

## Komax Steam Heater Reduces Costs for Paper Mill

**Pulp Stock Heating at 210 tons/day**

**KOMAX SYSTEMS INC**  
MIXING BY DESIGN

**CASE STUDY 317**

After upgrading its bleach plant in 1987 to accommodate a two-stage elemental chlorine-free (ECF) bleach sequence, Cross Pointe Paper (now Flambeau River Papers LLC), Flambeau mill in Park Falls, Wis. subsequently added a totally chlorine-free (TCF) sequence in response to market demand. The TCF sequence, however, required heating, rather than cooling, of the mill's medium-consistency stock during transfer from the first-stage O<sub>2</sub> washer to the second-stage retention tower. After careful study, Flambeau installed the more cost-effective heating system.



This new inline direct steam injection system--reported to be the first of its kind--has reduced heating costs at the mill by two-thirds. The mill had originally heated the stock with O<sub>2</sub> washwater, which is a convenient but costly method.

With a capacity range from 170 to 210 tons/day, Flambeau pulps 100% white birch timber. The sulfite mill, which produces uncoated free-sheet printing/ writing papers, operates three batch digesters. The mill runs its TCF bleaching sequence, depending on customer specification, about four times/month, and runs the ECF sequence the remainder of the time. Both sequences produce bleached pulp with a brightness level of 87.

In Flambeau's TCF sequence, pulp passes through the first O<sub>2</sub> delignification stage to the O<sub>2</sub> washer, with 50% delignification. In the past, temperature adjustment to the stock, which is at 10% consistency, was made prior to leaving the washer. Hot water showers on the washer were used to raise stock temperature to 190deg F.

From there, the heated stock is transferred by the mill's medium consistency pump to a second-stage, upflow retention tower, where it undergoes a 90-min residence time. At this point, it was becoming clear to the mill that heating the stock using steam would be less expensive than heating it with the washwater.

Looking for solutions. Flambeau began analyzing better ways to heat its TCF. The mill first considered several direct contact steam injection systems. Typically, these compact

units are installed inline like a control valve Heat is transferred to the pulp when the heater injects specified amounts of steam at high velocity (near Mach 1) into the stock. The steam, in turn, shears the pulp into minuscule droplets, creating sufficient surface area to facilitate rapid, efficient heat transfer. Flambeau found that these heaters, however, had one main drawback. While they had proven effective in heating low-consistency stock (5%), medium consistencies (10 to 15%) would cause the units to plug, and thus were ruled out.

Another approach the mill considered was to install a conventional steam mixer. Fabricated of stainless steel, this mechanical device consists of single or double shafts equipped with mixing vanes rotating in a housing. Stationary pegs project from the housing into the space between the rotor vanes. These pegs prevent the pulp from rotating as a plug, as well as kneading the pulp to help create a more even distribution of mixing. The unit then brings the stock up to the required temperature by injecting steam into the mixer housing. Steam flow is regulated by a temperature sensor located at the mixer outlet.

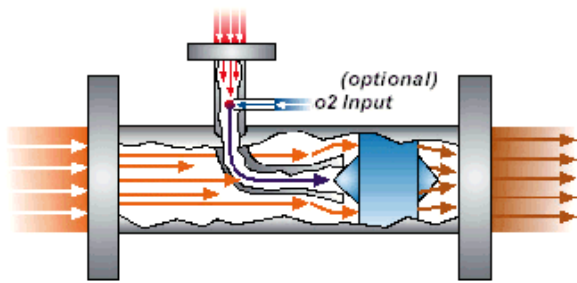
This system presented Flambeau with some drawbacks. First, it is highly energy-intensive, requiring a 50-hp motor to provide sufficient agitation to mix the stock. At the same time, because it operates mechanically, the heater-mixer's rotating parts are constantly under considerable torque and stress, which could mean higher maintenance costs and unscheduled downtimes.

In addition, this system would not only have required extra floor space, but also special piping to and from the main pipeline. A high initial purchase price, coupled with a long lead time for delivery, also worked against its selection.

Flambeau's remaining option was to install a static mixer/heater. The mill investigated one such unit, but rejected it for two reasons. First, studies indicated that pressure drop through the mixer was too great. At the same time, more than one mixing unit would have to be installed in series, as recommended by the manufacturer, to raise the stock's temperature. This would require some modification to the mill's existing pipeline and proved unacceptable.

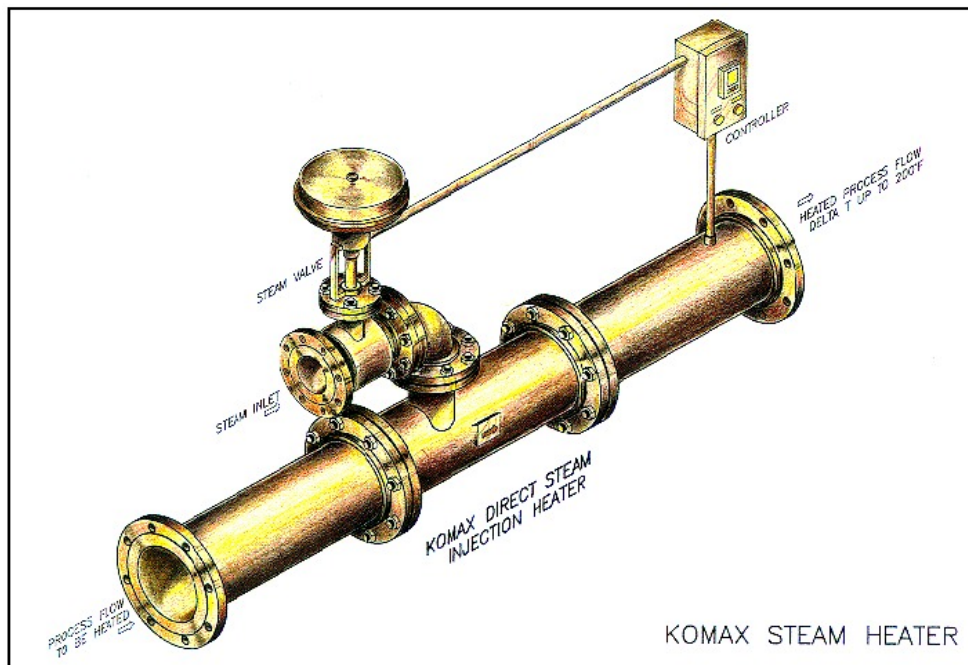


Mill engineers then read that a new static mixer/heater, capable of injecting steam into medium-consistency stock, had been developed for the paper industry. This STM direct steam injection unit (manufactured by Komax Systems Inc.) uses a fundamentally different design than other inline direct-steam heaters.



At Flambeau, this design allows the main product flow, the 10%-consistency stock, to pass through the unit while steam is introduced from a sideport, entering the internal structure in a coaxial fashion with the stock. Both steam and stock then flow into one of six holes, each containing a helical mixing element. These elements

rotate in the same direction, producing a spin on the steam/stock flow. This action, in turn, creates partial mixing as the flow exits each hole. The emerging flow now consists of six two-component streams, all rotating in the same direction.



Rotation produces multiple-impingement mixing areas that effectively contact the steam and stock. Adjacent streams impinge at the peripheries. Additional impingement regions occur at different places along the main pipe diameter. Complete contact between the two phases is completed in less than the length of two pipe diameters.

The 317L stainless steel unit selected by Flambeau was easily installed inline without modification to its main pipeline. A thermocouple was also installed just downstream of the heater to regulate the temperature of the entering system. Sales and service were handled by R.W. Baron & Associates Inc., a Brookfield, Wis.-based fluids handling firm.

As a result of installing the heater, Flambeau's TCF stock heating operation now proceeds smoothly and efficiently. The 10%-consistency stock leaves the O<sub>2</sub> washer much as before, but is now no longer heated. Instead, after washing, the mill's MC feeder pump transfers the stock to the mixer/ heater, which it enters at 140deg F.

During the mixing/heating process, the 25-in.-long heater brings the stock temperature up to 190deg F with minimal energy requirements. The stock exiting the heater is more thoroughly mixed than it had been by the pump, and pressure drop through the STM system aver. ages from 1 to 3 psi.

Since the heater's installation in July 1993, Flambeau has received several benefits. First, the mill estimates that it is now spending about two-thirds less to heat the stock with steam than with washwater. The unit has also enabled Flambeau to avoid the expense of purchasing, installing, and running a mechanical mixer/heater. The mill calculates that the energy required to drive the system alone would cost about \$10,000/year, with no additional floor space needed for the new heater.

At the same time, since its installation, the STM unit has operated continuously during the TCF sequence with minimal plugging. This field application, according to Komax, makes Flambeau the first mill to use an inline direct contact steam injection system to heat medium-consistency stock. The mill further notes that all of its tonnage both ECF and TCF--passes through the new system.

As a bonus, Flambeau reports that the heater has operated with minimal noise, creating a more pleasant work environment. The unit is equipped with a specially-designed valve that employs both hydraulic and viscous dampening to assure that steam and water never equalize. This feature eliminates water hammer, a frequent problem with other direct contact steam heaters.