Calender technology in nonwovens production

Added value and process optimization by innovative calender technology

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The first Küsters calender for the nonwovens industry was installed in 1961. This 2-roll calender for Freudenberg was equipped with two heated Swimming Rolls Küsters® with a chill casting sleeve. Since then, not only the calender technology has developed, but the entire industry has undergone continuing and rapid change. The search for ever new fields of application and the trend of moving away from mass production towards niche products has made our clients' processes increasingly complex and sophisticated.

In earlier days it was enough to supply a high performance machine; today this is, however, only one part of the performance spectrum expected by our partners in the nonwovens industry. For the client, it now goes without saying that there will be, at the end of a complete analysis process, a calender specifically designed to his needs. Then, as now, one fact is indisputable: the performance of the roll technology is crucial for the extent to which a calender adapts to the production processes and generates a relevant added value to product and company.

Roll systems by comparison

Conventional roll systems without deflection compensation

When two conventional rolls are pressed together, they bend, i.e. the linear force at the roll edges is much higher than in the roll center. Various solutions have been developed for compensating this deflection. One of them is to use larger roll diameters in order to reduce the above-mentioned unevenness in the nip. Due to big weight and heavy construction this version can only be recommended for narrow machines.

Another option is crowning (fig. 1). The middle section of both rolls is ground to a greater diameter, falling down towards the roll edges to the specified diameter. This causes friction between the roll center and the edges, which leads to an unfavorable effect on the nonwoven's strength. In order to prevent this, the crowning needs to be calculated for one defined line force. The flexibility of varying between different line forces and material widths is therefore extremely limited.

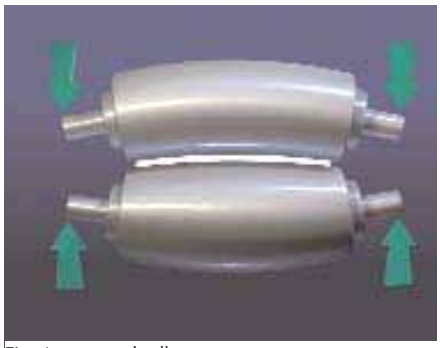

Fig. 1: crowned rolls.

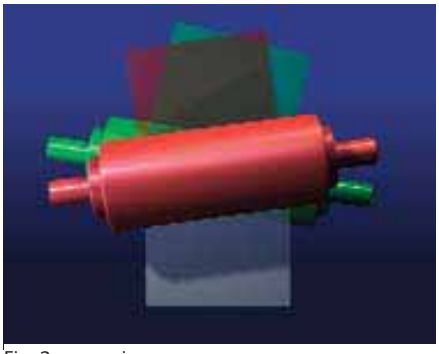

Fig. 2: x-crossing.

This limitation can be partially compensated for by the use of x-crossing. One or both rolls are swung out of the machine center by adjustable bearing houses. Instead of working parallel to one another, they cross over each other at the center lines, thus producing artificial crowning. The disadvantage is a smaller line force range. The axial forces of the x-crossed rolls create transverse tension within the nonwoven material, resulting in many undesirable effects at high production speeds (fig. 2). The adjustment of the x-crossing is possible only with the machine stopped; i.e. the line has to be stopped for each setting.

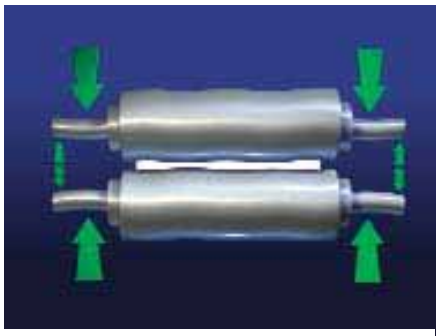

Fig. 3 roll bending

Another option of minimizing the uneven nip is the roll bending principle, where the roll deflection is countered by additional hydraulic cylinders at the roll edges. Two different forces affect each end of the roll resulting in a product thickness profile similar to oxen yokes (fig. 3). This design is distinguished by very high bearing loading and an increased energy requirement for the drive technique. Here too, only a restricted line force range is available.

Calender Technology with deflection controlled Swimming Roll (S-Roll)

The principle of the Swimming Roll (fig. 4), which has been employed by Andritz Küsters from the very first nonwoven calender until today, can be described as follows:

A tube rotates around a fixed axle. The annular gap is divided by two seals into two semi-circular chambers. The chamber facing the nip is hydraulically pressurized by oil.

In this way an oil pressure is generated that stands in linear ratio to the cylinder forces. This allows the S-Roll to adapt against the counter roll ideally. Thus an even and infinitely variable line force over the entire roll width is ensured. In the nip no friction whatsoever occurs, as the rolls rotating against each other are absolutely cylindrical. The line force can be adjusted infinitely during running production.

The heated Swimming Rolls currently used by Andritz Küsters in the nonwovens industry, Hot S-Roll 200, 250 and 275, have been specially adapted to the process requirements in modern nonwoven production. Their distinguishing feature is the attainable maximum roll surface temperature (T_{max} 200 – 275° C).

The Hot S-Roll systems have been designed for production speeds of up to 1000 m/min and a line force range of 150 N/mm (in case of special applications even up to 300 N/mm and more).

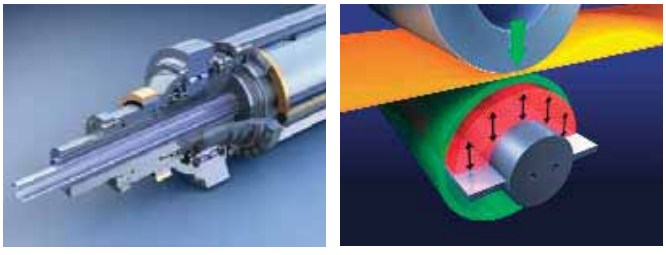

Fig. 4: Hot S-Roll® by Andritz Küsters.

Another product of the heated S-Roll family is the CS-Roll, a calibrating Swimming Roll primarily used in the airlaid industry. All roll systems are designed for a roll surface width of up to 7000 mm (in case of special applications even wider).

New calender design demands

Be it a spunbonding, airlaid, wetlaid or carding line – depending on fiber blend, speed and final application different calender concepts are required. Calenders with two, three or more rolls in vertical or horizontal design, according to the process demands, are part of the Andritz Küsters neXcal program. Flexible machine concepts which are created for a wide variety of products and for use in the high speed-range are required by the nonwovens industry. A drastic reduction in set-up times in case of design or process change was an essential demand. Change-over times of up to 12 hours for a two-roll calender or 5 hours for a three-roll calender have hitherto prevented quick product changes.

The neXcal twin with two engraved rolls that can alternatively be turned in towards the system roll (fig. 5) is the high-tech solution for more flexibility in modern nonwoven production. All Andritz Küsters system rolls (Hot S-Roll, CS-Roll or hydrostatically controlled HyCon Roll) are applicable. Be it a new pattern or the change from embossing to bonding, by turning out and in the engraved rolls a new process can be set up within a few minutes.

Fig. 5: Andritz Küsters neXcal twin, change of engraved roll .

Another unique feature: An exchange of the roll currently not in use is even possible while the machine is still in production and one engraved roll is in operation.

Ongoing re-engineering of all Andritz Küsters calender concepts ensure further optimization for all neXcal types. Closed bearing houses (seals) and quick nip change are only two of the improvements already achieved to date. Standardized bearing houses make it possible to install system rolls and engraved rolls in any position in the calender, thus putting an end to elaborate machine modifications when position changes. Vibration optimizing measures ensure smooth running in the high speed range (Vtech. = 1000 m/min).

Not every process, however, takes place in the higher performance range. For carding or spunbonding lines with production speeds of up to 400 m/min Andritz Küsters offers an adequate alternative with the neXcal compact and the proven deflection controlled Hot S-Roll technology.

For manufacturing the engraved rolls (fig. 6 and 7) the most varied materials are selected (depending on hardness and surface finishing).

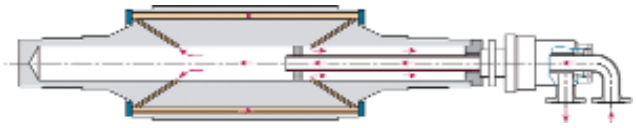

Fig. 6: Oil heated roll with central bore.

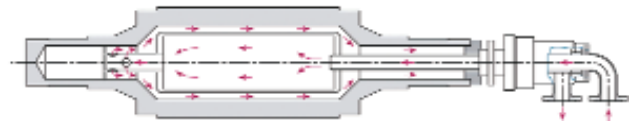

Fig. 7: Oil heated roll with peripheral bores.

Be it nitrogen or inductive hardening, special coatings or hot grinding – the individual application determines the selection. Cooperation with roll engravers of renown on all continents guarantees the largest possible selection of patterns and individual counseling in the product development stage. In addition, the Andritz Küsters Technical Center offers the possibility of comprehensive tests at laboratory scale.

Added Value, optimized processes and special effects

The search for added value leads to an increasing number of production and finishing processes in the nonwovens industry. In the strife for innovation, technical and optical products are being sought in order to differentiate from competitors and thus to increase the value of the own product. In such processes the highly flexible mode of operation of all Hot S-Rolls stand out. In nonwoven embossing, for example, the even line force adjustable over the entire working width ensures that the motif appears equally even and precise over the whole material width.

In perforating, either by burn-out, different speed between top and bottom roll, or by material weakening due to engraving indentation, the Hot S-Roll adapts radially to the counter roll. The even line force distribution ensures longer life-time of the engraving and an optimum process.

When laminating composites of two or more substrates the Hot S-Roll even permits the passage of spots through the nip. Slight springing in protects the roll pair against damage.

Isotropic bonding of a 10 g/m² spunbond nonwoven over a width of up to 7 meters and at a speed of more than 700 m/min is a standard performance of the Hot S-Roll. Slightly hardened polymer droplets (not unusual in the spinning process) passing through the nip without causing any damage to the engraving, however, is already part of the special features and daily challenges of this system.

This shortlist of the Hot S-Roll's various applications may give a basic impression of how much an intelligent roll system contributes to adding value for nonwovens. The Andritz Küsters team of engineers and process technologists will be pleased to assist further with comprehensive process knowledge and practical advice.◆