Steam boxes significantly increase dryness in the wet press and reduce cross direction moisture variance, making them indispensable paper mill automation.

The applied steam from a wet end steambox heats the water in the sheet, reducing the water’s viscosity and its tendency to cling to the sheet’s fibers. The sheet’s hotter, thinner water can then drain more readily. Additionally, wet end vacuum sources pull water out of the sheet more easily and press nips can squeeze out more water.

It’s not surprising that wet end steamboxes are so widely used; a profiling Fourdrinier steambox typically increases wet press dryness by 1.0% to 1.5% and provides a 40% to 60% reduction in CD moisture variance at the reel. As a result, there is at least one steambox installed on virtually all large and medium-sized board machines in paper mills worldwide, and many machines have units installed over the last few Fourdrinier flat boxes.

Older steamboxes, especially Fourdrinier units, need to use a large amount of steam. Most are very big—from 48 inches to 60 inches in the machine direction (MD)—so the internal steam header pipes can support the unit over the sheet. Although it seems like a larger steambox would be beneficial because the sheet would have more dwell time under the unit, extensive trials conducted by The Institute of Paper Science and TAPPI have proven that a Fourdrinier steambox mounted over a vacuum will not produce a greater sheet temperature increase with a dwell time over 30 milliseconds (see Figure 1).

ABB’s SteamPlus Profiler is one of the new steamboxes that has been developed with a more compact, efficient design. These streamlined new models not only do a substantially better job of achieving dryness and improving CD profiling results, but they also help mills save on energy costs.

A Fourdrinier steambox mounted over a vacuum will not produce a greater sheet temperature increase with a dwell time over 30 milliseconds.

Papermakers replacing their old steamboxes with the latest models are achieving ROI in less than six months.

ECONOMICS OF STREAMLINED DESIGN

Efficient design plays a key role in the way the new steamboxes reduce a papermaker’s expenses. Notably the new models save costs by minimizing steam flow.

The cost of running a wet end steambox depends largely on the cost for the pounds per hour (PPH) of steam flow the unit uses. Large, older, Fourdrinier units are usually designed to have a steam flow rate of 0.20 to 0.30 pounds of steam per pound of paper produced at mid range operating conditions. Since average steam usage is approximately 0.25 pounds of steam per pound of paper produced, if the paper machine is producing 60 tons of paper per hour (TPH), or 120,000 pounds of paper per hour, these units would typically have a steam flow rate of 30,000 PPH during normal operation.
Steam flow costs range from $4.00 to $12.00 per 1,000 PPH, so the average cost is approximately $8.00 per 1,000 PPH steam flow. If, for example, a large Fourdrinier steambox uses 30,000 PPH, it costs the mill $240 per hour to raise the sheet temperature at the average cost of steam of $8 per 1,000 PPH.

With no internal header pipes, ABB’s Fourdrinier Steam-Plus Profiler uses no more than 0.14 pounds of steam per pound of paper produced during normal operating conditions. With, for example, a 60 TPH production rate, a SteamPlus Profiler would use no more than 16,800 PPH, or 13,200 PPH less than the large unit it replaced. At $8.00 per 1,000 PPH, this equals a cost reduction of $105.60 per hour or $887,040 annually if the machine operates 350 days per year.

The new steamboxes provide additional steam savings by producing a sheet that is dryer because less steam is used to raise the sheet temperature to its maximum. New units with their smaller size can be installed as close as 3/8 inches from the sheet even on the widest machines. The newer design minimizes problems such as bending, bowing or warping.

The new models also increase reel moisture MD targets while also raising MD moisture averages at the size press, raw stock scanner and/or reel. When the MD moisture average target is raised, less steam is needed in the dryer to maintain the MD moisture average at target. Raising the MD moisture target at the reel by only 0.25% can produce a significant dryer steam savings along with reduced fiber costs.

MORE MILL SPACE, DECREASED REJECTS, LESS STEAM CLOUD

In contrast with older steamboxes that have large internal steam header pipes, today’s efficient steamboxes feature highly-robust solid beam design with formed plates that reduce welding and distortions caused by welding stresses. The unit’s surfaces are contoured to prevent fiber buildup, there are no cold areas to eliminate temperature distortion and there is no dripping from condensate on the surface or from internal water buildup.

Another advantage of the new units is the smaller cross section, because it reduces rejects and sheet breaks caused by stock buildup since wet line fingers can’t readily travel under the steambox and accumulate.

In contrast to older steamboxes, solid beam design without steam header pipes.

One of the most important benefits of the new models is that their compact size means that each takes up far less real estate in a mill. As a result, the new smaller and lighter steamboxes can be installed in demanding locations.

After start-up, many papermakers find they particularly value their new steambox’s reduced steam cloud. With less steam cloud, operators can more easily see the process and there is less drip on the sheet and less condensation on the machine frame or mill ceiling.

For example, a mill with severely limited space recently replaced a 48-inch Fourdrinier unit that had been squeezed in just a foot from their Top Wire Former, with a 24-inch solid beam SteamPlus Profiler. The compact design of the new unit created extra space between itself and the Former, allowing personnel to clearly see the sheet in this critical area.

REDUCED CD VARIATIONS

Importantly, today’s wet end steamboxes dramatically reduce CD moisture variance. Unlike older models with wasteful preheating or non-segmented internal steam sections, the new units lessen CD moisture variance with an efficient single stage steam application (see Figure 2).

Reducing CD moisture variance gives papermakers important benefits including reduced wet end breaks along with faster on-grade times following breaks, start-ups and machine upsets. Having a flatter moisture profile leaving the wet press reduces stress-related problems caused by drying a sheet with uneven moisture in the cross direction too quickly. That is a key reason why many mills ramp the dryer surface temperatures in the first section or two. However, having to ramp dryers can lead to a larger production loss on dryer limited machines.

After papermakers replace their older steamboxes, they often find that the sheet temperature exiting the wet press is hotter because new units operate at optimum levels and provide the maximum sheet temperature increase. With less of a temperature differential between sheet and the dryer shell, mills have fewer stress related problems. Also, with a hotter sheet temperature entering the first dryer, even if it is only a degree or two, the sheet reaches its evaporation point, or wet bulb temperature, more quickly. This means...
less main dryer steam will be needed to dry the sheet, leading to additional steam savings.

In January 2006, a Linerboard mill replaced a 48 inch wide Fourdrinier unit that was only two and a half years old with ABB’s 24 inch wide, solid beam SteamPlus Profiler. Steambox steam usage was reduced from 0.25 to 0.14 pounds of steam per pound of paper produced which equates to 11,000 PPH at this mill (28,000 PPH down to 17,000 PPH). The SteamPlus Profiler also reduced 2-sigma CD moisture variance at the reel by more than 50%. Instead of reducing dryer steam, the mill increased machine speed by 100 fpm on their 33 lb. grade. Six months after their initial purchase, this mill ordered another SteamPlus Profiler to replace the large, inefficient Fourdrinier steambox on PM2.

EVALUATE FEATURES AND NEEDS

In most mills, price is an issue. The best advice for mills planning a steambox purchase is to initially budget enough to cover the highest-cost unit. Then, during the vendor selection phase of the project, evaluate each feature of the steamboxes offered by the vendors. If the automation does not have the features your mill wants or needs, factor that in too. When all the information is in, the economics associated with the individual features can be part of your mill’s decision-making process.

If a mill purchases an inefficient unit simply because it costs less, the initial savings may not cover the long-term loss. For example, if a mill plans to purchase a unit that costs $50,000 less than a more efficient unit, they need to consider that the new, more efficient model can make the mill over $1,000,000 a year more than the less expensive, inefficient unit. In just two or three years a mill can lose $2,500,000 to save $50,000.

Paper mills that replace their old steamboxes with the new and optimally efficient models can reduce their steambox steam usage costs by 30 to 50 percent. With the potential for wet end steamboxes to quickly provide these extremely high returns, it’s not surprising that so many mills are choosing to replace their old steamboxes.

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