directly proportional to its speed, and its customized stator ensures an identical compression ratio along the entire length of the rotor/stator interface.

### IMPROVED COATING KITCHEN OPERATION.

After the installation of the four new progressive cavity pumps, Badger's coating kitchen operation now proceeds more smoothly and efficiently.

*Coating kitchen operations.* Basically, to start a new batch, binding agents are added to water in a 250-gal hot mixing tank, while pigments are added to water in a 325-gal cold mixing tank (Figure 1), according to coating formulations pre-established for a specific customer order. Contents in the hot tank are mixed and heated for a given time and temperature. Some binding agents such as latex, are added to the cold tank to avoid curdling.

A typical coating batch of 400 gal to 450 gal lasts about two hours during the continuous running of the Yankee machine, so the kitchen has been designed to meet greater demand such as for a five-hour run, by means of its coating tank system, without interrupting the papermaking process. There is also no production time lost in between batch changes.

After mixing in the hot and cold tanks is completed, the contents of each tank are transferred by the mix pump to the first coating tank, which is able to re-circulate the solution so that, if necessary, other ingredients may be added to the recipe. From this tank, the coating is transferred by progressive cavity pump No. 1 to the second coating tank, whose primary purpose is to maintain a constant level in the third coating tank, to which the coatings are pumped by the No. 2 progressive cavity pump. Levels in the second tank vary and are controlled by an overflow cylinder/throttle-valve system that feeds the third tank or re-circulates coating back to the first tank.

From the third tank, the coating is transferred by the No. 3 progressive cavity pump through a coating filter, to remove any contaminants, and then upstairs to the paper machine. Pumps No. 2 and No. 3 have been installed with variable speed drives (VSDs) to accommodate the tank system's fluctuating tank levels. These pumps run continuously when coated paper is in production. The two other progressive cavity pumps, with fixed speed drives, operate intermittently. After a coated run is finished, the kitchen performs a boilout and shuts the system down.

*Results.* As a result of standardizing its coating kitchen with progressive cavity pumps, Badger has received several benefits. First, there have been no major maintenance problems since the units were installed. Leakage of coatings and loss of production time have been eliminated. Based on pumping leaks alone, assuming an average coating loss of 3%/batch, the company has realized an annual savings of $8,700.

In addition, with the previous centrifugal pumps, the coating kitchen was particularly problem-prone when either the No. 2 or No. 3 pump broke down. In the former case, the kitchen was left with a batch of coatings sitting idle in a tank with nowhere to go, while, in the latter case, the

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kitchen was unable to supply coatings to the Yankee machine, causing delays in paper production.

At the same time, the close-coupled, compact progressive cavity units fit more easily into the kitchen's existing configuration than a competitive progressive cavity pump the company was evaluating, while also providing more convenient operator access, and, with its pin-joint construction, better serviceability. The extra linkage in the other progressive cavity pumps also presented some potential long-term maintenance problems for the company, plus their initial quoted purchase price was $2,000/pump higher. Badger had also looked at rotary-lobe pumps, which were ruled out because they cost twice as much as the **seepex** progressive cavity units.

In conclusion, the new progressive cavity pumps easily paid for themselves in their first year of operation over the earlier centrifugal pumps, and Badger would purchase them again if the need arises. The **seepex** units were part of an $80,000 coating kitchen rebuild program that included replacement of makedown equipment, such as mixers, and had an estimated total return on investment (ROI) of over 40%.

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