Bulk is an essential characteristic for some paper and board products. But one of the challenges of papermaking has been that achieving a smooth surface on paper has meant a considerable reduction in bulk. The latest innovation from ANDRITZ Küsters, the *Prime*Cal Y, overcomes the challenge by enhancing gloss and smoothness without compromising too much of the sheet's bulk and stiffness. The first unit has been sold and will soon ship.

A well-recognized brand

We are visiting the ANDRITZ Küsters facility in Krefeld, Germany, which has a long tradition of innovation since its beginning in 1953. The founder, Eduard Küsters, was a pioneer in deflection-controlled rolls. Today, ANDRITZ Küsters offers a full range of calendering systems – hard nips, soft nips, multi-nips, and shoe press calenders.

The conversation today is with Gerhard Gabriel, Director of Product Development, and Peter Svenka, Senior Product Development Manager. Gabriel and Svenka have something new to show us.

An innovation from ANDRITZ Küsters, the *Prime*Cal Y calender, uses belt calendering to achieve desired paper or board surface properties while preserving the maximum amount of bulk. "The advantage of belt calendering with moisturizing is that a smooth, glossy finish can be put on the sheet with lower roll temperatures and lower nip pressures," Gabriel says. "This saves energy and preserves bulk."

The *Prime*Cal Y belt calender undergoing testing at the ANDRITZ Paper Technology Center in Krefeld, Germany. ▶

The use of computational modeling tools allows Center personnel to duplicate commercial production speeds and scale. ▼

"We ran a lot of trials on our pilot *Prime*Cal X shoe calender and saw the limitations of its soft belt, and the advantages of its long nip," Svenka says. "Our development of *Prime*Cal Y, which began in 2008, was to take the limits off the shoe calender's limitations and expand upon the strengths."

Limiting the limitations

The objective of calendering is to soften the surface of the paper so that it can be mechanically smoothed in the nip. The main control factors are temperature, nip pressure, and dwell time (the time that the paper sheet is in contact with the calender roll).

A calender roll is heated so that the surface of the paper can reach the glass transition point, the point at which the wood and cellulose fibers change from a solid to a malleable state (typically in the 200-260° C range with low moisture content). "The way to preserve bulk is to heat only a thin layer underneath the paper surface to the transition point, while the inner layer stays below transition and remains unchanged," Svenka explains. "But this is difficult to do when the dwell time of a typical heated calender is only one millisecond. Roll temperatures have to be set extra high, which requires special roll material and the consumption of more energy, which is then lost to the atmosphere. Plus, for a sheet with poor formation, the high roll surface temperatures can result in excessive mottling."

"PrimeCal Y is designed to remove a shoe calender's limitations and expand upon its strengths."

Peter Svenka,
Senior Product Development Manager,
ANDRITZ

Gradients to the rescue

The development work began in 2008. "We built a prototype in early 2009 and tested it extensively," Svenka explains.

"I believe we have made all the possible mistakes on our pilot machine and have made adjustments to the product so that they will never happen on a paper machine," Svenka smiles. "For example, at first, it was difficult to control the position of the belt. We have very precise sensors measuring the edge position, and the belt width does not have to be absolutely precise. Our control software was too precise, over-reacting to every change. Our programmers tuned the algorithm, then things ran very stably."

The key to the *Prime*Cal Y is the use of temperature and moisture gradient calendering technology. "These concepts have been around for many years but were often considered separately from each other," Svenka says. "Control of the moisture gradient allows us to first moisturize the sheet to lower the glass transition point. An even water layer is misted on the web surface to keep the water in the surface layer of the sheet only."

In the *Prime*Cal Y belt calender, after the surface of the sheet is moisturized, a belt presses the sheet against a heated roll in the pre-heating zone. The contact time between the sheet and the heated roll can be precisely controlled. The angle and degree of wrapping can also be controlled. "With this belt, the dwell time is more than 50 times longer than in a hard-nip calender," Svenka says. "Because of this, the temperature of the heated roll needs to be only 20-30° C above the glass transition point. We can properly soften the paper surface using moisture and temperature, use lower line forces in the roll nip, and achieve the desired calendering effect. Lower compression rate means that bulk is preserved.

"Since the belt guide rolls do not touch the heated roll, there is no danger of belt marking or delamination during a web break or threading, which is a huge improvement over traditional shoe or belt calenders," Svenka adds.

Adjustability with energy-saving benefits, too

Belt calendering technology can be applied to all paper grades and basis weights. Unlike a shoe calender, where the nip presses through the belt, the *Prime*Cal Y's nip is behind the belt, and completely independent from it. "You can use any kind of nip roll," Gabriel says. "For example, our *Prime*Roll MHV to ensure exact CD caliper control."

*Prime*Cal Y offers another welcome benefit: cost savings. Because the calender's heated roll temperature is significantly reduced – only 20-30° C above the glass transition point – there is considerably less energy loss when compared to a traditional calender with a high roll surface temperature.

"This is actually a very flexible machine because it gives papermakers control of the glass transition point and the gradient degrees," Svenka says. "You have precise control of the temperature, wrapping length and angle (dwell time), pressure, and moisture."

For example, when producing a higher basis weight where bulk is important, the papermaker can pre-moisturize the sheet, adjust the roll heating to a defined depth under the surface, and lower the nip pressure. When producing a lower basis weight where high-gloss and densification are desired , the papermaker can amplify the calendering effect by heating the entire sheet and increasing the nip pressure. "Or anywhere in between," Gabriel and Svenka are quick to point out.

ANDRITZ Küsters is planning a first commercial installation in 2013. It will be interesting to learn more about the first mill experience. "This kind of research – in direct response to customer requirements – is the kind of work ANDRITZ is well-known for," says Gabriel.

CONTACT
Belt Calenders
beltcalender@andritz.com

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Gerhard Gabriel,
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Working on **customized solutions**

Customers from around the world can be seen doing product research and pilot trials at the ANDRITZ Paper Technology Center in Krefeld, Germany, which is replete with a paper lab and pilot machines. "We enjoy a close relationship with our customers and encourage them to use our facilities," Gabriel says.

On-site pilot machinery available for customer trials includes: *Prime*Cal (soft, hard, X, and Y) and *Prime*Cal ProSoft (multi-nip). There is also a *Prime*Feeder Tail threading and web guidance system.

With the use of computational modeling tools, production speeds and scale can be duplicated. The Center also has a fully instrumented paper lab to test paper characteristics.