

Roll cleaning during production improves operability and quality

This article is based on the author's master's thesis "Roll Contamination and Cleaning on a Paper Machine," TUT (Tampere University of Technology) 2004. The thesis charted problems with dirt on the rolls, with particular emphasis on mills making coated paper.

The surfaces of rolls and different cylinders must be completely clean so that the paper machine works without interruptions both in normal use and especially during startup and malfunction situations. Traditional cleaning methods, such as doctor blades or manual cleaning, are not necessarily suitable for all surfaces and may not fulfill safety requirements. There has been a clear need for alternative methods in cleaning the rolls. The new cleaning method during production is suitable for all roll surfaces and it cleans the roll safely without disturbing production.

A problem called dirt

As paper machines' water circulations become more and more closed, impurities can also get into them. The rolls that are most susceptible to dirt are ones inside a press unit, backing rolls at coating stations, rolls behind a size press or coating unit, spreader rolls, guide rolls, and calender rolls. Dirt causes web-breaks and stoppages, thus reducing a paper machine's operability and productivity.

Dirt affects not only capacity, but also the quality of paper and increases the volume of broken paper. A dirty roll leaves marks on the paper web, causing various quality problems, such as spots, holes, or streaks. Particles coming off the roll get onto the web and make imprints in it. This is harmful for high-quality printed materials.

Dirt is also very harmful economically because the loss of production due to a machine stoppage can cost tens of thousands of euros per hour. Furthermore, treatment with chemicals and water increases costs. Cleanliness of the roll is also a matter of work safety: if impurities and dust do not get stuck to the roll's surface, deteriorating the paper quality, they spread into the factory hall and make the working environment dirty.

Different roll types and coatings get dirty in different ways. For example, the backing rolls at coating stations get dirty by coating paste penetration through the web, through holes in the web, or through edge cracks. Dirt on the backing roll causes web-breaks and unusable paper. Dirt obstructs the grooves of grooved rolls and can spread across the whole width of the roll, thus hindering the movement of the web. With the supercalender, problems arise when the coating paste gets stuck on the roll's surface, for example, due to coating paste composition and due to moisture from paper and paste. Dirt spreading onto the calender can cause permanent marks or so called "hot-spot" damages on the roll's surface.

What exactly is dirt?

Impurities on the rolls can contain substances such as organic and inorganic pitch, pigments, sizing, and anti-foam agents. Increased production rates, higher process

temperatures, and increased use of recycled paper increase the generation of harmful deposits.

The mechanisms by which dirt is generated are chemical accumulation and precipitation processes, microbial growth, and mechanical accumulation. Dirt formation is affected by the properties of the roll's surface, the dirt material, and the liquid medium. These include the quality of the roll's surface, its temperature and smoothness, and the composition of the coating paste. One way dirt can be reduced is by reducing the unevenness of the surface or by reducing the roll's surface energy.

Weaknesses in traditional solutions

Normally, the roll is kept clean by means of doctor blades. However, not all roll covers can withstand the use of doctor blades, or in some cases the roll's structure and form prevent the use of them. For example, many rubber and polymeric covers cannot withstand doctor blades. There are also problems with grooved rolls because the grooves get stuck, in spite of the doctor blade.

Lubrication and cleaning jets are often used to keep the roll's surface clean and to increase the service life of the doctor blade and the roll's surface. It is not possible to use cleaning doctors with all rolls because water is not allowed on the web. It is also possible that the doctor blade might leave part of the roll uncleaned, thereby leaving some paste on the roll. Sometimes the doctor blade can rise up from the roll due to impurities, making cleaning impossible. The doctor blade does not necessarily have a vacuum system for conveying dirt away, so the particles loosened from the roll will be blown around and spread into the process, causing an occupational safety risk and decreasing end product quality.

It is also possible to avoid getting the roll's surfaces dirty by passivating impurities chemically and by fixing impurities onto the web. The latter alternative often causes problems, such as linting of the web. On the other hand, modern so-called release composite coatings prevent the accumulation of dirt and dust on the rolls' surfaces.

Manual cleaning increases risks

At some factories, production is stopped while the rolls are cleaned, whereas at other factories the rolls are cleaned manually during production. In these cases, the occupational safety risks are very great. For example, if the web breaks at the moment the operator is cleaning the roll, the tail of the web can be thrown against the operator. It is also possible that a hot water jet could spray over the operator.

When cleaning chrome or steel-faced rolls manually, different sharp blades and abrasive paper are used. This work is strenuous and slow, requiring a great deal of physical force, even by a strong man.

When cleaning backing rolls at coating stations manually during production, a lot of water is used in various ways. Variations in the quantity of water affect the uniformity of quality, and broken paper will be created due to differences in quality. As for supercalenders, cleaning during production is not even possible because it is not possible to get near the rolls during production. The rolls can be situated in hard-to-reach places, for example, on a

reject conveyor, where manual cleaning is impossible during production even if there were a need for it.

Considering the speeds of today's paper machines, manual cleaning is very slow. A delay of even two minutes with a fast paper machine means far too much paper of poor quality. Besides this, the possibility of a web-break increases due to a spot of paste.

A new cleaning method during production

The new device for cleaning rolls during production uses a rotating brush to clean the roll's surface while it is running. During cleaning, the exact amount of water needed for removing the dirt is sprayed onto the roll's surface. The amount of water can be adjusted. The device has suction nozzles which vacuum up loosened dirt particles and waste water and convey them outside the web. The cleaning device to be used can be selected according to the purpose of use, so it will not damage the roll's surface under any conditions. The bristles of the cleaning device will also stay firmly attached to the brush.

Controlling the device is easy. It can be controlled with the signals coming from the fault detecting system, and then cleaning can be done without delay, directed to the right place. The whole width of the roll, or only some parts and sectors, can be cleaned. For example, the device can continuously clean up paste that is penetrating onto the roll's surface from a thin and porous paper web with just a small amount of water during production. Correspondingly, in web-break situations, the roll can be washed with a so-called quick wash method using a large amount of water.

This new solution can be used with all roll surfaces—even the soft ones. With it, the grooves of grooved rolls can be kept open during production. In the brush method, the bristles clean the grooves and the device recognizes the roll's form, so the crowning of the roll is of no importance in cleaning.

Shorter breaks

In the event of a web-break, an interruption in production normally lasts 10–35 minutes. Coating machines normally have 2–5 breaks a day, on bad days as many as 10. The use of this cleaning device makes cleaning stoppages after a web-break shorter. With a cleaner roll, the frequency of web-breaks can also be reduced. Fast cleaning of the roll after a break can critically improve the paper machine's time-use proportion.

More uniform quality

With the new roll cleaning device, it is possible to finely regulate the amount of water used in cleaning, so that cleaning does not disturb production or lower the quality of the end product. As dirt and water are vacuumed outside the web, there will be no marks on the paper and the paper will be of first-class quality. Thanks to the vacuum extractor, impurities do not move forward in the process. The cleaning device does not accumulate dirt in itself or spread it to the environment, which can happen when cleaning with a coarse scouring pad. It is easy to adjust the efficiency of cleaning by changing the distance between the cleaning device and the roll, and by optimizing the speed of rotation.

Resulting in better operability

Thanks to this new solution, cleaning of rolls during production is easy. The automatic unit cleans paste spots immediately when it receives information about a hole from the paper machine's fault detector, for example, from ULMA. As the amount of paper damaged by the paste spot is minimized and the spot does not disturb the web's run in the coating nip, the risk of web-breaks on the backing roll decreases. This results in better operability. Automatic cleaning of the backing roll at the coating station also makes it possible to make coatings for more high-spec and porous products.

The use of automatic cleaning instead of manual cleaning improves occupational safety and leaves workers more time for other tasks. Automation also reduces the risks of the rolls getting damaged, due to the fact that the cleaning tool cannot get into the coating nip.

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