Energy Savings through Optimized Doctoring at the Dryer Section

Improved doctoring processes help mills improve cylinder drying capacity and runnability, achieve better paper quality and higher production efficiency, reduce power consumption, and cut both doctoring and operating costs.

By Pasi Viitasalo

Would you be interested in cutting your energy costs while also gaining such additional benefits as improved drying capacity, better runnability, lower doctoring costs and less waste? What's more, all this is available without major capital outlays, long payback times or extended shutdowns. Optimized doctoring processes can improve dryer section performance and reduce energy consumption, which are important considerations for any production line or end product.

ROLE OF DOCTORING IN PAPERMAKING

Almost all rolls and cylinders need doctoring. The primary functions of doctors are simple: shed the sheet at sheet breaks or sheet threading and remove excess water and contaminants from the doctored roll surface. The keys to an optimal doctoring process are state-of-the-art blade materials, modern roll covers and optimal doctoring parameters. Metso has taken big steps forward in recent years both in terms of materials technology and innovations dealing with roll covers and doctor blade composition.

IMPORTANT FACTORS RELATED TO ENERGY SAVINGS

The total number of doctoring positions differs between machine concepts. Modern paper machines typically employ 50 to 120 doctors. Pressing a doctor blade against a roll surface generates friction (braking effect). In other words, there are 50 to 120 mechanical brakes on a paper machine that are trying to drag down the speed generated by electric motors. Some 50 - 90% of these mechanical brakes are located at the dryer section.

The dryer section, in turn, has an effect on machine speed, the sheet's moisture profile and break frequency, and on overall energy balance and power consumption; and its good runnability is based on trouble-free doctoring and clean cylinders. Due to the number of dryer cylinders involved, even small friction reductions between doctor blades and cylinders are multiplied several-fold along the section and can thereby produce considerable savings.

Important Factors Related to Dryer Section Doctoring and Energy Savings Potential
Doctor blade friction coefficient
Blade loading pressure
Blade angle
Blade wear rate and lifetime
Blade dimensions
Condition of cylinder surface or possible cover
Cleanliness of roll surface
Dryer cylinder cover/ material
Machine speed
Condition of all doctoring components
Oscillation
Temperature

Figure 1.

The acting coefficient of friction, which cannot be determined through theoretical calculations but has to be measured empirically, depends on a number of factors (**Figure 1**). High friction can be a real issue at the dryer section as there are several hot drying cylinders that are doctored without any lubrication. Dryer section start-up problems are often caused by the fact that the coefficient of static friction is higher than the coefficient of kinetic friction for a given material. It is not uncommon to even overload the motor, gearbox or other power transmission components under such conditions. The dryer section's hot and humid surroundings also constantly challenge doctor blade materials.

Conventional doctor blade materials, like bronze, steel and fiberglass, have relatively high coefficients of friction and therefore high energy consumption rates (**Figure 2**).

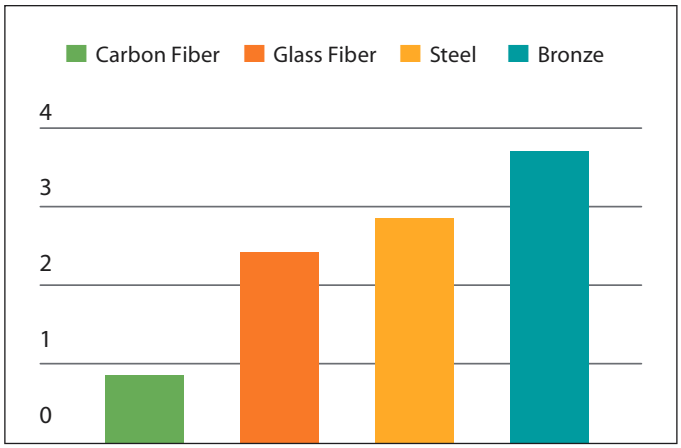


Figure 2. Relative power consumption of doctor blade materials. Based on laboratory test in simulated paper machine environment.

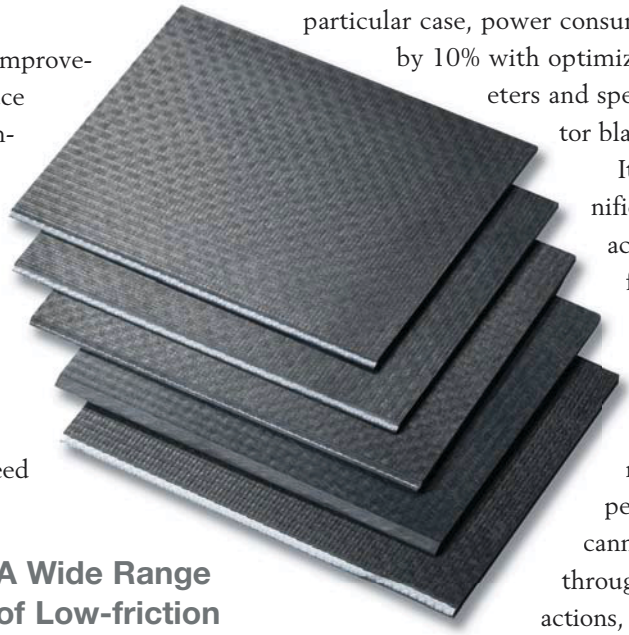
Despite this, they are still widely used due to their relatively lower price and deep-rooted mill practice. In other words, the dryer section constitutes a good potential source of energy cost savings at many mills.

SIMPLE DOCTORING IMPROVEMENT PROCESS FOR REDUCED ENERGY COSTS

Even when theory and calculations clearly point to potential energy savings, results are often verified in practice through comprehensive trials to determine the real savings potential of a specific machine.

Metso has developed a simple step-by-step improvement process that enables papermakers to reduce their doctoring-related dryer section energy consumption. The process starts with a thorough study of the current status of doctoring that produces a clear project plan and recommendations for optimal doctoring parameters and blade materials. The mechanical condition of all doctoring components is checked and a list of required maintenance work and replacement parts is generated. All maintenance work and spare parts can also be included in the agreed project scope.

Metso's intensive R&D and long-term experience in doctoring, roll covers and advanced blade materials are fully utilized in selecting the best blade materials for the customer's process. A process-specific, or sometimes even customer-specific, low-friction doctor blade material is selected from a broad range of advanced composite materials. The results of the process are evaluated both in terms of operational aspects and clear energy consumption numbers summarizing the situation before and after.



A Wide Range of Low-friction Doctor Blade Materials.

"...even small friction reductions between doctor blades and cylinders are multiplied several-fold along the dryer section and can thereby produce considerable savings."

RESULTS THROUGH OPTIMIZED DOCTORING

The following real-life case examples show that energy efficiency can be enhanced also with modest investments. Improved doctoring processes help mills improve cylinder drying capacity and runnability, achieve better paper quality and higher production efficiency, reduce power consumption, and cut both doctoring and operating costs. Optimal doctoring can also have favorable safety and environmental effects.

CASE EXAMPLE 1

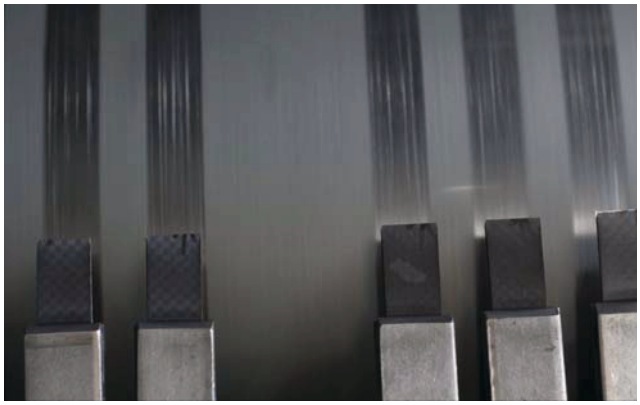
Significant Savings in Energy Costs. The targets were clear. The mill wanted to reduce dryer section energy consumption and improve doctoring results. A 30% difference in dryer section electric motor energy consumption was reported on the basis of onsite testing comparing section operation with doctors engaged to operation with doctors released (which could also be mathematically proven with typical dryer section parameters, blade materials and operating speeds). This means that the annual dryer section energy savings potential of over 8.5 meters wide and fast (1,500 m/min) newsprint machines, for example, may be on the order of EUR 45,000 (about US$57,000). In this particular case, power consumption was reduced by 10% with optimized doctoring parameters and special low-friction doctor blades.

It is obvious that significant savings can be achieved, but trouble-free and effective doctoring is also needed to support the operational efficiency of a paper machine. Operating performance therefore cannot be compromised through any short-sighted actions, not even for electricity savings.

CASE EXAMPLE 2

How is Optimization Carried Out? In another real-life case, the customer wanted to find opportunities

for energy savings by improving the doctoring process at the dryer section. A doctoring study was arranged for the second dryer group consisting of six regular cast iron dryer cylinders, which was selected due to the fact that all doctor positions in the group provided easy access for doctor setup and visual follow-up.



The performance of doctor blade materials against different roll cover materials is continuously tested and developed at Metso's service and technology centers.

The doctoring study started with the checking of cylinder cleanliness, doctor condition and runnability during normal production. Existing doctor setups and materials were used at this stage. Cleanliness was recorded by means of several photographs. Current power consumption was also recorded for further comparison.

All blades were changed and measured in the course of a maintenance shutdown. New blades were installed on all cylinders within the selected group and doctoring parameters were checked. The main focus was on optimal blade angle, doctor alignment and blade pressure, which were adjusted.

Doctoring performance was visually monitored and cleanliness documented through photographs after machine restart. Electricity consumption was checked and recorded every four hours over the next two weeks. After two weeks all blades were taken out of the machine and measured. All of the data collected were analyzed, including energy consumption, doctoring results and blade wear rates.

The results were clear after the doctoring study. In this specific case energy consumption was reduced by 8%. The wear rates of the test blades were also lower, which meant potential annual savings through the extended lifetimes of doctor blades. ■

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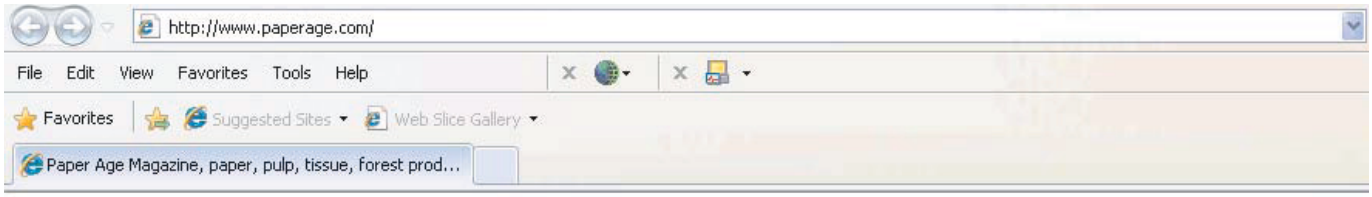

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