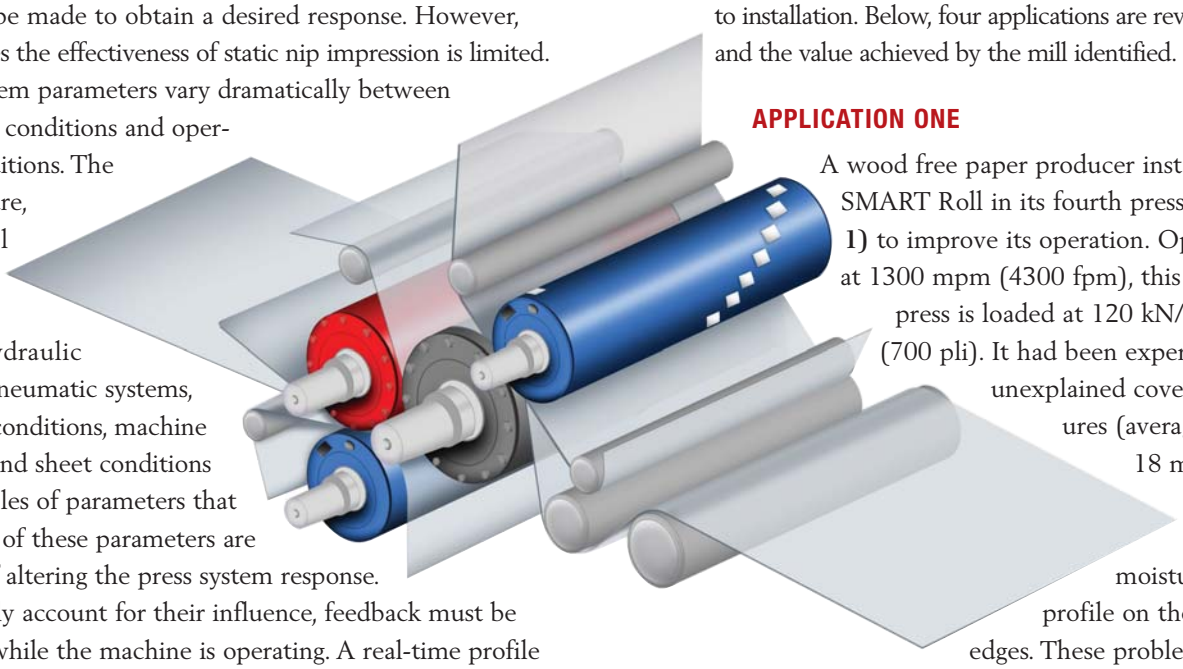
So Smart

Measuring press nip performance during machine operation is hands-down a better way to gain critical feedback from the nip — feedback that can be used to improve sheet quality, decrease production costs, and reduce machine downtime.

By Eric J. Gustafson

Effective control of any system or process requires reliable feedback. The press nip is no exception. Often attempts to obtain press nip feedback are made with static nip impression. These results vary. Sometimes the impressions show an undesired response and system corrections can be made to obtain a desired response. However, many times the effectiveness of static nip impression is limited. Many system parameters vary dramatically between downtime conditions and operating conditions. The temperature, vibrational energy, vacuum system, hydraulic systems, pneumatic systems, moisture conditions, machine clothing, and sheet conditions are examples of parameters that vary. Any of these parameters are capable of altering the press system response. To properly account for their influence, feedback must be obtained while the machine is operating. A real-time profile monitoring system is required to provide this feedback.



Stowe Woodward's SMART Roll provides loading profile feedback during machine operation. The system's sensors are embedded within the cover and are directly monitored by electronics mounted on the roll head. The head-mounted electronics, which rotate with the roll, use wireless communication to maintain connectivity to stationary electronics mounted off the machine. A computer provides an operator interface as well as data processing capacity. The system provides the pressure profile and pressure profile standard deviation in real time as well as a history log of past nip data. This wireless embedded system offers easy data acquisition and quick nip performance feedback.

There are a number of successful applications of this system. The value provided by the system varies from installation to installation. Below, four applications are reviewed and the value achieved by the mill identified.

APPLICATION ONE

A wood free paper producer installed a SMART Roll in its fourth press **(Figure 1)** to improve its operation. Operating at 1300 mpm (4300 fpm), this fourth press is loaded at 120 kN/m (700 pli). It had been experiencing unexplained cover failures (average life 18 months) and poor moisture profile on the sheet edges. These problems forced the mill to extend scheduled downtime and to take additional downtime for nip impressions to resolve these issues. It was unable to correct them.

A SMART Roll system was embedded in the fourth press bottom roll's 4 P & J polyurethane cover. This cover ran for 17 months in the bottom position before it was removed for grinding. During this time, the SMART Roll assisted the mill in preventing the cover from being overloaded, thus avoiding a failure, along with providing feedback to improve the moisture profile.

The resolution of this loading problem is a tremendous value to the mill. It improved the moisture profile, which lead to decreased drying costs and improved machine runability. It also eliminated the need to take nip impression during the downtime. Based upon the time required to take nip impressions and the machine's downtime cost, the elimination of nip impressions results in a $30,000 saving for each downtime without them.

Cover failure prevention is another value the mill realized with this system. By preventing failures related to overloading, the mill is on track to save $130,000 every 18 months.

The roll was out of service just a few weeks. When the sister machine to its original machine required a roll change, rather than leave it out of service for its normal cycle, the mill selected the SMART Roll to be installed. The mill mounted hardware on the sister machine to utilize the data and obtain a benefit from the roll in this new position.

APPLICATION TWO

A SMART Roll system was successfully installed on a linerboard machine running 760 mpm (2500 fpm). This system was installed in the first press **(Figure 2)** to identify the source of multiple cover failures and to improve the felt performance. Felt performance, both pick-up felt and bottom felt, suffered because the permeability varied dramatically across the machine width. Static nip impressions were not successful resolving this problem. The static nip impression showed a biased loading that required a 410 kPa (60 psi) to 550 kPa (80 psi) actuator pressure differential from tending side to drive side. This dramatic differential was difficult to believe. After one static nip impression, the mill did bias the load in an attempt to correct the profile. However, absent any feedback, the operators quickly restored the loading to traditional levels after a short time.

Shortly after the machine started up with the SMART Roll system, the system reported dramatically biased loading profiles that were discounted because of their magnitude. The reported profiles indicated a 3.1 MPa (450 psi) to 1.7 MPa (250 psi) load variation across the face of the roll. Operators felt the machine would not be capable of producing paper with profiles this skewed and the data was discounted.

At the same time, the mill began taking felt permeability profiles across the pick-up felt and the first press bottom felt. Both of these felts exhibited permeability profiles that matched the loading profile displayed by the SMART Roll. The mill then began using the SMART Roll feedback as it adjusted the first press loading. A series of small adjustments were made. After obtaining a uniform press loading as reported by the SMART Roll, the pick-up felt permeability, bottom felt permeability, and sheet moisture were uniform. During the annual outage, the mill will inspect and repair the loading mechanism that is requiring the extreme actuator pressure differential.

This system provided a value to the mill. The improved sheet quality and moisture profile lead to improved drying efficiency. The improved felt permeability profiles resulted in improved felt performance. The system has also protected the cover from excessive localized loads. Each avoided cover failure results in a $275,000 saving.

APPLICATION THREE

A third mill installed the SMART Roll system as part of a package to improve sheet solids and increase bulk. This machine produces bleached board at 365 mpm (1200 fpm). The SMART Roll was embedded into the first press bottom controlled deflection roll cover **(Figure 3)**. Prior to the system installation, the roll had a 22 P & J cover. Press loading was limited by bulk requirements. Any attempt to improve sheet solids resulted in a product with unacceptable bulk.

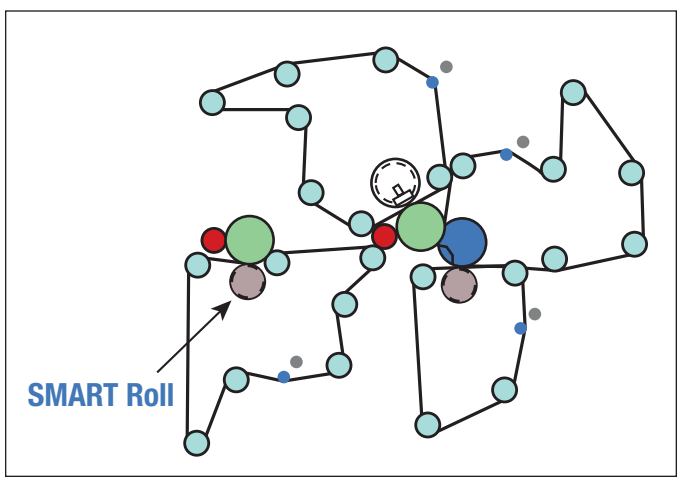


Figure 1

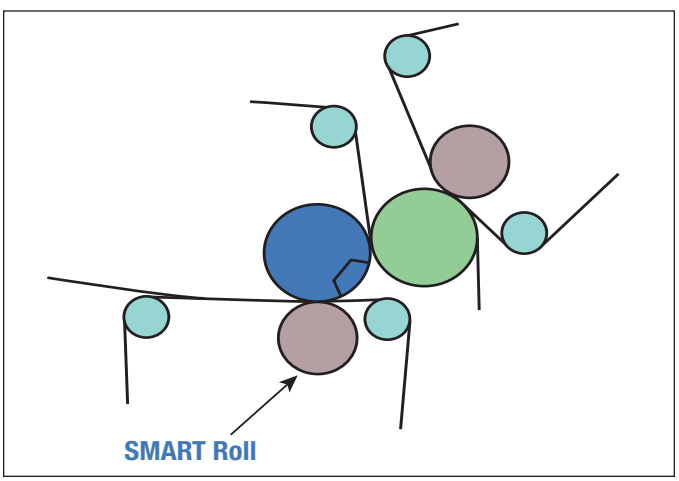


Figure 2

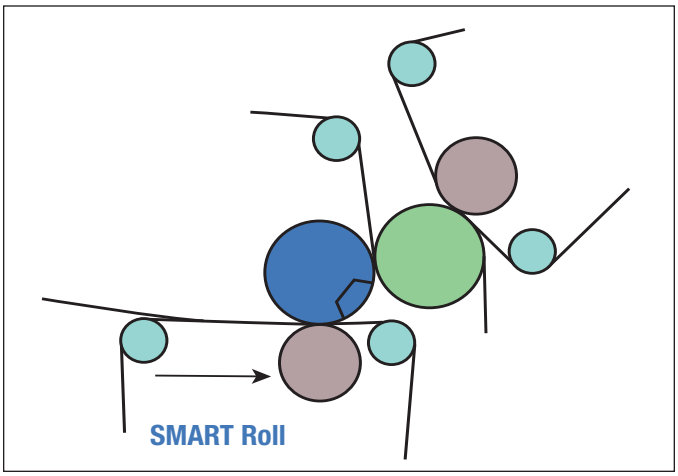


Figure 3

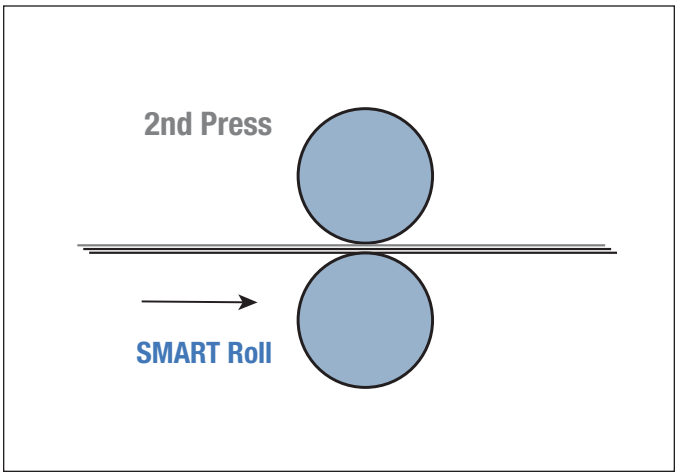


Figure 4

As part of an Engineered Nip program, the SMART Roll system was embedded in a 40 P & J cover. At the same linear load, this softer cover increased the nip width and decreased the nip stress. Bulk improved because of the reduced peak stress. With the softer cover, the mill was able to increase sheet solids by increasing the press load without the bulk decreasing to unacceptable levels. The increased loading changed the crown requirement between the roll and its mating suction roll. The mill used the feedback from the embedded system to flatten the profile as the load increased. Eventually the controlled deflection roll bias system was unable to compensate further. The mill maintained that level until it could remove the roll to grind a larger crown in the cover. When the roll was removed, its spare was installed, also equipped with SMART Technology.

These systems enabled the mill to implement cover changes that improved the product quality while reducing material costs. The increased bulk has let the mill realize a 3-4% reduction in fiber usage. The improved CD moisture and caliper profiles have improved drying efficiency and sheet quality. These improvements are valued at $700,000 annually by the mill.

APPLICATION FOUR

A fourth mill was fighting wet edges caused by load variations on its linerboard machine. This machine operates at 760 mpm (2500 fpm). Numerous static nip impressions were taken, but they were unable to identify the source of the problem. The wet edges persisted. A SMART Roll was installed in the second press bottom position **(Figure 4)** to help resolve this issue.

After the system was installed, the mill quickly learned that the load instabilities occur after a sheet break. This observation is important in isolating the source of the problem. It also explains why static nip impressions were futile in identifying it. The mill is aggressively pursuing the interaction between press loading and other mill systems because of the impact the instability has on profitability. When the machine quickly returns to a stable operation after a sheet break, production lost by the break is diminished. The SMART Roll showed there is a dependency between the press loading system and other mill systems used during a sheet break. This understanding is necessary to minimize lost production.

SUMMARY

Uniform cross machine loading is critical to optimizing the press nip performance. It affects many aspects of paper machine performance including efficiency, quality, and costs. Controlling and maintaining a uniform nip requires feedback from the nip. Until recently, this feedback could only be obtained when the press was not actually operating. While useful for correcting some situations, static feedback is inadequate for many loading issues. Parameters such as temperature, vacuum, vibrational energy, hydraulic systems, pneumatic systems, moisture, clothing, and sheet characteristics are all absent when static feedback is collected. These variables have an impact. The SMART Roll system is capable of providing feedback when these variables are at operating levels. The improved control it enables results in value for the papermaker. ■

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