

Pigmenting and soft calendering of printing papers

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ABSTRACT: *This paper presents results from pilot machine experiments, together with production machine data, on the use of film size presses for pigmenting. Since paper surface characteristics depend greatly on the type of calender used, some soft-calendering results achieved with pigmented paper are presented. The new equipment needed for manufacturing papers of this type also is described. Results show that a modern film size press combined with a soft calender is a viable solution for grade improvement.*

KEYWORDS: *Calendering, coating color, coating weight, pigment, printing papers, size presses, soft nip calenders, surface sized papers.*

There is no clear definition of what pigmenting actually means. Normally it refers to the application of a coating color at the rate of 2 g/m² to about 7 g/m² per side.

Traditionally, pigmenting has been carried out with a conventional size press for lower coat weights and with short-dwell coaters and gate roll coaters for higher coat weights. Now the development of film size presses makes it possible to cover the whole range and even to extend it to 10 g/m² per side.

Since film presses are sensitive to abrasive pigments, new types of applicators and roll covers capable of withstanding these running conditions without excessive wear are required. This new equipment offers an ideal way to replace more expensive fiber with cheaper pigment.

If the film press is used to give the paper its final surface, the type of calendering is very important. In many cases, an on-machine soft calender is the ideal option for new paper machines, as well as for rebuilds, in terms of both economy and paper quality.

There are many factors to be considered when selecting the type of calender to use. These include the gloss and smoothness level required, the printing process in question, and the space available in the mill.

Principle of the film size press

Figure 1 shows the difference in application principles between blade coaters and film presses. In a film press, a liquid film of starch or coating color is metered onto the press rolls, which transfer the film to the paper

surfaces in the nip. In this method, no stationary applicator is in contact with the paper.

With a film press, it is important to obtain good film profiles on the press rolls. Since the films are formed between the roll surface and the applicator, both surfaces must be in good condition. Knowing this limitation, we have developed a totally new roll cover material and new applicators that are able to withstand the abrasive running conditions.

Light pigmenting

Light pigmenting of fine papers has gained popularity recently, thanks to the development of film presses. The advantages of light pigmenting are:

- Cost of raw material
Expensive chemical pulp is replaced by cheaper pigment.
Less optical brightener is needed.
- Paper quality
Higher brightness
Lower porosity
Smoothness improves with soft calender
Higher opacity
- Higher paper quality permits higher sales prices.

Film size press for light pigmenting

Figure 2 illustrates a film press used for light pigmenting. The size and pigment mixture is metered onto the press

Pigmenting/Soft Calendering

rolls by special grooved rod applicators.

Figure 3 shows the application principle of a film press with a grooved rod applicator. Unlike a short-dwell application, this design is equipped with a sealing blade instead of an overflow dam. For this reason, the flow to the application chamber is lower, minimizing the turbulence and air in the chamber.

The applicator itself is a chrome-plated steel rod with a diameter of 10 mm rotating in a polyurethane holder. Typical coat weights applied with this method are 2–4 g/m² per side.

Normally, bond size presses do not run much over 10% size solids. The durable grooved rods have proved extremely good for light pigmenting up to 30% solids. The limit is set by excessive wear to the rod. However, thanks to advances in the rod manufacturing technique, the lifetime of the rod has been increased to about two weeks at a speed of over 1000 m/min, depending on the type of pigment and the solids content.

One of the advantages of the grooved rod applicator compared to blade metering is its ease of operation. The film thickness is determined mainly by the groove profile. Each rod profile thus gives a certain film thickness. The profiling of the rod is not actually used. However, the profiling can be used to compensate for a worn-out cover, if necessary.

High-solids pigmenting

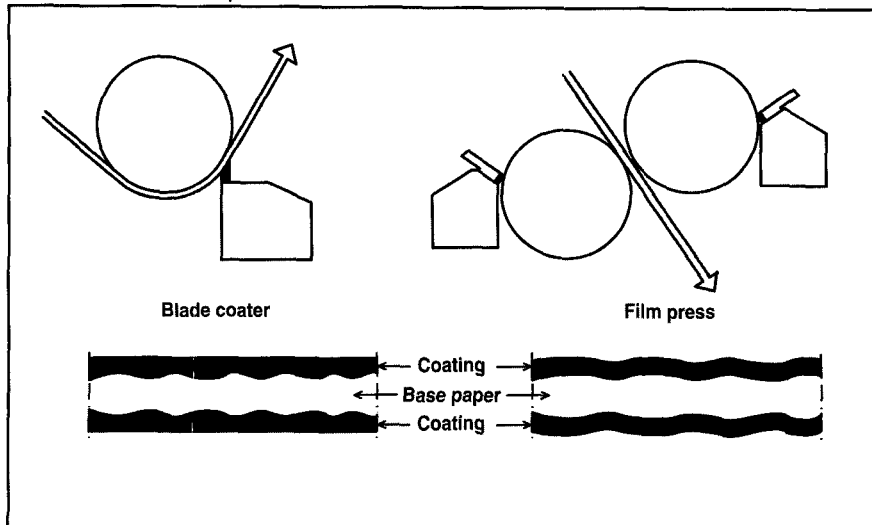
Large-diameter rod metering

For higher coat weights, a totally new type of applicator is needed. During the past two years, Valmet has been developing the large-diameter rod applicator (**Fig. 4**), which allows coat weights up to 10 g/m² to be applied.

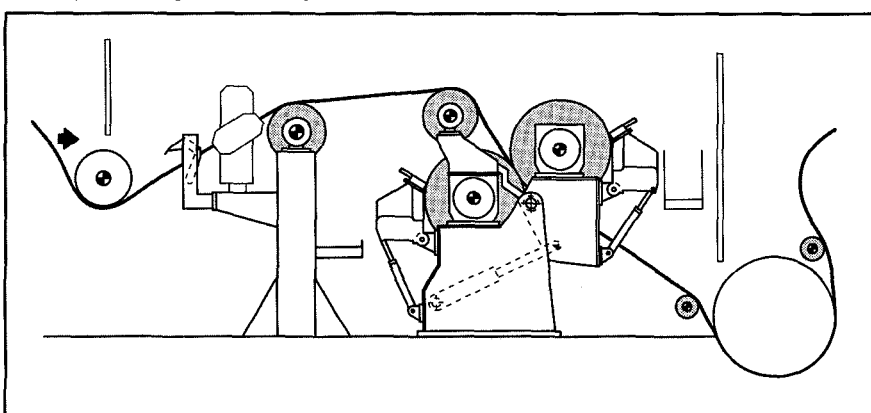
This applicator is based on a large-diameter smooth rod. The characteristics of the large-diameter rod applicator are:

- Excellent film profiles
- High solids content (up to 60%)

1. Blade coater vs. film press



2. Film press for light pigmenting



- High-speed capability (up to 1500 m/min)
- Minimized wear to the rod
- Sym-Sizers can easily be converted to run with the large-diameter rod.

A Sym-Sizer with a large-diameter rod has proven to be a good tool for upgrading existing paper machines for value added grades. It is particularly suitable for coating fine papers and upgrading existing machines (e.g., newsprint). The lowest basis weight run on the pilot machine so far is a 29-g/m² wood-containing base paper at 1500 m/min with an 8-g/m² coating per side. The coat-weight adjustment is easy, as can be seen in **Fig. 5**.

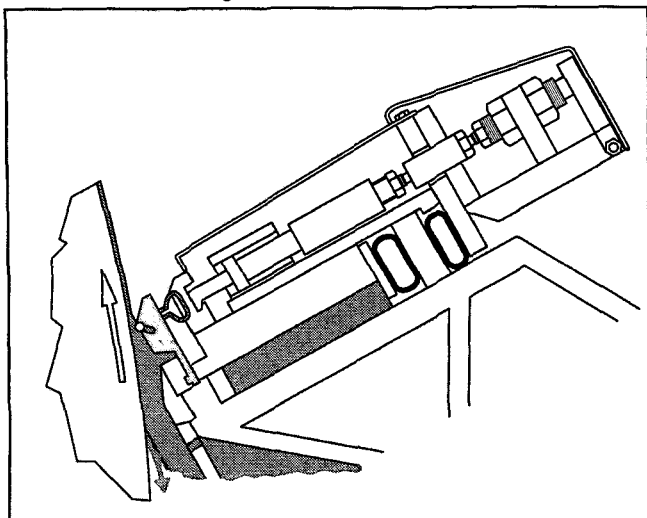
A typical operating range is shown in **Fig. 6**. This, of course, depends on the coating color.

Film press for high-solids pigmenting

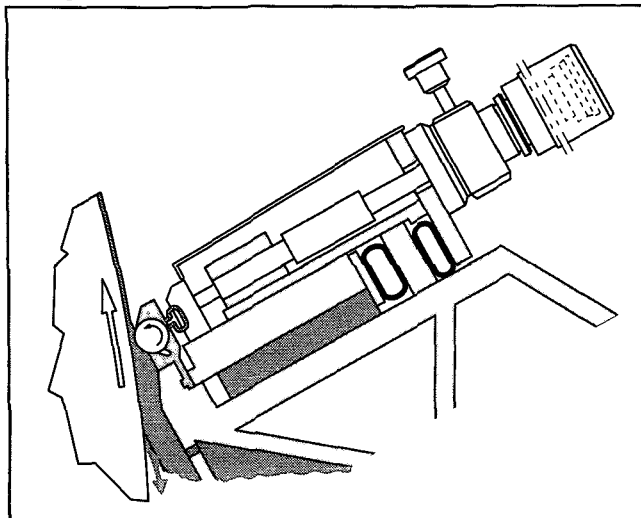
The first size press with a large-diameter rod was successfully started up in production early in 1992 at the MoDo Husum mill in Sweden. The wire width is 7250 mm, and the design speed is 850 m/min. This fine-paper machine was rebuilt in 1990.

After the rebuild, it produced surface-sized, bleached wood-free grades with basis weights of 70–200 g/m². In 1991, we supplied the new large-diameter rod applicators, and the necessary auxiliary equipment was installed

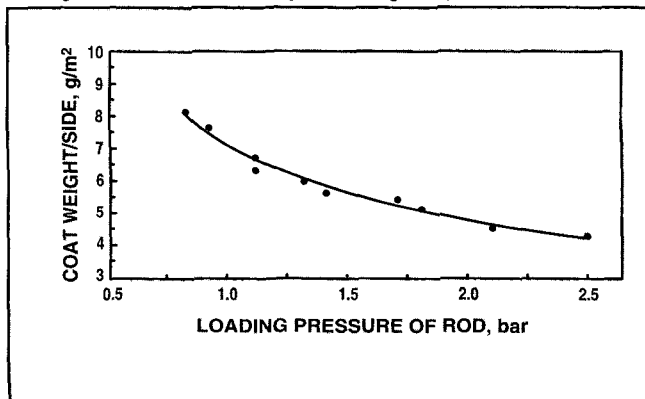
3. Grooved rod metering



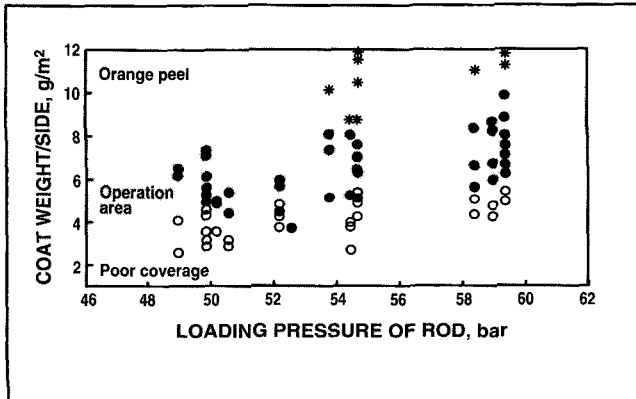
4. Large-diameter rod metering



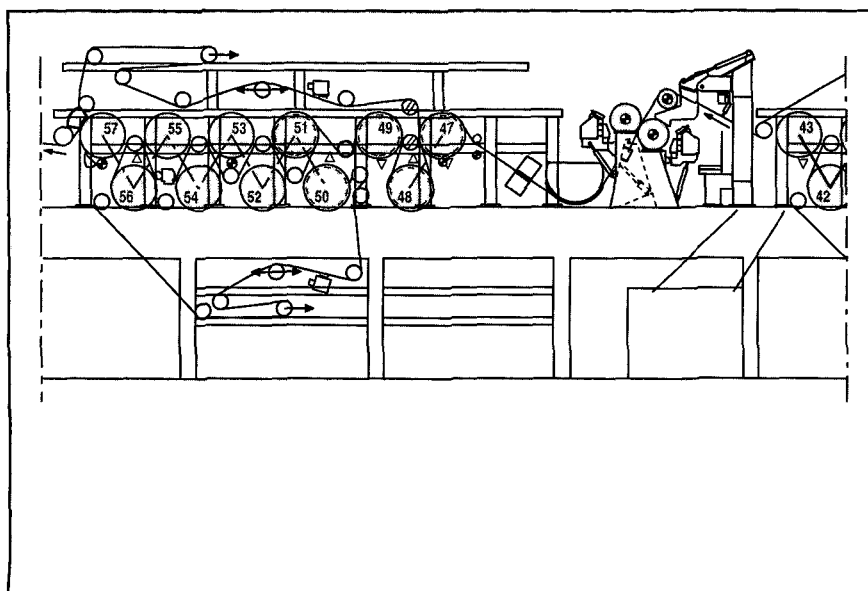
5. Large diameter rod metering, coat-weight adjustment



6. Operating parameters of the large-diameter rod



7. MoDo Husum paper machine no. 6



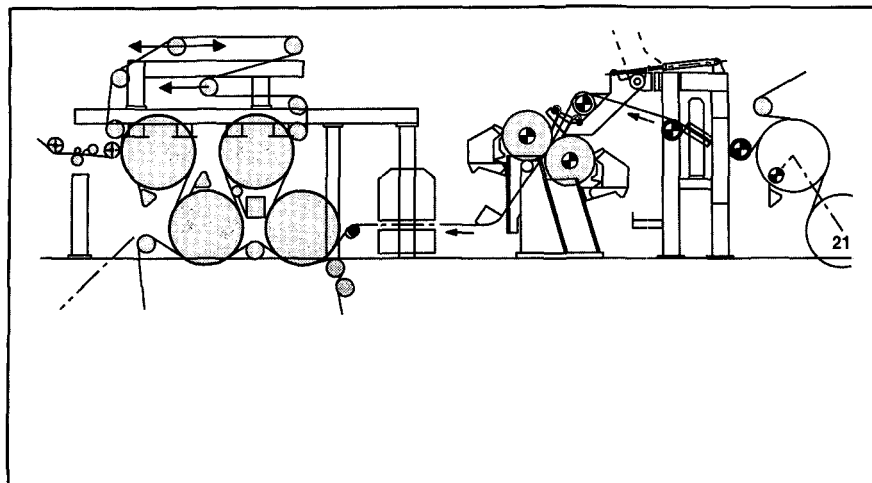
including: air turn foil, gas infrared dryer, and coating color kitchen. The layout is illustrated in Fig. 7.

This unit applies an 8-g/m² coating per side at speeds over 700 m/min. A final coat then is applied on top by an off-machine coater. In this case, the unit exceeds the limits of a pigment going to the area where coaters are operated. The solids content of the coating color is 50–55%.

Even if the large-diameter rod can be profiled, the wear of the rod and the roll cover must be minimized. This meant that new cover materials had to be developed.

Thanks to new materials, grinding intervals are now 3–5 weeks instead of 5–7 days, depending, of course, on the running conditions.

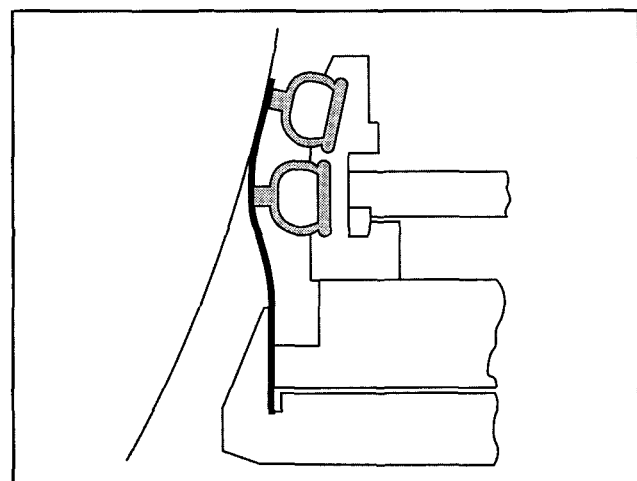
8. Tervakoski paper machine no. 12



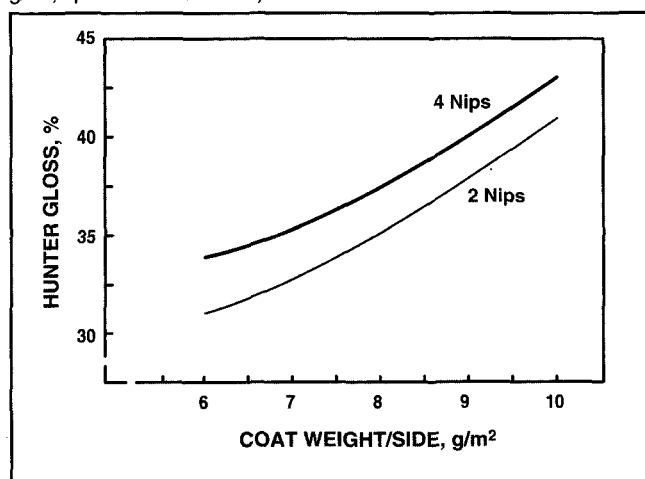
I. Operating parameters of Tervakoski paper machine no. 12

Trim at reel, mm	4500
Maximum speed, m/min	550
Basis weight, g/m ²	28–60
Size solids content, %	11–13
Pigment solids content, %	35–50
Coat weight, g/m ²	Up to five per side
Applicator for size	Grooved rod
Applicator for pigment	Double-loaded blade
Roll covers	X-mate
Grinding interval of rolls	1 month

9. Double-loaded blade



10. Size press soft calender (surface temp. = 200°C, base paper = 40 g/m², speed = 1200 m/min)



Since the applicator is a large-diameter smooth rod, its lifetime is several weeks, depending on the machine speed and the type of pigments used. The main advantages of precoat at MoDo Husum are:

- Better print quality
- Higher print gloss
- Higher color intensity
- Better fiber coverage.

Film press and soft calender

In 1989, Valmet delivered a film press and a soft calender to Enso-Gutzeit's Tervakoski mill for pigmenting or siz-

ing of fine papers (Fig. 8). The paper finish can be either glossy or matt. Glossy grades are produced using higher calender temperatures. The main operating parameters are given in Table I.

This rebuild is a good example of how a grade improvement can be carried out in a multigrade machine.

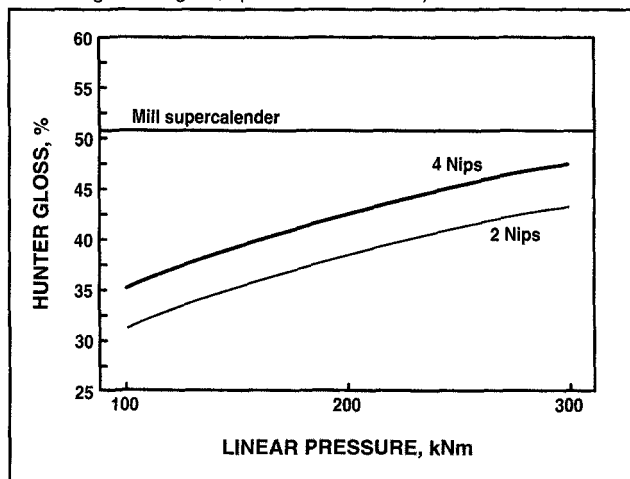
One of the special features of this concept is the double-loaded blade applicator. In this system (Fig. 9), the tip of the applicator blade is kept in place by one loading tube, and the blade angle is controlled by the other one. There is no risk of the tip of the blade leaving the surface of the roll. This has a beneficial effect on paper quality and

runnability, and the coating color solids content can be higher than in regular blade operation.

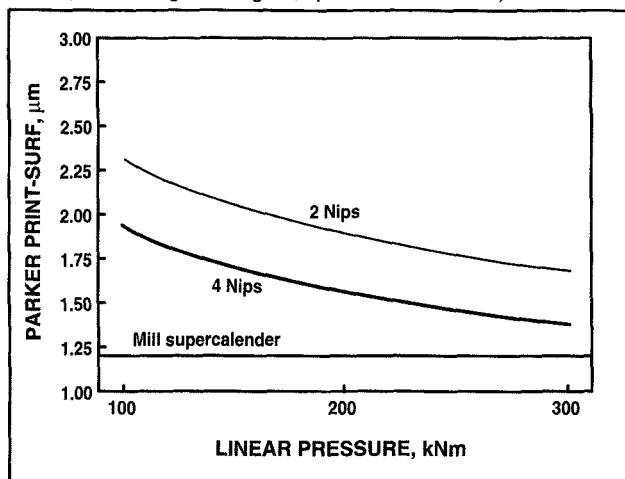
Soft calendering

The use of soft calenders for the surface treatment of both wood-containing and wood-free coated papers has gained popularity during the past couple of years. It offers a wide range of surface treatments from matt finished to glossy papers. To obtain a matt finish, a one-nip, on-machine soft calender with two soft rolls often is used. For higher gloss and smoothness, two or four nips are needed.

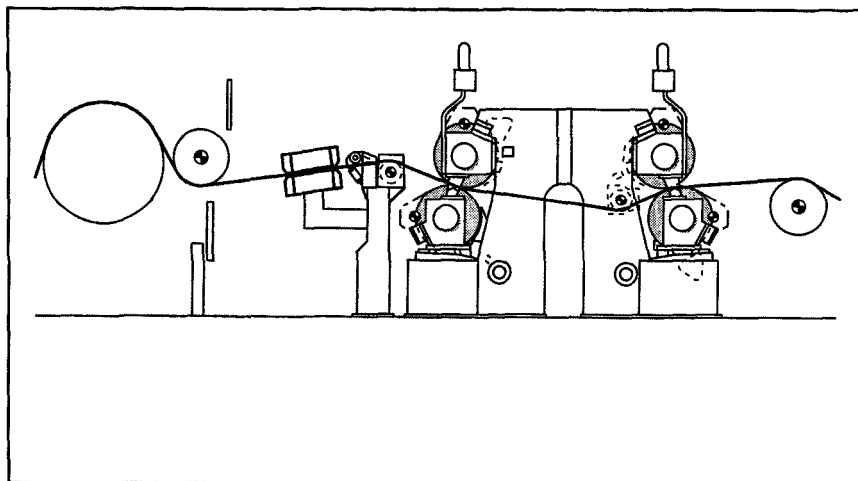
11. Gloss on a blade coater, soft calender (surface temp. = 200°C, basis weight = 54 g/m², speed = 1100 m/min)



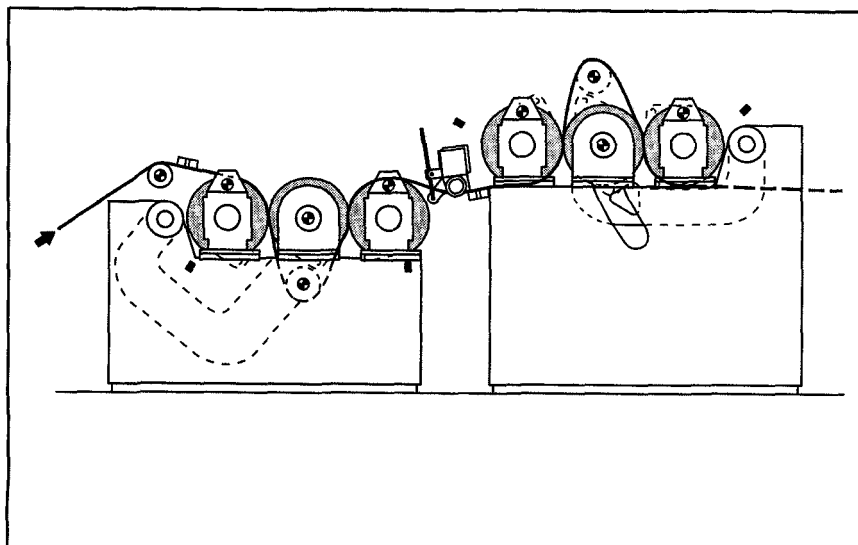
12. Smoothness on a blade coater, soft calender (surface temp. = 200°C, basis weight = 54 g/m², speed = 1100 m/min)



13. On-machine two-nip soft calender



14. Four-nip soft calender



For many paper grades, a high gloss is desirable. With a modern soft calender, it is possible to produce paper with a finish ranging from matt to high gloss. The most important factors influencing gloss are the surface temperature of the thermo roll, coat weight, number of nips, speed, type of coating color, linear load, and base paper properties.

The gloss achieved depends greatly on the coat weight applied. The number of nips has less influence, as shown in Fig. 10.

Figure 11 shows the results of a four-nip soft calender running high linear loads and temperatures similar to those used for lightweight coated (LWC) papers.

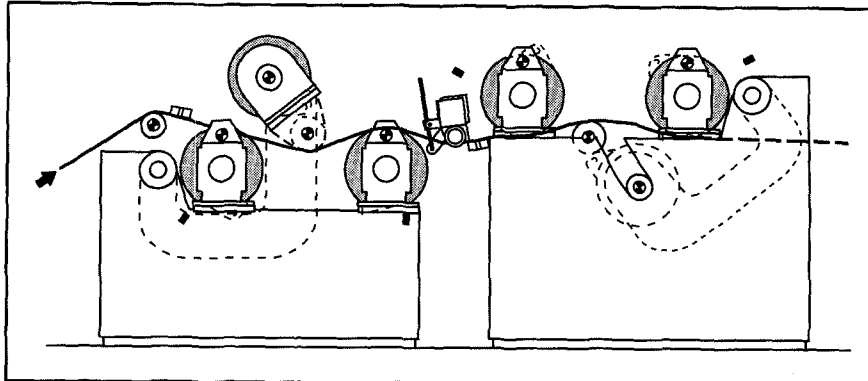
The same trend can be seen in the roughness numbers in Fig. 12.

Two-nip soft calender

The most favored design is the on-machine two-nip soft calender (Fig. 13). The design is well suited for a variety of grades like coated and uncoated fine papers, matte finished LWC, newsprint, and wood-containing uncoated grades with up to 20% fillers.

Today, surface temperatures over 200°C and linear loads well over 350 KNm can be used.

15. Tail threading



Four-nip soft calender

To achieve the gloss and smoothness of standard supercalendered LWC, a four-nip soft calender is needed. Traditionally, four-nip soft calenders have been installed as off-machine units. The biggest problem with an on-machine unit is tail threading.

With on-line soft calendering in mind, a new four-nip soft calender was developed (Fig. 14). In this design, the tail can be threaded easily by moving the center rolls during threading (Fig. 15); this allows the tail to be taken straight through. After the web has been widened, the center rolls are moved to the running position by adjusting the tension of the web.

In this design, the center roll is a heated nondeflection-compensated roll, and the others are soft deflection-compensated rolls.

Today's modern, soft roll cover materials make an on-machine soft calender a viable option for supercalendered coated papers.

The quality of the paper is approaching that of supercalendered papers, with the advantages of higher bulk

and opacity. Only one four-nip soft calender is needed instead of two or three supercalenders. The costs of construction, equipment, and labor are substantially lower than for two or three supercalenders. Compared to four "straight through" soft-calender nips, this design is more compact, considerably cheaper, and easier in terms of both roll change and service.

Conclusion

The film size press with a proper pigmenting applicator and a soft calender offer an ideal way to improve paper grades both on existing machines and on new machines. The equipment, roll covers, and process know-how available today make high-speed on-machine installations possible at a very reasonable cost. **□**

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