Cost-Efficient Center Roll-Based Press Section to Boost Efficiency

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ABSTRACT

According to recent studies, the Indian paper industry is poised to grow from 7.2 million tonnes in 2005-06 to 13.95 million tonnes in 2015-2016. The demand for paper in India is witnessing a healthy growth of 7% to 8 %, compared to 5% in the past, and there is huge potential for more.

Machine manufacturers need to provide solutions that meet the specific requirements of the Indian pulp and paper industry. Volume grades are the largest market but an attractive market is offered by high-quality printing and writing paper production. New machinery and well-engineered rebuilds are providing the Indian paper and producers with better opportunities to succeed in the growing domestic market and to get payback from the investment. Additionally, it gives the opportunity to participate in the global market.

The key variables of an efficient rebuild are investment costs, operating costs, production tonnage and production efficiency. These are also the main arguments for considering a press section rebuild by replacing a conventional roll press with a shoe press. A new center roll-based press concept has been developed with no cantilevering. This press concept is equipped with a shoe press for good runnability and high dry content. A shoe press will increase dryness after the press section by 5 to 8 % compared to a conventional roll press. The design of the new press concept is cost-efficient and robust, without compromising safety aspects. In addition to the lower investment costs involved, the robust design of the new center roll-based press section also produces remarkable construction cost savings thanks to the reduced need for foundation work.

This paper will present the new press design, which is applicable to paper and containerboard grades. An overview of closed draw press concept is also given.

INTRODUCTION

The underlying growth trends in the Indian pulp and paper industry are good and consumer needs are going up. Indian paper and board producers wish to participate in the global market, but their growth strategy is focused on the domestic market as it offers the opportunity to grow profitably. The overseas operations will be built gradually but primary investment focus will be on the domestic market.

The rapidly growing demand in the Indian market calls for more efficient production lines, both in pulp and paper production. New production lines are being built but there is a strong need to rebuild existing machinery. Second-hand machines are not rare. End-product quality is also an increasingly important factor in packaging and in printing and writing. Healthy business growth in the paper market is only guaranteed by making quality paper and board more efficiently.

The driving force in the paper and board industry is the increasing pressure to produce top-quality paper and board more cost-efficiently, to meet the market demand and be able to manage in the competition with electronic media. Existing and new printing methods set new requirements for paper quality. Producers must increasingly concentrate on making paper a more efficient medium for carrying information.

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Another consideration is the total investment cost of papermaking equipment. Investment payback times in the paper industry are not as attractive as in the IT industry for example. The key variables here are investment costs, running costs, production tonnage and production efficiency. Considering the investment payback time, a press section rebuild alone can have a major impact. An efficient pressing process guarantees higher dryness, clearly improved runnability and higher speed, which together boost production, quality and efficiency. These are the main considerations when new press concepts were and are being developed.

PRESS NIP DEVELOPMENT

The main task of the press section is to remove as much water as possible from the web without impairing the quality of the paper. When the paper web enters the presses it has a dry solids content of about 20%. In the press section the web is then pressed between one or two felts in a number of press nips and the dry solids content sometimes increases to more than 50%. This process is called wet pressing.

Wet pressing has a marked impact on the properties of the paper. Press geometry, rolls, roll covers, felt choices, and the linear load combinations used greatly influence the end result. Dewatering is the function of the compression pressure, compression time, and temperature, when running with the same furnish. What happens in the wet pressing process depends on the web properties, but of course also on how the pressing is done. The press nip in a paper machine can be designed in many different ways. The result of the pressing depends on the pressure in the press nip and on the nip length.

Higher dewatering capacity is achieved by increasing the dwell time in the nip. With the running speed being unchanged, the only way to increase the dwell time in the nip is to increase the nip length. Using roll nips in a press section results in nip lengths between 20 mm and 60 mm. With a shoe press common nip lengths are between 150 mm and 350 mm.

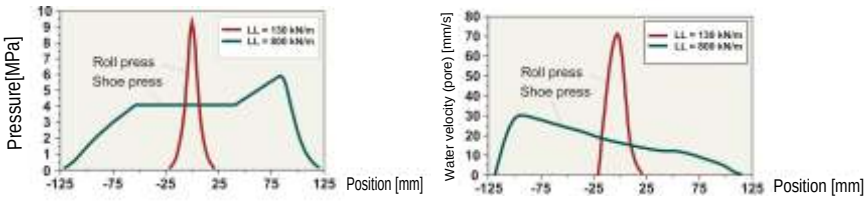

Figure 1: Comparison of nip length: long shoe press nip vs. roll nip

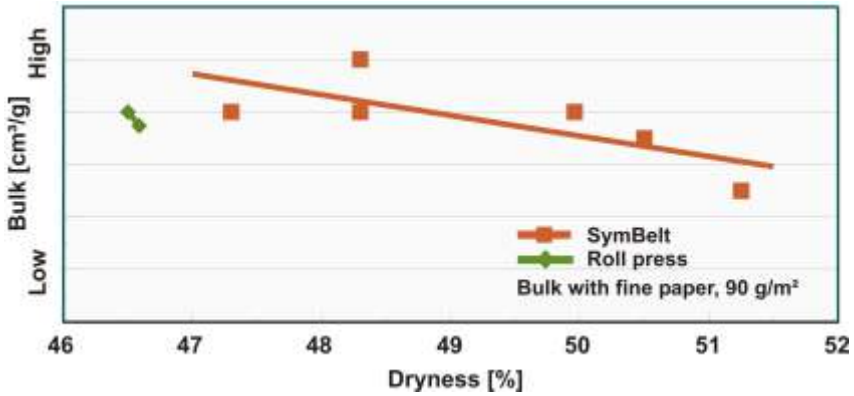

Figure 2: With the shoe press it is possible to significantly increase press exist dryness without sacrificing bulk. Production case with woodfree uncoated paper.

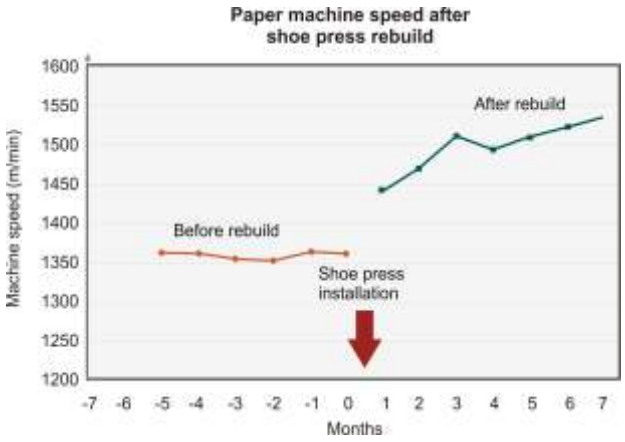

Figure 3: With a shoe press rebuild it is possible to reach a remarkable increase in paper machine speed.

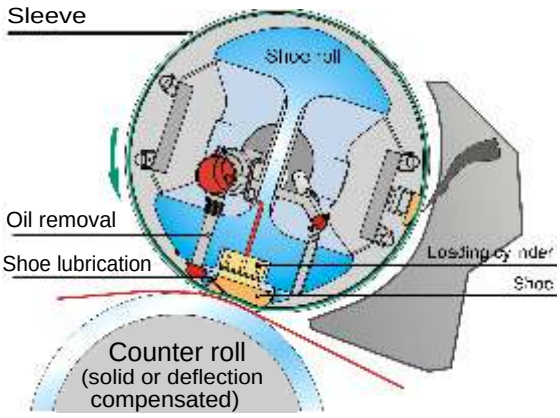

Figure 4: A shoe press nip

The technology of the press nip with a shoe roll differs considerably from that of a conventional roll press nip. A longer dewatering time (dwell time) is the biggest functional difference (Figure 1). The shoe press permits high linear loads and therefore high press impulse. Compared with conventional press rolls, the press impulse of a shoe press nip can be as much as 10 times higher. An increased press impulse leads to greater dewatering of the sheet and improved strength, which, in its turn, results in increased runnability in the press section. The shoe press also provides quality advantages thanks to a slower dewatering speed, which improves surface-density two-sidedness.

The shoe press was introduced to board grades some 24 years ago. For more than 14 years, the shoe press has been an integral part of printing and writing paper machines as well.

A shoe press will increase dryness after the press section by 5-8 %, which means

- increase of production on a machine with limited drying capacity
- increased web wet strength, which decreases breaks in open draws
- increase of speed at the same level of breaks
- improving runnability in the beginning of the drying section
- improved moisture profile

This leads us to produce even better paper at a lower production cost level.

Shoe press rebuilds have a lot of potential for the further development of paper production - as those producers that have rebuilt their machines have observed (Figures 2 and 3). Typically, a mill will install a shoe press on one machine and, a bit later, it will do the same to the next one, and so on. Shoe press technology is a standard solution today, with hundreds of successful references worldwide with both center roll-based and closed draw-based concepts.

THE SHOE PRESS

The shoe press roll is at the heart of efficient dewatering. The shoe press consists of a shoe press roll and a counter roll (deflection-compensated or solid roll, see Figure 4). A separate load joint between the bearing housings of the shoe roll and the counter roll carries the linear pressure of the shoe press.

The SymBelt shoe press consists of a shoe roll covered with a polyurethane belt (sleeve). The belt usually has a grooved surface for efficient water handling. The shoe length can be selected according to end-product

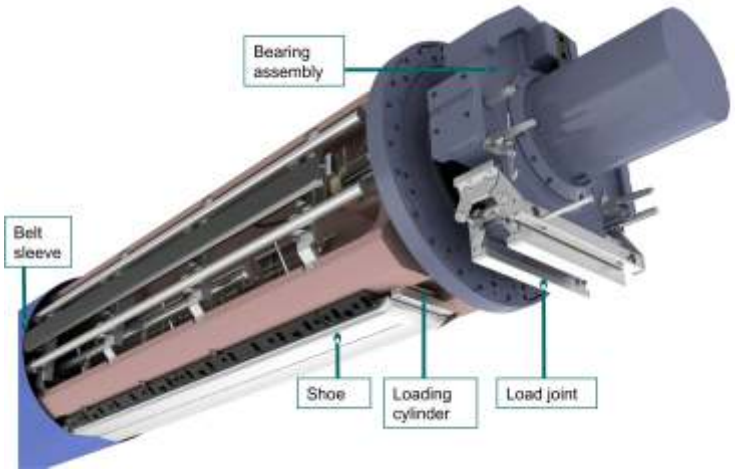

Figure 5: Shoe roll design.

grade. Loading in the nip takes place with hydraulic cylinders located under the shoe. The cylinders in the shoe roll press against the shoe, which, in its turn, presses against the shell of the counter roll (Figure 5). The shoe has a unique design with a low friction hydrostatic oil pocket in combination with the hydrodynamic parts, which will lead to an increased belt lifetime.

A shoe in a deflection-compensated counter roll presses against the roll shell in a similar way. By controlling the pressure in the cylinders in the shoe roll and those in the counter roll to give the same force, these forces will be in a state of equilibrium and the nip will always be straight. In cases with a solid roll as counter roll the roll shell carries the load.

Oil is fed into the central zone of the shoe to provide lubrication between the shoe and the flexible belt rotating around the shoe roll. The thick oil film in hydrostatic area results in reduced power consumption, lower shoe and belt temperatures, improved high-speed runnability, reduced friction forces on the belt surface and reduced sensitivity to paper wads thanks to improved lubrication.

The most important features of the shoe roll are:

- Robust, reliable one-zone design
- Optimized hydrodynamichydrostatic shoe design
- Low energy consumption and running temperature
- Excellent sleeve life times through hybrid shoe and other technical features

PRESS CONCEPT DEVELOPMENT

The process related advantages of shoe pressing, such as higher dryness and better runnability, and the intensive development of roll technology have made this technology a standard solution in almost every rebuild or new production line. The as much as 5-8 % higher dry content after the press section compared to a roll press translates into 20-32 % higher production. Alternatively, it can also mean a 20 meter shorter dryer section which is a significant investment saving.

Figure 6 presents shoe press concepts that have been fine-tuned according to investment and operating costs of medium-width and -speed machines.

In the closed draw press concept the paper web is fully supported throughout the press section to the 1st dryer.

A single-nip closed-draw press is designed especially for uncoated fine paper grades. The concept produces a very symmetric sheet with high dryness. The single-nip closed-draw press is equipped with two felts that are responsible for removing water, producing the required roughness level, bulk and moisture profile, and transferring the sheet throughout the press section, all at the same time. Felts help to reach the desired quality and production efficiency. The primary advantages of the single-nip concept are its lower operating and investment costs compared to the two-nip concept and the very compact design. Felt change intervals are shorter due to the multiple tasks.

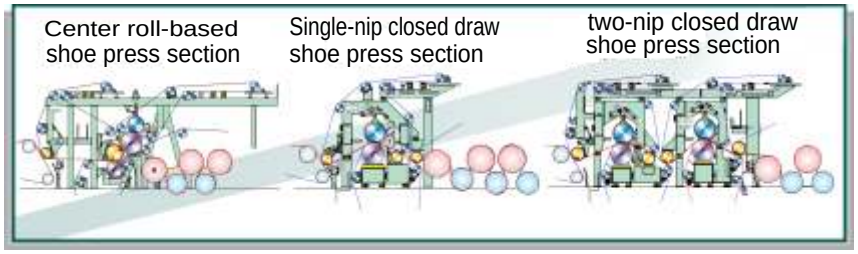

Figure 6: Press section selection for medium-speed and -width paper and board machines

The two-nip closed-draw concept is suitable for all paper and board grades except SC paper. The concept was originally developed for the highest operating speeds. This concept offers a major advantage by making it possible to optimize the bulk/roughness ratio with the help of the 1st press shoe design. Transfer belt as the 2nd press bottom fabric in paper machine press sections ensures excellent runnability and moisture profile, with a low roughness two-sidedness. It is recommendable to equip the machine line with a two-nip soft calender.

Closed draw press sections, two- or one-nip ones, offer possibilities for furnish optimization, such as the use of cheaper raw materials in terms of

- long fiber - short fiber proportions
- kraft wood-containing fiber proportions
- fiber - filler proportions

Closed-draw presses have now been built for nearly ten years and their performance can be evaluated with respect to both production efficiency and quality. Effective dryer section runnability components also help to ensure the good runnability of fast paper machines.

Center roll-based press sections are press configurations with an open draw after center roll to the 1st dryer. Center roll-based press sections have been manufactured since the early 1980's, with numerous excellent references worldwide. Shoe press-based center roll presses were introduced successfully in mid 1990's, and there are more than 60 paper machine and 20 board machine references worldwide. The shoe press roll is placed in an overhead position at the third nip for good runnability and high dry content.

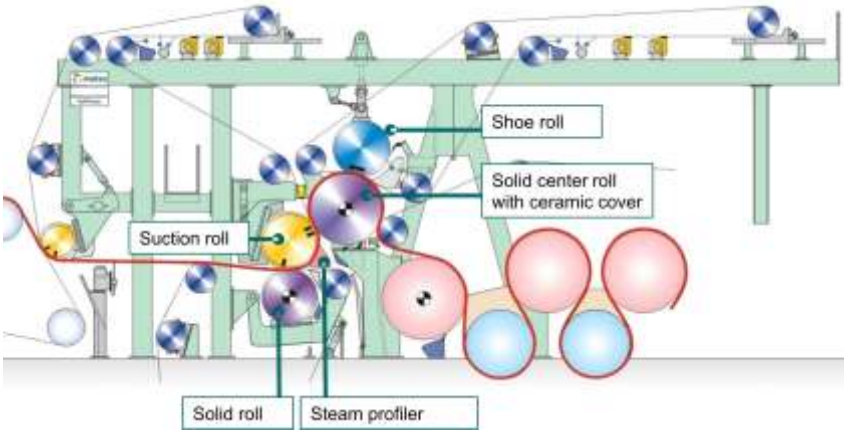

Figure 7: The new center roll-based shoe press concept with no cantilevering

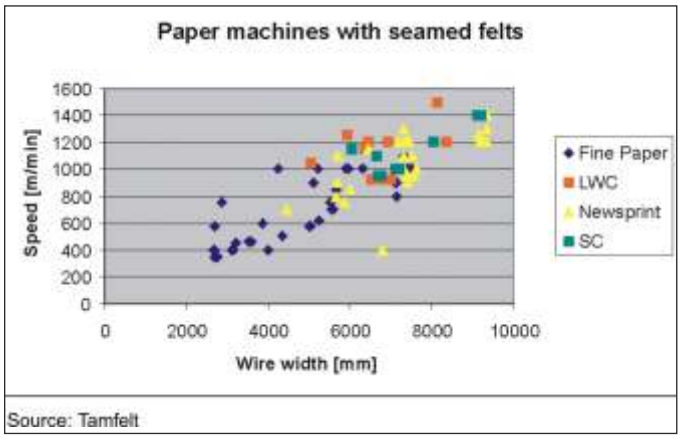

Figure 8: Paper machine references with seamed felts. Source: Tamfelt.

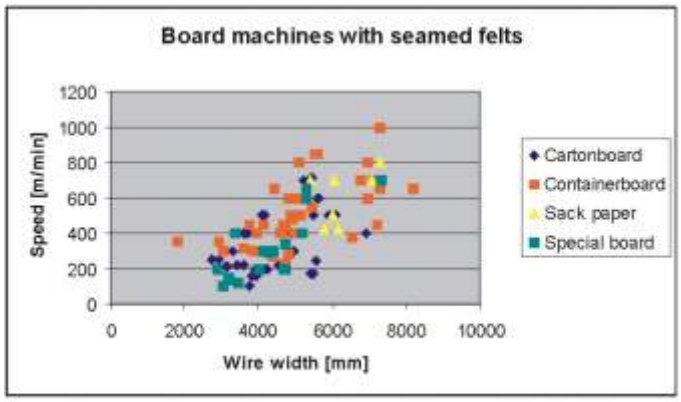

Figure 9: Board machine references with seamed felts. Source: Tamfelt.

The new center roll-based shoe press concept with no cantilevering is based on this proven three-nip press section technology. The target has been to create a reliable, low-cost concept with minimized automation. The frame design enables the use of seamed felts, which have numerous references in center roll-based press sections, including ones producing the most sensitive paper and board grades.

The pressing efficiency of this new press section design equals that of standard center roll-based press sections, and it is well comparable with the pressing efficiency of the closed draw concepts. The shoe press in the third nip can be replaced with a roll nip if necessary. The investment and operating costs are slightly higher than those of the single-nip closed draw press section but the frame design is equally compact.

It is important to study carefully the concept criteria when selecting the press section. The speed level of 1,300-1,500 m/min is especially interesting when considering an open draw or a closed draw press concept. The concepts are different in terms of investment and operating costs and end product quality. The importance of machine runnability and ability to maintain a high production speed cannot be underestimated.

NEW CENTER ROLL-BASED SHOE PRESS CONCEPT WITH NO CANTILEVERING

The new center roll-based shoe press concept is designed for machine speeds up to 1,400 m/min and a width up to 6.2m. These parametres enable the straightforward, economical and robust design and high production with a reliable pressing process.

New center roll-based shoe press section without cantilevering

Process	Center roll-based with a shoe roll
Speed max	1,400 m/min
Width max	6.2 m
Linear loads	100/120 kN/m nip load at the 1st and the 2nd press (woodfree coated) 80/90 kN/m (woodfree uncoated) for efficient dewatering 800 kN/m at shoe press as the 3rd press
Cantilevering	No
Framework	Painted mild steel
Automation	Optimized (I/O 80% compared to conventional shoe press)

Faster, safer and easier felt replacements with seamed felts

There has been a strong increase in the use of seamed felts on wide and fast paper machines due to the development of seamed-type felts. The driving force behind the development has been tightened safety regulations and requirements for minimized felt replacement times. Seamed felts are also less expensive, and have no effect on the paper quality. There are hundreds of machines within a wide speed and machine width range using seamed felts globally (Figures 8 and 9).

Compared with a conventional press section, felt replacement on a press section without cantilevering beams provides many benefits. The replacement process is safer and remarkably faster. There is no need to release and move rolls, spacer blocks or walkways during the felt replacement. The seamed felt can be changed without any cable wires or change beams, and the use of overhead cranes is reduced, thus releasing it to other tasks.

Key elements of the new press concept: economy and simplicity

Cantilevering beams can take up to $50m^3$ of the space on machine back side. Thanks to the elimination of cantilevering beams and anchoring in the new press design, more space is left at the back of the machine and in the basement. This makes the placement of drives, water separators and pipe systems more straightforward, and balances the press section weight between front and back side.

The best space utilization on the back side significantly improves the maintenance access, making it easier to keep the press section clean. Because there are less cross directional structures, the amount of build-ups is minimal. Consequently, the cleaner the press section is, the less breaks are caused due to it.

In addition to the lower investment costs involved, the robust design of the new press concept also produces remarkable construction cost savings of up to 20-40 % thanks to the reduced need for foundation work. It is easier to position the press section in the machine hall when there are no cantilevering beams. The building can be lower because the use of seamed felts enables very free basement configurations. The new design is especially suitable in rebuilds where the foundation would require reinforcement if a cantilevered press section was installed. Thanks to the overall compact design of the press section, it is easy to fit into existing machine lines.

The automation system of the new center roll-based shoe press section has been optimized to include all the necessary controls to ensure a reliable and easy operation. Compared to a press section with hydraulic cantilevering the testing time of the new center roll-based press concept is shorter. The more straightforward frame design and elimination of cantilevering beams shorten the press section testing and installation time by 10 - 25 %.

CONCLUSION

Indian pulp and paper industry requires machine solutions that meet the specific requirements of this area. New machinery and well-engineered rebuilds produce a good end-product quality, which provides the paper and producers with better opportunities to succeed in the growing domestic market and to get payback from the investment. With efficient production lines they can also improve their position in the highly competed global market.

For more than 14 years, the shoe press has been an integral part of printing and writing paper machines. The application of shoe press technology in center roll-based press section has resulted in a 5-8 % point higher sheet dry content after the press section than is possible with roll pressing, and has raised production speeds by roughly 200 to 250 m/min.

Through strong research and development work, new press section concepts have been developed to help the paper and board producer to better manage in the increasing competition, and to get payback for the huge investments. New designs, such as the center roll-based shoe press section with no cantilevering beams, have helped to make the press section easier to install, start up, use and maintain and to produce paper more efficiently compared to earlier solutions.

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