

Valmet

Technical Paper Series

Roll Modernizations: Suction Rolls

Executive Summary

A Roll Mechanical Audit is typically the first step in a roll modernization, and is performed to learn the past behavior of the rolls and document current requirements for roll maintenance intervals or any needed process improvements. In most cases, reconditioning of the rolls is enough, but in some cases roll improvements, modernizations, cover changes or complete replacement is required to achieve the target. Roll modernization can improve roll performance to a higher level than when the roll was new. This is an economical way to increase machine performance and/or to reduce maintenance costs.

Regular roll inspections are the key to avoiding unexpected failures. Scheduled maintenance, e.g. inspections, grinding and seal changes, aims at ensuring each roll's operational condition and performance in the machine. Over the years, roll fits, shapes and dimensions change. To avoid unnecessary shutdowns and other related problems caused by rolls, Valmet highly recommends full-scope reconditioning every four to six years.

Valmet performs roll modernizations regardless of the original manufacturer of the roll or the type of roll. Rolls that are modernized include suction and deflection compensated rolls as well as other rolls such as tube, fly and spreader rolls. The white paper describes many of the most common modernizations.

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Why modernize your rolls?

Roll modernization can improve roll performance to a higher level than when the roll was new. This is an economical way to increase machine performance and/or to reduce maintenance costs.

Valmet has the Power to Serve

Valmet provides paper mills with comprehensive services through its extensive network of over twenty one-stop roll service centers (**Figure 1**) around the world. Situated close to customers, they are staffed by roll service professionals with the latest know-how and technology for large rolls. These centers are dedicated to handling all suction roll related process and maintenance issues.



Figure 1. Valmet's Columbus, Mississippi roll shop, employing over 80 people, is the largest roll repair and reconditioning facility in North America.

The services range from grinding, scheduled maintenance, repairs, reconditioning, and modernizations to long-term agreement-based maintenance programs - always according to customer needs. In addition to maintenance, roll covers and replacement rolls are also available.

Inspections minimize unexpected downtime

Regular roll inspections are the key to avoiding unexpected failures. Valmet's experts compare inspection results with the original roll specifications, then, based on that comparison, provide the mill with maintenance recommendations. For example, regular crack inspections minimize risks of unexpected shell failures, provide valuable information on the status of cracks, and improve roll reliability. These roll inspections also show how the latest roll technology can boost the performance and reliability of your existing rolls.

Scheduled maintenance keeps the process going

Scheduled maintenance, e.g. inspections, grinding and seal changes, aims at ensuring each roll's operational condition and performance in the machine. The scope of scheduled maintenance is based on long-term benchmarking and an understanding of the needs of roll performance and maintenance. During scheduled maintenance, the main bearings are inspected by vibration analysis and only the most critical remaining roll parts are inspected and wearing parts are replaced with new ones.

Reconditioning increases reliability

Over the years, roll fits, shapes and dimensions change. Depending on the position, rolls wear out due to corrosion, micro movements, stress relief, thermal movements, overloading (e.g. due to automation

failure), and normal wear. To avoid unnecessary shutdowns and other related problems caused by rolls, Valmet highly recommends full-scope reconditioning every four to six years.

The aim of reconditioning is to restore the roll to as close to the original condition as possible, and to increase the roll's operational reliability. During reconditioning (**Figure 2**), a roll will be completely disassembled, all critical parts inspected and the necessary repairs made based on recommendations.

Modernization enhances performance

Valmet performs roll modernizations regardless of the original manufacturer of the roll or the type of roll. Rolls that are modernized include suction and deflection compensated rolls as well as other rolls such as tube, fly and spreader rolls.

When a mill wants to increase paper machine speed, enhance roll reliability, extend maintenance intervals, improve paper quality, or eliminate maintenance problems, a roll modernization is the perfect solution. It can raise roll performance to a level higher than before.

Modernizations are usually needed for:

- higher machine speeds
- increased operating reliability and maintenance intervals
- increasing paper quality
- eliminating maintenance problems
- changing roll cover types to correct paper moisture and caliper profiles

Customized service agreements

The best way to ensure that rolls are utilized to their full potential is to enter into a long-term service agreement with Valmet. With combined targets and shared expertise better results can be achieved not only in terms of improved roll performance and extended service intervals, but also in annual maintenance cost savings.

Modernizing suction rolls

A suction roll is one of the most important process rolls and also one of the most costly rolls to maintain in a paper machine. By optimizing suction roll maintenance, a paper mill can reduce total maintenance costs, enhance roll reliability, lengthen service intervals and increase the total lifetime of the suction roll. Valmet offers a wide range of modernizations for all suction rolls, regardless of the original supplier. The remainder of this paper briefly discusses each of several suction roll modernizations (**Figure 3**).

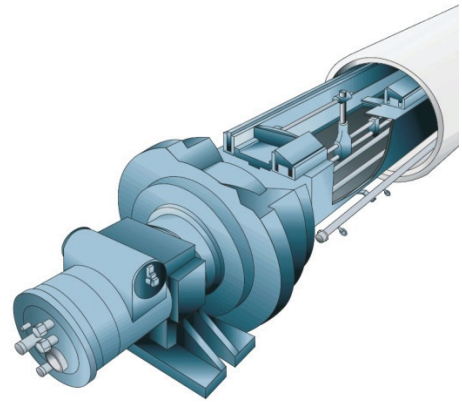


Figure 2. During reconditioning, the roll is disassembled and checked out.

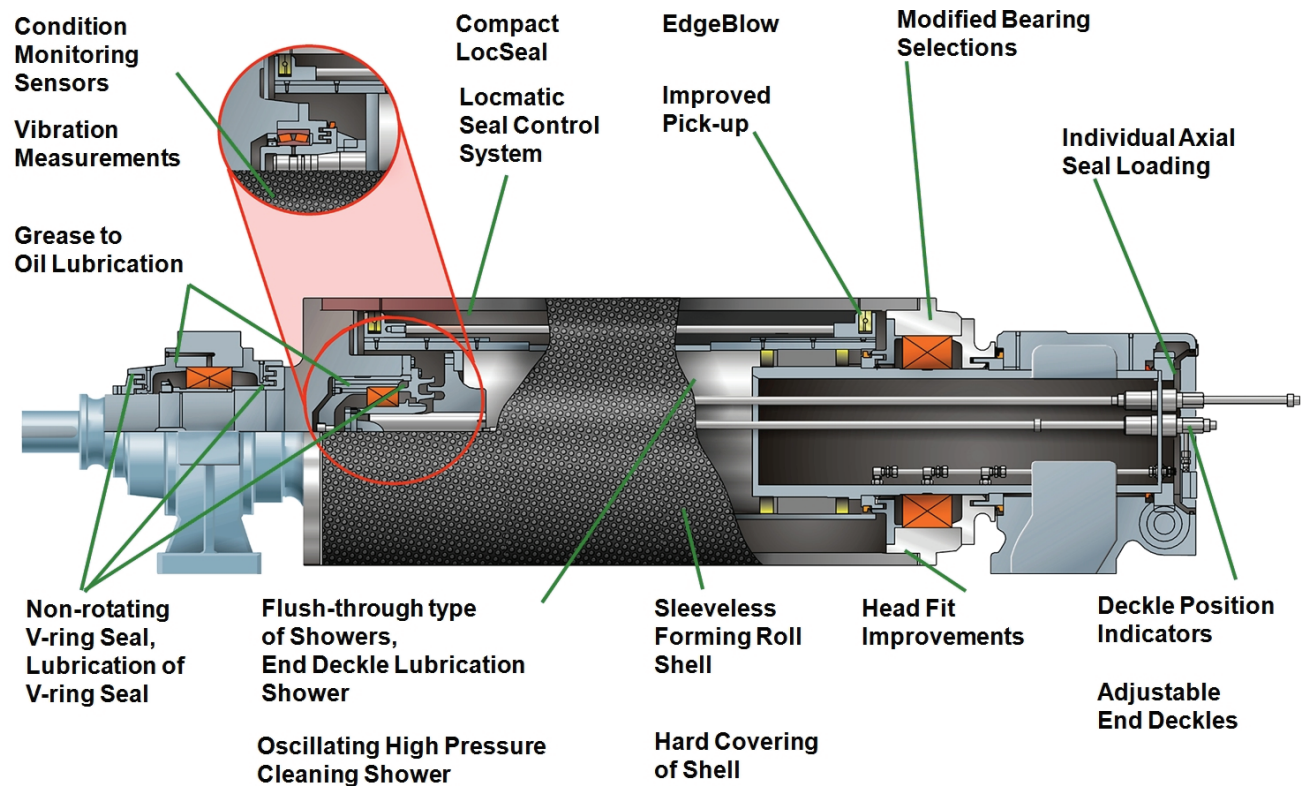


Figure 3. Suction roll modernization options employ the latest in Valmet technology.

EdgeBlow™ for pick-up rolls

EdgeBlow will keep trim from travelling with the paper web into the press section. An EdgeBlow modernization will significantly improve the efficiency of paper machine pick-up rolls and contribute to more uniform web edge pick-up from the forming fabric. EdgeBlow will also reduce the number of press section breaks caused by trim and tattered web edges.

An EdgeBlow modernization (**Figure 4**) includes the addition of an edge blow system to the pick-up roll. Air pipes are installed on the roll tending and drive sides, while the end deckles are modernized with air jet systems. A system integrated inside the roll will keep the felt and shell suction holes clean at the edges of the web. Separately adjustable air volumes on the tending side and drive side facilitate appropriate airflow settings for any run conditions.

The advantages of pick-up roll modernization include: improved paper pick-up from the former fabric, improved paper web adhesion at the felt edges, optimal use of vacuum and suction capacity savings as compared to a roll-wide suction zone. With EdgeBlow you can expect results such as improved paper web control during pick-up into the press section, fewer web breaks and improved paper machine efficiency.

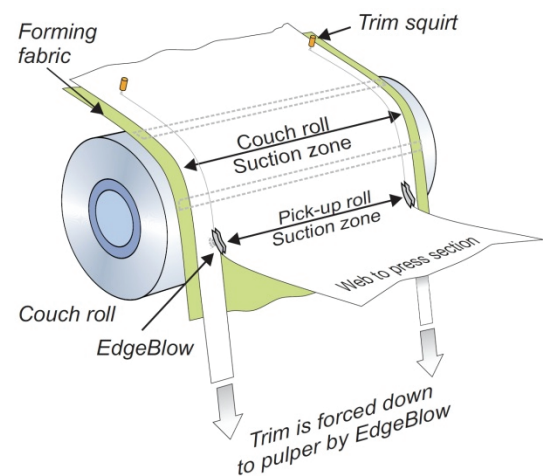


Figure 4. EdgeBlow reduces web breaks in the press section.

Optimized suction zone for pick-up rolls

During web transfer the web adheres to the felt, thanks to a vacuum produced inside the pick-up roll, and travels into the press section. If the vacuum effect is removed too soon, the edge of the web may detach from the felt. Loose web edges will flutter as they travel into the press, and the likelihood of web breaks will increase.

Optimization of the suction zone in the pick-up rolls (Figure 5) improves paper machine runnability before the first press. It enables stabilization of the web before it reaches the press section. The web will follow the felt into the press without process-disturbing edge flutter. Paper machine runnability will improve and breaks caused by tattered edges will be brought under control.

Suction zone optimization is a question of increasing the machine direction length of the suction zone at the ends of the roll only. The total vacuum required is only nominally increased. Vacuum capacity at the mill is typically adequate for the modernization. This modernization is available for both one- and two-chamber pick-up rolls.

Axial seal improvements

Functional axial seals have a vital role in suction roll performance and reliability in a paper machine. Non-functioning axial seals negatively affect dewatering capacity, vacuum level uniformity, maintenance intervals, overall maintenance costs and shell life. Depending on machine speed, size and each customer's specific needs, Valmet offers different levels of innovative axial seal improvements to existing suction rolls.

New materials

ValSeal™ or FlexSeal™ rubber-graphite materials are recommended for their excellent properties. The advantages of these new materials include: reduced friction, improved wear resistance, good corrosion resistance, controlled seal counter-surface temperature and good fatigue strength. You can expect results of increased seal lifetimes, extended service intervals and better seal storability.

FlexSeal is a cost-efficient suction roll seal strip that delivers premium quality and performance. True to its name, it quickly conforms to the inside of the suction roll shell. The seals are made of wear-resistant

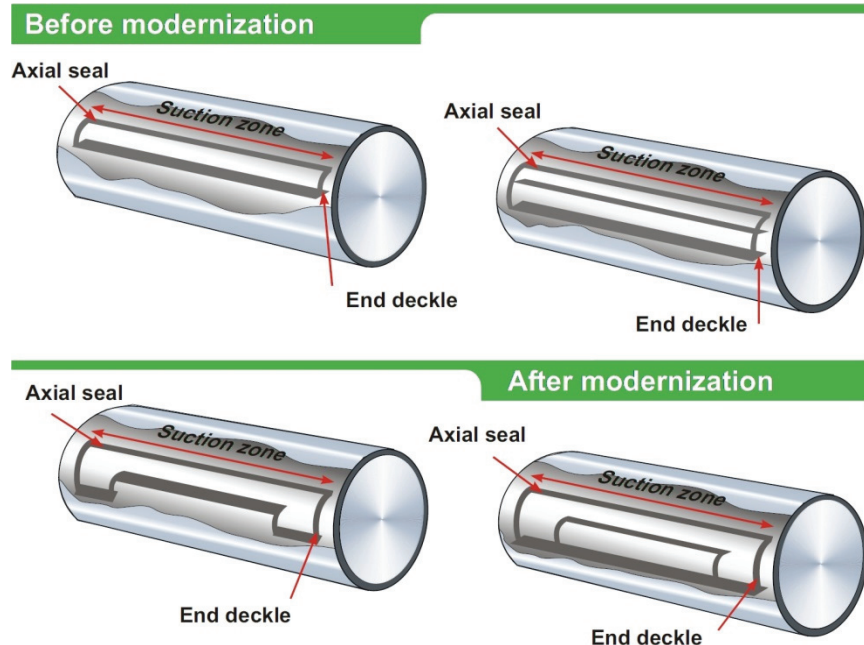


Figure 5. Both one- (left) and two-chambered (right) pick-up rolls can be modernized.

and low noise rubber-graphite material. They can be used at all suction roll seal positions: pneumatically loaded axial seals, conventional LocSeal seals, non-contacting Compact LocSeal seals, and spring-loaded end seals. FlexSeal sealing strip material also offers other outstanding benefits (**Figure 6**).

A FlexSeal strip is much easier to install and less susceptible to handling damage, particularly in the case of longer seal

strips. It conforms better and faster to the inside contour of the suction roll shell and establishes an operating vacuum more quickly. FlexSeal has superior handling characteristics; it's tough and not breakable. You can expect improved wear resistance, both wet and dry; improved low-volume swell and a low swelling strain coefficient, which prevent common wear pattern problems.

Compact LocSeal and LocMatic Seal Control System

The Compact LocSeal™ axial seal construction enables the seal strips to be relieved off the suction roll shell during running (**Figure 7**), which slows down wear and prolongs the seals' effective lifetime while extending suction roll maintenance intervals. It also lowers power consumption and noise level. LocSeal sealing is suitable for couch and press suction rolls as well as for pick-up and transfer suction rolls.

The benefits of the new Compact LocSeal and LocMatic will have a significant positive impact on your maintenance scheduling and costs, including: extended roll service interval, more paper machine uptime, reduced maintenance cost, reduced operation cost and optimum LocSeal operation.

Extended suction roll maintenance intervals

The most important benefit Compact LocSeal provides to your operation is that your suction rolls will run longer. The axial seals don't touch the shell when the roll is rotating, so wear is minimal. At the same time power consumption and shell wear are reduced. Lubrication shower water is minimized, further reducing shell wear and heat impact. Compact LocSeal adjusts itself for optimum vacuum and reduced wear.

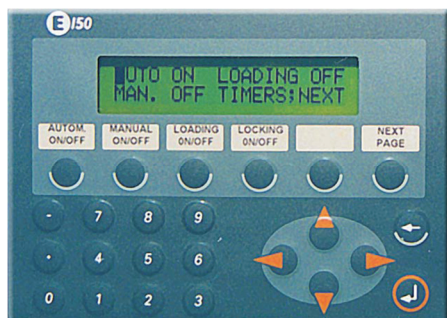


Figure 8. The LocMatic control system ensures optimum LocSeal operation.

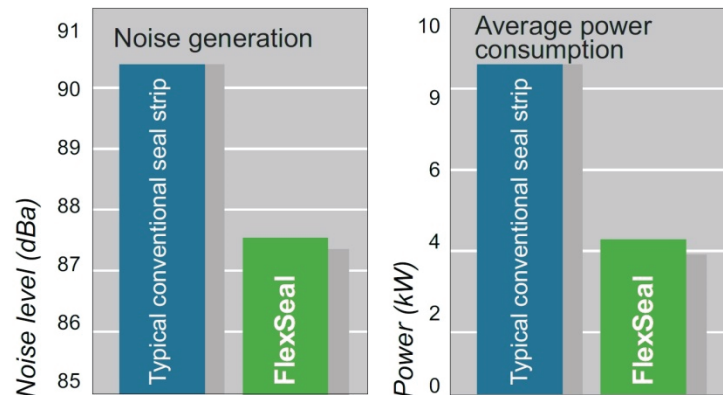


Figure 6. FlexSeal also reduces noise and power consumption.

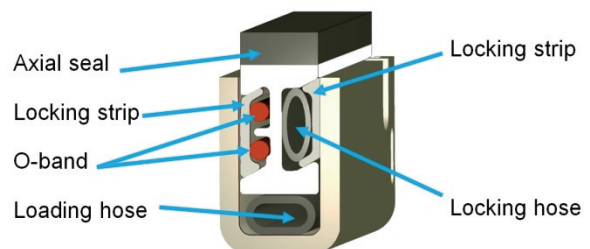


Figure 7. When applying air pressure into the locking hose, the axial seal comes off the shell. When locking air pressure is off, the seal acts like a conventional axial seal.

LocMatic™

The new LocMatic control unit (**Figure 8**) ensures optimum operation of LocSeal. It is also an easy way to connect the roll to the control unit, as only pressurized air (usually already

available) and electric power are needed. Connection to your mill's operating system is easy, so that all alarms and other outputs can also be seen in your existing control system. One LocMatic control can be connected to any LocSeal position if needed. This way just one spare control unit will serve all positions.

With Compact LocSeal and LocMatic you will receive longer seal life, longer shell life, reduced noise level, reduced power consumption and a reliable control unit with alarms.

Shell materials and covering

High production speeds and improved efficiency are constantly being sought after in the papermaking process. In addition, the amount of fresh water applied will be radically reduced when changing into more closed water circulation systems. This requires greater mechanical strength, chemical resistance and durability from press suction roll shells (**Table 1**).

Cover	Hardness	Material	Application
X-Press 5000	10-35 P&J	Special rubber with extra wear resistance	Press suction roll
X-Press II	10-35 P&J	Standard rubber	Press suction roll
VacuFox	4-25 P&J	Advanced polyurethane	Suction roll
PressBison S	6-15 P&J	Advanced polyurethane	Press suction roll
PressBear S	4-15 P&J	Advanced polyurethane	Press suction roll
X-Press C	87 +/-2 ShD	Composite	Couch and press suction roll
TuffMate	1050-1150 HV	Hard carbide coating	Press suction roll in fast paper machines

Table 1. Suction roll covers and coatings vary depending on the application.

In cooperation with leading material suppliers, Valmet has constantly kept abreast of the latest metallurgical intelligence and production technologies. In fact, Valmet was the first to use low-carbon Duplex stainless steels and, as the latest innovation, the powder-metallurgical super Duplex stainless steel.

Powder metallurgy is a manufacturing technology in which fully dense pieces are pressed out of metal powder using high temperature and pressure. This method allows the manufacturing of alloys with significantly better strength properties and a higher purity level than those by conventional methods, such as casting. The homogenous fine-grained and defect-free microstructure results in excellent mechanical properties. The increased alloying enabled by the powder metallurgical manufacturing method gives these shells high corrosion resistance and as the most important property for suction roll shell material, extremely high corrosion fatigue strength. Due to their high corrosion fatigue strength, powder metallurgical press suction roll shells allow the use of higher nip loading. As a result the water removal in the press can be improved. Higher paper dryness means improved sheet wet strength and machine runnability and a decrease in steam consumption in the drying section.

If you increase nip load with a standard material shell, you must increase the outside diameter (OD). This will then require an expensive press section rebuild to accommodate the larger suction roll diameter. However, with powder metallurgical shells, increasing the nip load does not increase the shell OD, so only the shell is replaced, making the press rebuild much more cost effective.

Conversion to sleeveless forming roll shell

Another suction roll modernization option is to convert to a sleeveless forming roll. In this case, the forming roll has a grooved cover with holes that eliminates the need for a sleeve. The lack of a sleeve is important due to a sleeve's tendency to tear off at high speeds because of the amount of torque applied to the roll.

Mills report that the sleeveless forming roll is a great investment. The grooves are machined into the stainless steel shell to mask the impression of the holes on the sheet, so mills see no impacts on the sheet. And the elimination of sleeve failures is also a huge plus.

At one mill, Valmet's sleeveless forming roll replaced the complex honeycomb shell on the mill's newsprint machine. The simple, robust design reduced the need for maintenance and extended the shell lifetime. Valmet's approach is to avoid the layering of the honeycomb design and thereby eliminate the potential points of failure, either the welded honeycomb or the shrink sleeve. A high open area, hence high water removal capacity, is achieved by machining a network of channels that connect the countersunk drill holes (**Figure 9**). This symmetrical channeled design permits even dewatering and avoids shadow marking. The shell is thicker and stronger, thus providing a longer lifecycle compared to the original honeycomb design.

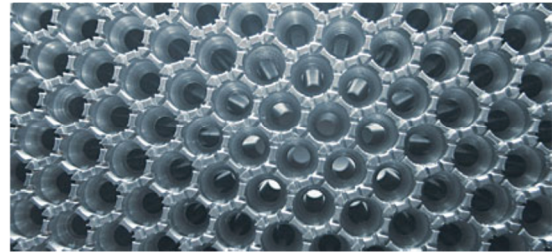


Figure 9. The countersunk drill holes, connected by a network of machined channels, provide a high open area and even dewatering.

There are many benefits of the sleeveless forming roll:

- The paper machine will realize extended running time, as there are no extra shutdowns due to a shrink sleeve change.
- The mill can be freer in their selection of detergents, without the risk of wearing the shell sleeve.
- Wire selection can be performed according to the papermaking process, not based on the maximum service time of the sleeve.
- The surface of the forming roll is easier to keep clean. The continuous high-pressure shower is no longer needed.
- Special tools for shrink sleeve change or a spare sleeve are no longer needed, leading to warehousing savings.
- There will be additional savings in sleeve costs and the maintenance work needed for the earlier sleeve changes.

Modified bearing selections

Given enough running time bearings will eventually fail. However, in many instances this is hastened due to an incorrect selection of the best bearing type for the application. Perhaps the operating parameters have changed from what they were originally. If you are experiencing constant bearing failures and nothing seems to help, perhaps your current bearing is not the most suitable selection anymore. Maybe your drive speed and nip load have increased. Or perhaps the load has decreased to zero or is just the weight of the roll, and the bearing is now too big. Bearings need some load in order to work.

Valmet can redesign the bearing, selecting a different bearing size and type as appropriate for your current running conditions. New bearing types are available now, such as SKF CARB bearings. The bearing choice should be based on the application – speed, load, etc.

A bronze ring can be used in the back internal bearing construction for a direct drive roll, for easy suction box assembly. The construction also features a locking mechanism to prevent rotation between the ring and the journal. A vibration sensor may be used to monitor the condition of the internal bearing. An inner bearing seal system provides lubricant retention and prevents water from entering the bearings. A hard-coated seal mating surface reduces wear and maximizes reliability. The seal system can be constructed for either oil or grease lubrication.

Condition Monitoring Sensor

The suction roll internal bearing, the small bearing supporting the suction box on the drive end, is not easily accessible – either to replace or to place a handheld sensor nearby in order to monitor the bearing's performance. Plus the bearing is so small it's hard to clearly measure anyway.

If this internal bearing fails, the box starts to drop and is only supported by internal seals. The seals then start to wear and the seal holders start touching the shell where metal-on-metal wear occurs.

For suction roll internal bearings, the best results are attained if one sensor is located as close as possible to the bearing (**Figure 10**). In this modernization, Valmet installs a sensor inside the roll next to the bearing, and runs a cable to the front plate. The mill can then run a cable to their ongoing monitoring system for 24x7 monitoring or just connect a handheld monitoring and recording device to the cable once a week and trend the results. This sensor allows the mill to record both the vibration and temperature.

A condition monitoring sensor will avoid catastrophic bearing failure. The sensor gives the signal that the bearing is nearing failure, well before a failure occurs, when there is ample time to replace the bearing on a planned shutdown.

Oscillating high pressure cleaning shower

Suction roll shells can collect so much buildup while the line is running that a traditional cleaning system will not keep them clean. Buildup will clog the roll's suction holes, which impacts paper web dewatering.

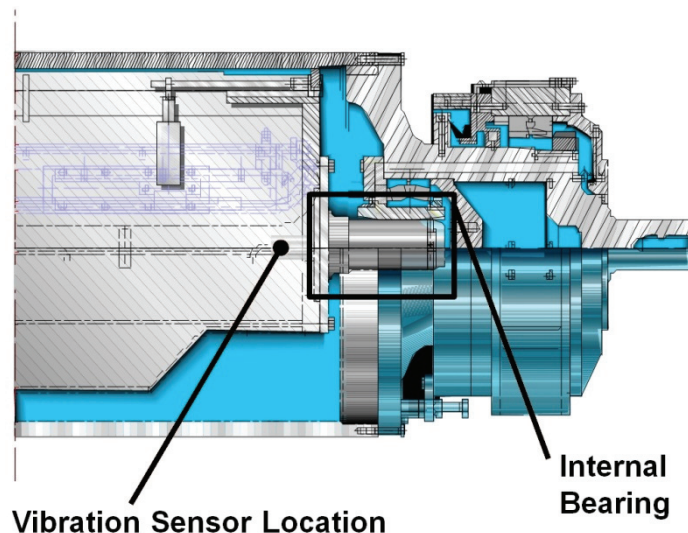


Figure 10. Adding a sensor near the internal bearing helps reduce vibration and unplanned maintenance, while prolonging bearing life.

Effective internal cleaning systems help to ensure the reliable operation of suction rolls. Oscillating high-pressure cleaning showers effectively clean suction roll shells on the machine. Clean shell holes ensure uniform dewatering of the paper web, which helps maintain uniform moisture profiles throughout the roll change interval. Roll service intervals and machine runnability also improve.

Uniform moisture profiles and extended suction roll service intervals

Uneven dewatering has a direct effect on the paper web moisture profile. In the worst case, rolls need to be changed due to deteriorating moisture profiles. Couch rolls and press suction rolls are particularly prone to clogging, given their long,

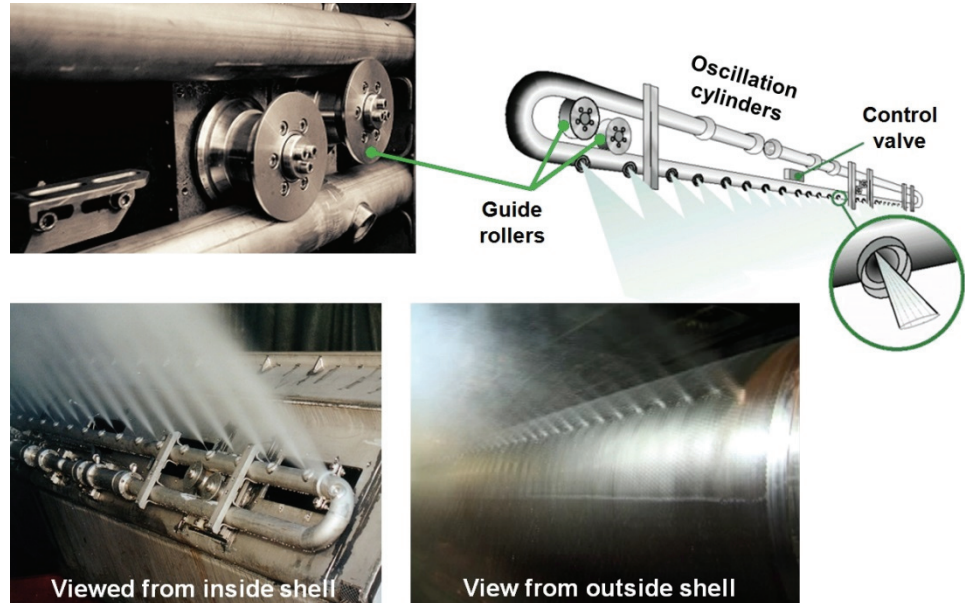


Figure 11. An oscillating high pressure cleaning shower in operation.

small-diameter suction holes. Shells can be kept clean with the help of oscillating shower pipes (**Figure 11**). Their effectiveness is based on narrow fan-shaped shower jets, high pressures and the oscillating motion.

Oscillating high-pressure cleaning showers replace stationary shower pipes on the side of suction boxes. Oscillation is based on reliable water hydraulics, powered by pressurized cleaning water. Therefore, leaks will not disturb the paper making process. Shells are typically washed during web breaks or shutdowns. Automation boosts the utility of the showers and ensures optimal cleaning results.

Flush-through type of showers

Non-functioning axial seal lubrication showers can be a root cause for heat cracks. These small cracks, sometimes found on the shell internal surface, can lead to more serious shell failure.

Conventional lubrication showers without a "flush-through" function have a high potential for clogging in the shower pipe ends. Non-functioning shell cleaning showers are not able to flush fibers out from the shell through holes. This causes shell plugging which in turn leads to:

- Reduced dewatering capacity and moisture profile variations (wet streaks): In a plugged area there is less - or possibly no - vacuum under the web.
- Shell failures: Corrosive chemicals build-up in a shell through holes and remain there (**Figure 12**). The worst combination is a bronze shell with a closed loop water system.

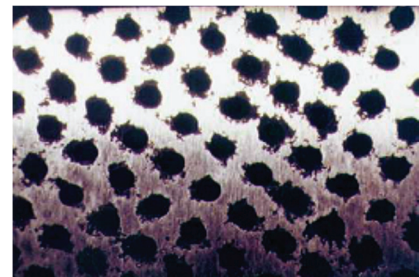


Figure 12. Fiber build-up in suction roll shell through holes with corrosive chemicals leads to shell failure.

- Shortened roll life time: The roll must be disassembled and the shell drilled clean manually. With hundreds of thousands of holes this is very time consuming.
- Short maintenance interval: Due to axial seal wear as a result of poor lubrication.

Clogging can be avoided by replacing the existing lubrication shower with a flush-through type of shower. At the same time, the axial seal life will be extended and the risk of overheating the shell will be reduced.

The suction roll will operate longer in the paper machine and total maintenance costs will be reduced. The flush-through shower flushing sequence will take place during web breaks and just before shutdowns.

Before modernization, conventional design

Non-circulating type lubrication (fog) showers are commonly used by many suction roll builders (**Figure 13**). Water is supplied at the mid-length of the shower pipe. Dirt and contaminants become trapped in the pipe ends. Over time the showers will become clogged and seal lubrication water is reduced resulting in premature seal wear and higher maintenance costs. In addition, increased temperature can develop heat cracks to the shell and further reduce the shell life.

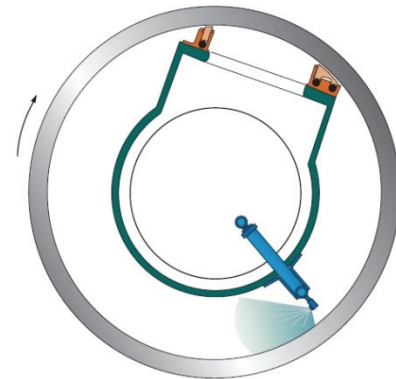


Figure 13. Conventional type lubrication shower used by many suction roll builders.

After modernization, with flush-through type of lubrication shower

Valmet's lubrication showers are flush-through type; water is fed from both ends (**Figure 14**). With this arrangement the shower can be flushed (cleaned) by changing the position of a 3-way valve, which allows water to flow through the shower from the opposite end, thus cleaning it. All this can be done without removing the roll from the paper machine.

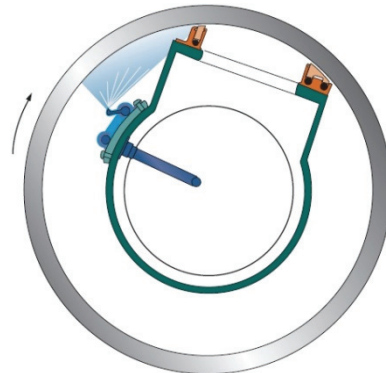


Figure 14. Flush-through lubrication shower, a Valmet standard for many years.

Adjustable end deckles and position indicators

Many mills have an adjustable deckle but no deckle position indicator in all the adjustable deckle zones (**Figure 15, left**) - either the equipment was delivered that way or the position indicators were destroyed or are hard to read (notches only). In any case, operators don't know the location of the end deckle without sticking a rod through the shell. Therefore they can't calculate the vacuum width. Additionally, the older spring-loaded end deckles had no pins to limit the travel, resulting in grooves in the shell bore.

For example, let's say the headbox slice opening is 200", and the operator looks at the adjustable deckle positions on the couch roll and both are

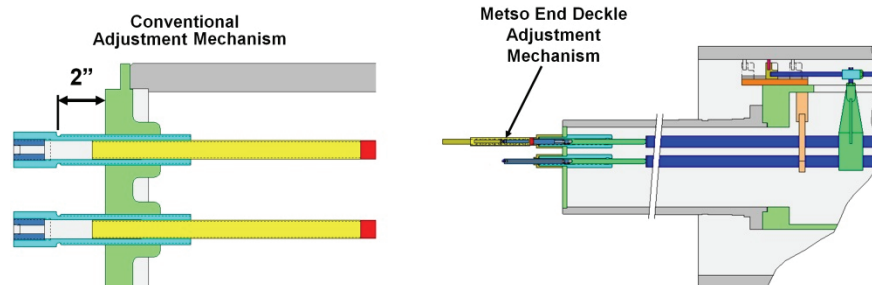


Figure 15. Conventional (left) vs. Valmet (right) end deckle adjustment.

at -5". Then the calculation is simple, $200 - 5 - 5 =$ the exact vacuum opening of the couch roll. You also know if it's centered or not. Without a means of accurately determining the deckle position, the operator doesn't know the vacuum width. If the deckles are too wide, he is leaking vacuum outside the web width. If the deckle is too narrow the edges don't have vacuum, so the edges have too high water content (wet edges).

The Valmet adjustment mechanism (**Figure 15, right**) adds an indicator rod to the adjustable deckle, which moves with the deckle. At the end of the rod there is an indicator plate. Using the Valmet end deckle detachable gage you can read the exact location of the end deckle from the scale (**Figure 16**). This aids in precisely positioning the end deckle.

Replacing a conventional end deckle adjustment assembly with a Valmet end deckle adjustment assembly will allow accurate adjustments while running. It will also aid in repeating past deckle running positions, while giving the papermaker the exact location of the end deckles at all times. There will be no waste of vacuum from the deckle being set too far out. Machine efficiency will also be increased by quicker and more accurate setting of the deckles. There will be no damage to roll covers due to steam box heat. Also, the new Valmet spring and pin end deckles use pins to limit the travel, thereby preventing excessive wear. Any manufacturer's suction roll can be updated to use the Valmet end deckle adjustment mechanism.

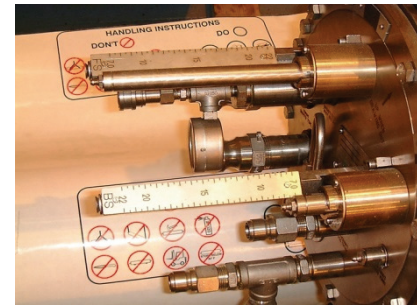


Figure 16. A glance at Valmet's detachable scale will show the operator the exact location of the end deckle.

Vibration Measurement

Vibration analysis performed in the mill can be expensive, requiring a shutdown and many hours of analysis. At the same time, knowing each roll's true vibration frequency spectrum is invaluable when performing a vibration analysis of the entire machine to determine roll excitation problems and causes.

When a roll is at Valmet's roll shop for work such as grinding, overhauling or upgrading, it is the best time to perform a roll vibration analysis. We record the true spectrum of vibration frequencies for that roll and present a report. This allows the mill to eliminate the roll in future vibration analyses of the paper machine as an exciting factor versus just following the excited frequency of another component.

It is much less expensive to add a vibration analysis report to the list of other modernizations. Valmet will do an incoming vibration analysis, before grinding, etc. and then an outgoing analysis as part of the test run certification. Or a vibration analysis can just be performed as a standalone analysis.

Grease to oil lubrication

The operating life of suction rolls can be relatively short if improper bearing lubrication is being used. Under certain operating conditions, grease lubrication may not be able to transfer the bearing heat and keep bearings lubricated all the time. For example, the life of the grease lubricated internal bearings of suction rolls (**Figure 17, top**) is relatively short and their reliability is low. In addition, most of the grease lubricated bearing arrangements have a poor seal construction against process water and especially against high pressure paper machine cleaning operations. By modernizing bearing arrangements from grease to oil lubricated, a longer bearing life and trouble-free roll operation can be achieved.

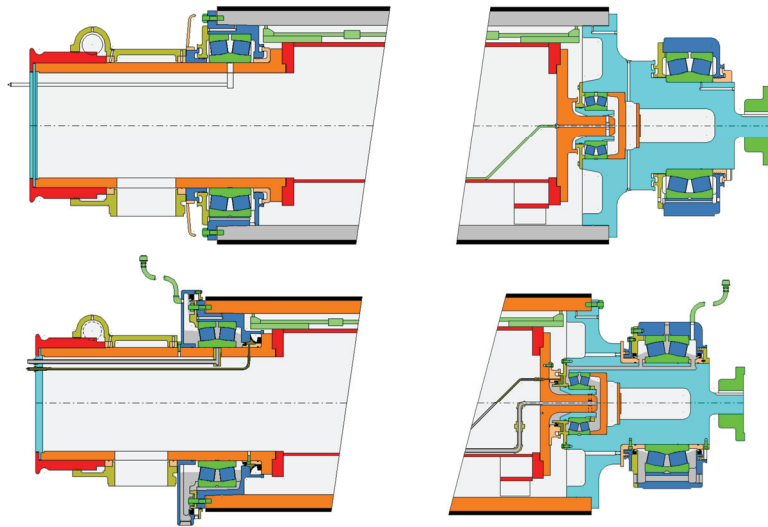


Figure 17. Typical grease (top) arrangement) vs. Valmet oil lubrication (lower) upgrade.

Suction roll reliability can be considerably increased by changing the roll bearing lubrication from grease to oil. At the same time the whole bearing and sealing construction will be checked and modernized to provide an optimized solution. The new construction (**Figure 17, bottom**) will ensure proper bearing lubrication and keep water and all external contaminants out of the bearing arrangement. Modernization will allow higher paper machine speeds and longer service intervals for suction rolls.

Individual axial seal loading

Another option for suction roll seals is a conversion from having all seals loaded by one header to each seal being loaded individually (**Figure 18**). This better secures the roll's operation, because when one hose malfunctions, i.e. becomes broken, the other hoses will remain loaded. Thus no immediate shutdown is needed. In addition, the pressure in each line can be independently checked.

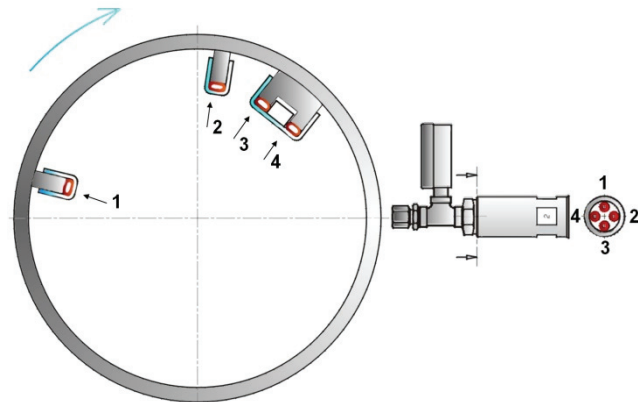


Figure 18. Individual axial seal loading secures the suction roll operation in the paper machine.

Conclusion

This white paper has presented modernization options for suction rolls. A separate Valmet white paper is available which reviews upgrades for deflection compensated, tube, fly and spreader rolls. Some modernizations are common to different types of rolls, therefore a careful perusal of all upgrades is recommended for a mill interested in improving overall roll and process performance.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers.

Valmet provides competitive technologies and services to the pulp, energy and paper industries. Valmet's pulp, paper and power professionals specialize in processes, machinery, equipment, services, paper machine clothing and filter fabrics. Our offering and experience cover the entire process life cycle including new production lines, rebuilds and services.

We are committed to moving our customers' performance forward.