

Modern newsprint machines served by automated single-drum winders

Herbert Schoenmeier

With lighter-weight newsprint on the horizon, the key to runnability on modern presses will be the elimination of crepe wrinkles, bursts, dishing, and core displacement.

Single-drum winders have been used almost exclusively to wind the large-diameter rolls of lightweight-coated and uncoated supercalendered rotogravure papers. Now, however, newsprint machines in Europe are using single-drum winders to reduce the occurrence of such defects as crepe wrinkles, bursts, starring, rope marks, dishing, and eccentric displacement of cores.

Background

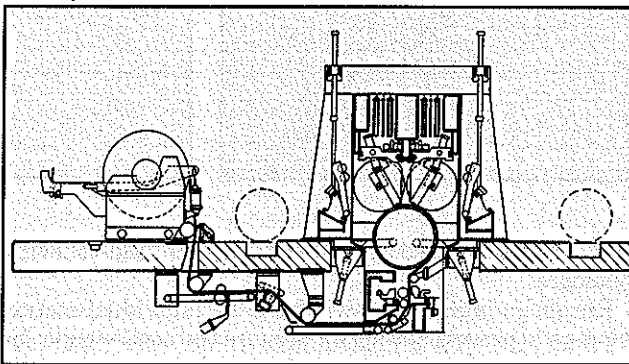
Individual-station winders have been used to wind a wide variety of coated papers since the 1960s. These winders feature staggered rewind positions (mounted in a 3 o'clock/9 o'clock pattern) for each roll. This type of winder is currently used with either a single drum or with two drums in vertical position. These designs, in contrast to the conventional two-drum winders, permitted programmed control of the nip load with the aid of cylinders even when winding to large diameters.

When finished rolls—especially those for gravure printing—became wider and heavier, it became apparent that this configuration had a significant drawback. The edges of the paper in the interior of wide, heavy rolls often developed such defects as crepe wrinkles and bursts.

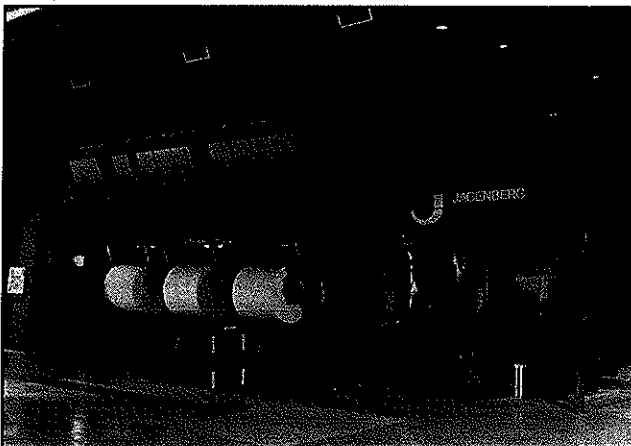
This drawback was overcome by a winder that was developed in the early 1980s. This winder features individual rewind stations staggered in the 1 o'clock/11 o'clock positions, as seen in **Fig. 1**. The new design reduced the forces in the area of the chucks and, consequently, the chance of damaging the paper inside the roll.

Until recently, this type of winder was used primarily for rotogravure printing papers. Finished rolls for these paper grades can be as wide as 3080 mm (121 in.) with diameters up to 1250 mm (50 in.). Such rolls weigh approximately 4600 kg (10,000 lb). About three years ago, the first such winder for newsprint was started up in Italy.

1. Winder with individual rewind stations staggered at 1 o'clock and 11 o'clock positions.



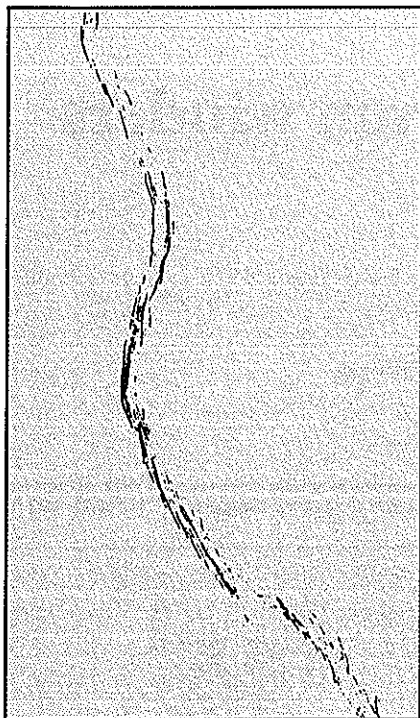
2. This 7400-mm (291 in.)-wide center-drum winder is used to process newsprint in an Italian mill.



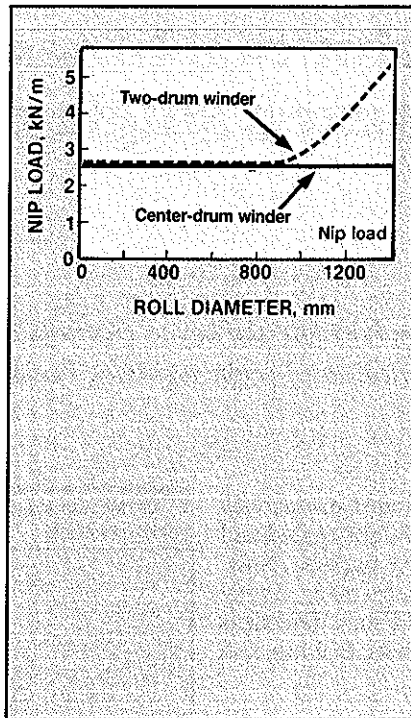
This machine, which is 7400 mm (291 in.) wide, is illustrated in **Fig. 2**. A second 7400-mm (291 in.)-wide machine is now operating in Italy. Three 8600-mm (338 in.)-wide winders are operating in a Dutch mill, and one is operating in Sweden. A 6200-mm (244 in.)-wide machine operating in southern Germany features three winder

Schoenmeier is the chief design engineer at Jagenberg Werke AG, Kennedydamm 15 17, Duesseldorf, Federal Republic of Germany.

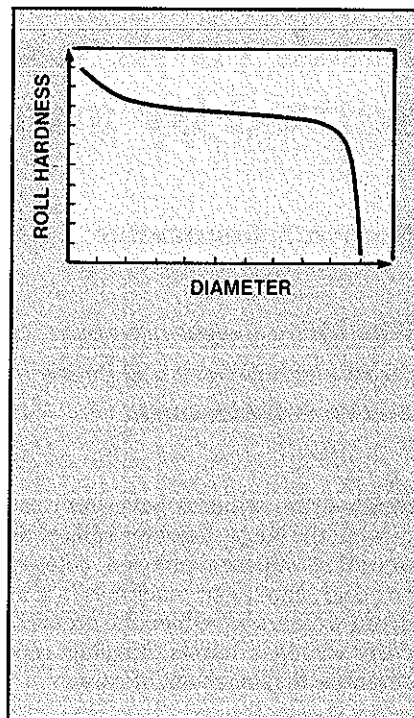
3. Crepe wrinkles are compressed wads of paper. Most defects of this type occur near the periphery of rolls taken from the sides of the paper machine.



4. Nip load as a function of rewind diameter for two winder configurations. When the dead weight on the rolls exceeds a certain limit, the nip forces increase in proportion to the square of the diameter.



5. Ideal hardness curve.



drums and staggered rewind stations with load-relieving cylinders.

European mills are switching to individual-station winders to process newsprint because the basis weight for the majority of the tonnage being produced has dropped to 45 g/m² (27.5 lb/3000 ft²), with a substantial amount of production at 40 g/m² (24.5 lb/3000 ft²). Rolls are frequently wound to diameters of 1250 mm (50 in.). This means that the footage on a roll can be as much as 19,800 m (65,000 ft), with as many as 9300 layers of paper being wound on each roll. The nip loads on a conventional two-drum winder can be as high as 4.5 kN/m (25 pli). Moreover, the use of secondary fibers with additives to improve smoothness has increased the apparent density of the paper.

Under the circumstances, it is not surprising that roll defects such as crepe wrinkles, bursts, starring, rope marks, dishing, and skewed cores have become serious problems. Recent test runs¹ with newsprint on a modern machine-wide center-drum winder indicate that these defects can be avoided. These findings are confirmed by results from machines currently in production.

Crepe wrinkles

Crepe wrinkles² are compressed wads of paper. Figure 3 shows a wad of paper that has been compressed. This

defect appears chiefly near the periphery of rolls taken from the sides of the paper machine. The wrinkles can run in a straight line, at an angle across the full width of the roll, or at an angle near the harder roll area, toward the center of the machine.

Crepe wrinkles are particularly troublesome because they often escape detection in the mill. Their presence then becomes apparent when the web breaks in the printing press. This condition is aggravated when rolls are stored before printing. In this case, the mill continues to produce defective product until the customer reports a problem.

The occurrence of crepe wrinkles can be reduced by any of the following:

- Lower specific nip load between the paper roll and the drum
- Higher sheet tension
- Lower surface smoothness of the paper
- Lower compressibility of the paper.

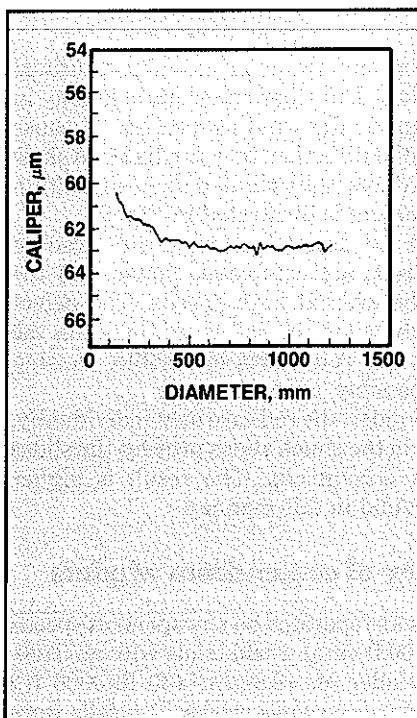
Crepe wrinkles often occur in conjunction with a splice after a web break. This is caused by the continued rotation of the paper roll after the break. Crepe wrinkles tend to form when the paper roll rotates without a change in diameter. This explains why thinner papers are more susceptible to crepe wrinkles than papers with a higher caliper.

Excessive nip loads between paper roll and winder drum are largely responsible for the formation of crepe wrinkles. A rider roll with programmed relief can control these forces up to a point. However, when the dead weight on the rolls exceeds a certain limit, the nip forces increase

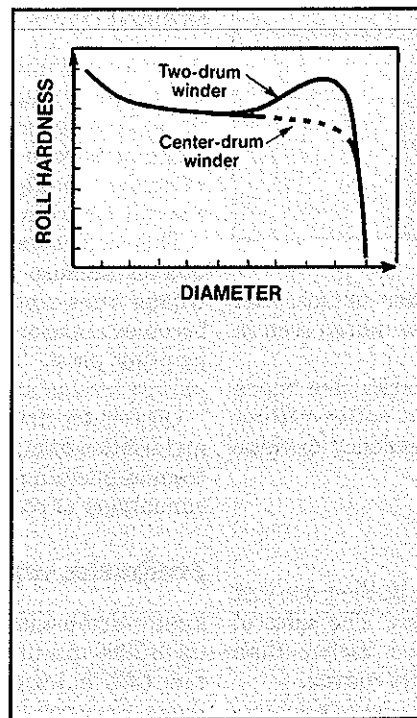
¹Welp, E. G., Papier 40(10A): 203(1986).

²Lucas, R. G., in 1981 Finishing and Converting Conference Proceedings, TAPPI PRESS, Atlanta, p.91.

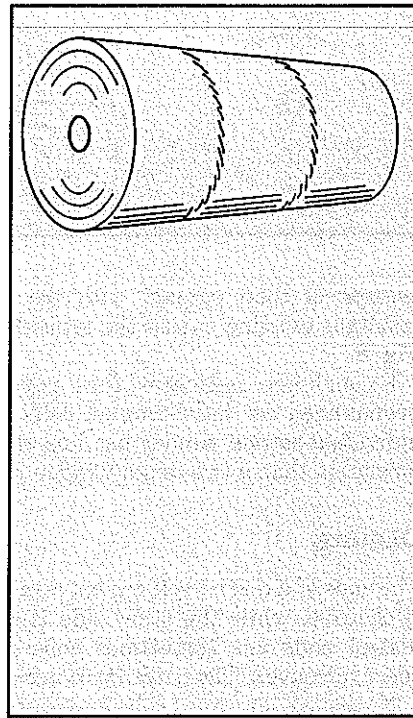
6. Typical output for online measurement of hardness.



7. Roll hardness as a function of roll diameter for a two-drum winder and a center-drum winder.



8. Rope marks.



in proportion to the square of the diameter. This phenomenon, illustrated in Fig. 4, explains why the outer layers of the roll are particularly prone to crepe wrinkles.

On center-drum winders, the rolls are rewound on individual stations equipped with pneumatic or hydraulic pressure cylinders. These cylinders can control the nip load over the total diameter range. Furthermore, there is only one nip, so that the amount of overwheeling is only half that of a two-drum winder. The specific-area nip load is also reduced, since the single center drum is of a much larger diameter than the drums of a two-drum winder.

On a two-drum winder, the occurrence of crepe wrinkles can be reduced only by increasing sheet tension and by lowering the paper's smoothness and compressibility. The sheet tension can be adjusted only within a limited range. Too much tension would overstretch the paper and increase the likelihood of a web break. The parameters of smoothness and compressibility cannot be adjusted at the winder.

Roll hardness and its effect on bursts and starring

It is useful to distinguish between diameter-related roll hardness and hardness related to the roll's profile in the cross-machine direction (CD).

Diameter-related hardness

A roll's diameter-related hardness profile ideally should resemble the curve illustrated in Fig. 5. Online measurement of diameter-related hardness is available, and Fig. 6 illustrates a typical output for online measurement of

roll hardness. On a two-drum winder, online measurement of hardness can be applied only to the two outer rolls of a set. On a center-drum winder, however, the hardness of each roll can be measured.

Figure 7 shows that roll structure on a two-drum winder follows the ideal curve in the low-diameter range. However, when the roll diameter exceeds a certain limit, the curve rises steeply instead of leveling or dropping. The excessive winding hardness seen in the curve for the two-drum winder can cause burst and starring. The conditions are the same as those that lead to crepe wrinkles, namely a sharp rise in the nip load.

Measurements taken on a center-drum winder result in curves that are close to the ideal. Consequently, bursts and starring will be avoided.

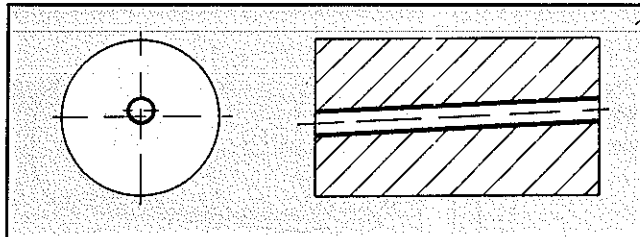
CD profile-related hardness

CD-profile-related hardness is determined with a Schmidt hammer or a Rhometer. When the paper profile is uniform, the CD-profile-related roll hardness corresponds to the diameter-related hardness. In the case of profile variations, however, the individually wound rolls on a center-drum winder show less variation than those wound on a two-drum winder. The low hardness level of the center-drum winder is responsible for this result.

Rope marks

Rope marks are defects that run over the total circumference of a roll. Rope marks are caused when various sections within a roll have slightly different diameters. These sections try to assume the same peripheral speed

9. Only the outer cores are confined by the chuck assemblies on a two-drum winder. The other cores can be displaced in a radial direction and are liable to skew when the winding hardness is distributed unevenly within one roll.



because of their contact with the winder drums. The resultant twisting causes the typical skew marks seen in Fig. 8.

Experience indicates that rope marks are more pronounced on hard-wound rolls. The softer-rolling individual-station winder has less of a tendency to ridge formation than a two-drum winder.

Dishing

The ends of a dished roll are not straight. Rather, one end is concave, while the other side is convex. The sides of dished rolls are sometimes cone-shaped rather than concave/convex. The outer faces are always convex.

No dished newsprint rolls have been observed on center-drum winders so far. There is only a very short draw on these winders from the slitters to the drum, and no

spreader is used at that point. Individual treatment of the rolls and exact parallel alignment of the nip line to the axis of the center drum are additional factors.

Skewed cores

On a two-drum winder, only the outer cores are confined by the chuck assemblies. The other cores are held only in the axial direction during the winding process. Because they can move in a radial direction, they are liable to skew when the winding hardness is distributed unevenly within one roll. Core displacement is illustrated in Fig. 9.

This defect cannot be detected during the winding process because the rolls are completely round and the winder runs smoothly, even at high speeds. The defect becomes apparent only when the roll is unwound on the printing press. Then the roll starts to wobble, causing uneven tension and, possibly, snapoffs.

On a center-drum winder, the rolls are held individually, and friction dampers in the chuck slides prevent the slides from replicating any eccentricity. The result is higher runnability of rolls wound in this manner.

Productive capacity of center-drum winders

Center-drum winders are operated on newsprint at speeds up to 2200 m/min (7200 ft/min). Field trials with an 8600-mm (338 in.)-wide winder on 48.8-g/m² (30 lb/3000 ft²) paper were conducted over several weeks. The rolls were wound to diameters of 1060 mm (42 in.), and productivity in excess of 180 metric tons (200 short tons) per shift was obtained on several occasions. This translates into an average production speed equivalent to a paper machine running faster than 940 m/min (3100 ft/min). Speeds up to 1095 m/min (3592 ft/min) were attained when running 45-g/m² (27.5 lb/3000 ft²) paper and winding rolls to diameters of 1250 mm (50 in.).

Newly developed systems for automated roll-set changes have reduced the downtime for this operation to approximately 1 min. This represents an improvement in efficiency for this type of winder and permits operation with a three-man crew.

Conclusion

Center-drum winders cost more than two-drum winders, and the productivity of center-drum winders is somewhat lower because of increased downtime. Despite these drawbacks, center-drum winders are preferred for lightweight coated and supercalendered grades because they eliminate crepe wrinkling, bursts, starring, rope marks, dishing, and problems associated with skewed cores. Center-drum winders provide a further incentive with their proven reduction of broke and a consequent improvement in operating efficiency.

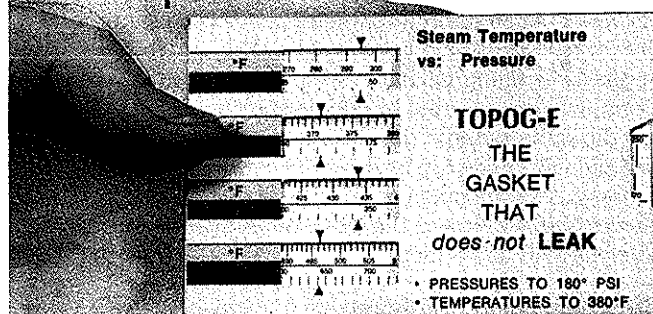
The field of application for center-drum winders is extending to newsprint, and it is reasonable to assume that this expansion will soon include other uncoated ground-wood grades, such as catalog and directory papers. □

Received for review June 24, 1988.

Accepted Oct. 19, 1988.

Presented at the 1988 Finishing and Converting Conference.

FREE...Steam Temp Calculator



PACKED WITH INFORMATION TO HELP YOU MEASURE THE PERFORMANCE OF YOUR BOILER

Helping you with your boiler is our business. Topog-E® Gasket Company pioneered the Rubber Boiler Gasket over three decades ago. Today you get the world's best Boiler Gaskets only from Topog-E®.

- For pressures to 180 PSI and temperatures to 380° F
- Easy to install & remove
- No chiseling or buffing required

FOR YOUR CALCULATOR AND INFORMATION ON TOPOG-E GASKETS
WRITE: **TOPOG-E® GASKET**
1224 NORTH UTICA
TULSA, OK 74110
918/587-6649

Circle No. 423 on Reader Service Card