How to improve your bottom line with minor machine upgrades: A comprehensive view of available upgrade technology

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Abstract: Paper machines built many years ago, some up to 30 or 40 years ago, are still operating and producing paper that must compete on a global basis with paper produced by modern machines operating at much higher efficiency and quality level. The extremely high demand on these modern machines has triggered the development of a large number of subsystems and components allowing these machines to produce the expected results. To eliminate the technical shortcomings of older machines, these very same components have been adapted to be integrated into existing production lines; they have the capability of significantly improving performance. Many machine upgrades performed in the past have further added to the product portfolio available to address specific issues of individual machines. This paper shows, with a few examples, how to tap into this existing technology to improve your bottom line.

EVALUATION OF THE PRESENT SITUATION

Looking at a typical paper machine, there are several areas of varied significance in terms of production, quality and economics. Of particular importance for paper quality is certainly the wet end of a paper machine. Basic sheet structure and paper properties are determined in this area. Forming and press sections are also very critical when it comes to product quality and certain parameters such as surface and two-sidedness, to name a few. The dryer end of the machine is of particular interest when looking at runnability and efficiency. As we know, breaks can significantly impact production, and drying with steam has recently become very expensive. Therefore, many upgrades focus on these issues when examining dryer sections and the finishing area of a production line.

BEST APPROACH TO ESTABLISH A STRATEGY FOR UPGRADES OR OTHER MACHINE MODIFICATIONS

One of the best long term solutions is certainly to contact a major machine or equipment supplier and jointly develop an all-encompassing strategy. Prerequisites for any successful project are:

- A clear understanding of present issues, challenges and problems
- Goals must be established in order to define what needs to be done
- A structured implementation plan needs to be developed
- Continued monitoring and the flexibility to change course as results start to influence further actions

One of the most challenging tasks is certainly the process of gaining a complete understanding of the “as is” situation and determining the root causes. For this, equipment suppliers have developed methods and installed teams to perform machine and process audits. This can range from a simple pulsation study for an approach flow system, all the way to a complete analysis from stock preparation system to the shipping dock. Recently, it has become routine practice to involve printers, converters and other paper mill customers when discussing overall product requirements. Experience has shown that only a supplier with a complete product and service portfolio can provide a solid and all-encompassing solution to the multiple challenges faced by paper mills today. The interaction of machinery, automation systems, machine clothing rolls and covers should not be underestimated. Of equal importance is also a complete maintenance and continuous improvement plan. Only a good combination of all of these factors will form the basis for a viable long term operation.

POSSIBLE UPGRADES FOR HEADBOXES

Starting at the headbox, probably the single most
important component in a machine, many options for upgrades are available. A dilution profiling system is most likely number one on the paper makers wish list. These systems can be added to almost any headbox, some examples are illustrated in Fig. 2. The cost is relatively low when looking at the benefits of such a system. Due to the nature of older slice profiling systems, profiling capacity is limited because of the resulting significant disturbances in fiber orientation. This might not have been an issue at the time the machine was installed; it certainly is of utmost importance today. The benefits are significant and range from better basis weight, MD/CD ratios, reduced fiber angle and resulting curl issues, for example. Figure 3 shows actual improvement in coefficient of variation achieved on 11 different machines. Depending on what method paper makers use at the present time to compensate for quality issues, savings in overall fiber consumption or increased production have also been achieved by adding a dilution profiling system.

**FORMING SECTION UPGRADES**

There are many different types of forming sections existing in today’s paper mills. Ranging from flat fourdriniers, designed as roll out fourdrinier, to sophisticated gap formers, all forming concepts have one common purpose - water removal. This water removal is achieved through a filtration process with a forming fabric acting as a filter. The huge amounts of water, combined with fibers, chemicals, contaminants and the speed of the machine can cause a number of disturbances. At the same time, this section is largely responsible for sheet quality.

Typically, older models do not deal well with some of these conditions. Many upgrades are available to improve the present situation. This can include minor rebuilds to improve sheet qualities such as formation, or reducing deposits within the forming section by installing mist elimination systems or adding fabric cleaning systems. One example is shown in Fig. 4.

Upgrading to a technology similar to that used on new machines will improve the performance of an existing forming section. Better formation, surface characteristics or sheet uniformity are some of the benefits. In most cases, production increases and runnability improves, as well. This is possible due to a reduction in rejects or fewer sheet defects, amongst other factors.

Better formation is a fundamental requirement for an efficient operation. As we can see in Fig. 5, each modification has significant potential to increase product quality. The actual result, of course, depends on the root cause of a given deficiency. If we now combine the two rebuilds as described, the results would definitely be another step closer to those produced by a new, state-of-the-art machine. If production had been limited because higher machine speeds were not achievable due to deterioration in quality, this would definitely allow for an increase in production.

Another recent development is a “rebirth” of the fourdrinier shake. Many shakes have been installed over the last two years, see photograph and graph in Fig. 6. The results have been surprising due to the fact that the new generation of shakes is much more sophisticated, and designed for high speed fourdriniers and hybrid formers. Sophisticated controls allow for a design without any dynamic load impact on the building.

**PRESS SECTION UPGRADES**

Press sections, frequently monitored for performance, offer many areas for upgrades. Today’s energy prices make it particularly rewarding if sheet solids exiting the press can be increased. In many cases, better conditioning equipment, new press roll covers, doctoring systems and recently introduced monitoring systems have added to the life of older press sections.

A seemingly minor modification (and expense), as shown in Fig. 7, can result in a significant improvement in machine performance. If properly designed, the Saveall will catch the spray generated by the roll. Normally, most of the spray water ends up in the felt, contributing to shorter felt life, more water in the felt and reduced solids out of the press section. A better conditioned felt will certainly perform better, reduce the risk of crushing and allow for a higher speed/production or reduced steam consumption.
DRYER SECTION
MODIFICATIONS TO IMPROVE RUNNABILITY AND EFFICIENCY

Many machines suffer from poor runnability in the dryer section. One particular concern is the beginning of the dryer section, where several operating conditions can have a large negative impact. Release problems from press rolls necessitate high draws, often combined with long open draws which were state-of-the-art at the time older machines were built. This, in combination with speeds exceeding the original design, low solids and resulting low wet strength, deterioration of raw materials and so on, increases sheet instabilities, wrinkles and breaks. An affordable upgrade at the start of the dryer section is shown in Fig. 8. Bottom dryer cans can be drilled, grooved or replaced by drilled rolls and modern sheet stabilizer boxes are installed in the pockets. Further upgrades to the threading system, such as ropeless systems, dryer fabric tensioning and guiding and cleaning systems, add additional runnability and reliability to the dryer section.

REEL MODERNIZATIONS

Paper machine reels are particularly challenging, as there are many complex movements, some happening in a fraction of a second, such as the turn-up. New devices have been developed to improve efficiency and, most importantly, avoid any on-machine operator involvement to eliminate hazardous situations, Fig. 9. Any missed turn-up reduces the efficiency of a paper machine. Furthermore, bad turn-ups can damage a significant amount of paper wound on the spool immediately following the turn-up. Up to 4 inches of paper are being culled in many cases due to a “rough” start. This lost production, added over one year, represents several percent of the total annual capacity of a machine. New devices ensure a positive turn-up, utilizing high pressure water jet cutters and double sided re-pulpable tags, combined with a state-of-the-art control system. These systems achieve over 99.5% efficiency.

Many other upgrades for reels are being offered by machine suppliers. These include replacing of control devices, upgrade of hydraulic systems or conversion from pneumatic to hydraulic systems. Automatic spool loading systems and additional nip loading control systems for better control of density further add to the available portfolio of products.

AUXILIARY SYSTEMS

A paper machine requires a large number of ancillary systems for operation. Many of these subsystems can also be upgraded or replaced without large capital expenditures. Paper machine drives are an area of high importance. Many systems today are operated at the upper limit, making accurate speed control difficult. On the other hand, smaller machine modifications frequently require additional drives for paper rolls, or individually driven dryers, felt rolls, etc. Figure 10 shows two examples of drives in paper machines.

SERVICES AND MAINTENANCE

Once a machine has been upgraded, the investment will start to pay off. To maintain the performance of the machine, it is essential to maintain the equipment in a “like new” condition. Many implementation strategies are available today. Regardless of what system is chosen, an all-encompassing and structured approach is essential for success. All major equipment suppliers today offer this service. Automation equipment, rolls and paper machine clothing are perhaps the most important part of such services. Annual service agreements, spare parts supply agreements and technology support for continuous improvement programs are additional services offered by your OEM.

SUMMARY

The paper industry is under extreme pressure to produce acceptable returns and keep up with rapidly increasing demands on product quality, demands which are driven by highly advanced technologies used in the printing and converting industry. At the same time, other resources such as plastics and, most recently, our advanced communication systems are rapidly taking market share.
from our industry. Nonetheless, paper is still used in large amounts, and will be for the foreseeable future. Product quality and efficiency of production lines are the key to this future. Machines and processes need to be upgraded and well-planned service and maintenance programs installed, with ongoing continuous improvement programs.

Résumé: Des machines à papier construites il y a plusieurs années, dont certaines ont jusqu’à 30 ou 40 ans, sont encore en exploitation et le papier qu’elles fabriquent est en concurrence sur les marchés mondiaux avec d’autres machines modernes dotées d’une plus grande efficacité et produisant du papier de plus grande qualité. La demande extrêmement élevée imposée à ces machines modernes a entraîné le développement d’un grand nombre de sous-systèmes et d’éléments pour leur permettre de produire les résultats escomptés.

Pour éliminer les faiblesses techniques de ces machines plus anciennes, ces mêmes éléments ont été adaptés et intégrés à des chaînes de production existantes, qui ont maintenant substantiellement amélioré leur performance. Le réaménagement de bon nombre de ces machines a aussi apporté un complément au portefeuille de produits disponibles qui permet d’adapter chacune des machines. La présente communication donne quelques exemples et indique comment tirer avantage de cette technologie existante pour améliorer vos résultats.


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