

Latest Paper Machine Rebuild Options Focus on Increased Efficiency, Quality

Dilution-type headboxes, gap and hybrid former retrofits, and shoe presses top the wish list of PM wet end rebuild options with the greatest bang for the buck.

— By **KEN PATRICK**, EDITORIAL DIRECTOR

Over the past five to seven years, North American pulp and paper companies have slashed capital spending by more than 50%. During this period, very few new paper machines have started up in North America and paper machine rebuild projects have slowed to a drizzle at best. Capacity in almost every grade sector has shrunk dramatically and currently is in a prolonged holding pattern.

However, as the industry moves (or limps) into 2004, there are some believable signs of an economic recovery dawning in North America. By summer or early-fall of this year, this fledgling upturn, if it does materialize as some observers expect, could reach the pulp and paper industry and encourage companies to loosen their capital spending belts, if only a tiny notch at first.

If so, there is a long list of must-dos that desperately need capital spending attention, among them, if not at the very top, the need to upgrade and modernize an aging fleet of paper machines to be more competitive—quality and cost-wise—in the world’s marketplaces.

With the help of equipment and automation technology companies, many mills have been doing an outstanding job of maximizing the paper machines they have in place. But a lot of production-inefficient papermaking capacity still remains in the North American industry, despite more than 70 mills having closed in the U.S. alone during the past five years, taking a hundred or so older machines permanently out of operation.

Many of the older, inefficient paper machines that remain will become rebuild candidates as the industry’s financial health slowly improves. How to best rebuild and modernize these machines to maximize efficiency while minimizing capital investment will require detail study of each individual mill’s operation and marketing strategies. But from a broader perspective, there are cer-

tain rebuild scenarios that can be generally evaluated for certain types of paper machines.

To explore some of these scenarios, PaperAge recently talked with Frank Herzog, VP Sales & Marketing, Paper Machinery, Voith Paper, to get his views on recent papermaking technologies and paper machine rebuild approaches that mills might consider. The key points of this discussion, which focuses on rebuild options for the wet end of the machine and design considerations for a new production line or a rebuild, are summarized below.



Frank Herzog

Stock Approach

Herzog points out that a well-designed approach flow is a crucial process step to achieve highest product quality. “The question as to whether the approach flow system of existing paper machines matches the demand of today’s operation should not be underestimated or forgotten,” he emphasizes.

Table 1 lists only the most important of the multiple tasks to be taken care of in approach flow systems. “There is virtually no remedy for MD variations on the

Stochastic Variations	<ul style="list-style-type: none"> • Perfect homogeneity of the stock in the headbox • No uncontrolled fluctuations in headbox consistency • Low signal noise level at headbox pressure readings
Periodic Variations	<ul style="list-style-type: none"> • Very low level of pulses created by rotating elements • Fast, stable and accurate control loops
Preconditions	<ul style="list-style-type: none"> • Low air content in the system • Stable retention and wet end chemistry

Table 1. The ideal case for minimum profile variations

“Significant formation improvements were achieved when upgrading a fourdrinier or hybrid former to a gap former”

—Frank Herzog, VP Sales & Marketing, Paper Machinery, Voith Paper Inc

paper machine,” Herzog says. “Bearing this in mind and considering the relationship of the investment for an approach flow system to the investment for a paper machine, sacrifices in this area should be kept close to zero. Relatively small investments may lead to big improvements in the produced paper. ‘small’ compromises may lead to big troubles on the other side,” he warns.

Headbox/Forming Section

According to Herzog, dilution headboxes with the capability to create a sheet with a low CD basis weight variation profile and low fiber angle can benefit most, if not all paper grades. As an example, he explains that the MasterJet headbox with ModuleJet dilution system depicted in Figure 1 is a hydraulic headbox that can be installed on a flat fourdrinier; however, it can be designed to operate initially on a flat fourdrinier and in the future on a gap former, if a wet end rebuild is done in separate steps.

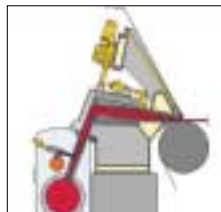


Fig. 1: Dilution headboxes such as the MasterJet headbox with ModuleJet dilution system can benefit almost all paper grades.

The principle of this type of headbox, Herzog explains, is that the cross-machine basis weight profile is controlled by locally adding low consistency dilution water, usually white water, to the high (main) consistency stock flow via a series of metering valves across the width. The basis weight change with a dilution water valve adjustment is significantly narrower than the slice lip adjustment, resulting in improvements in CD basis weight variation of 30% and better over a conventional slice lip controlled headbox, he says.

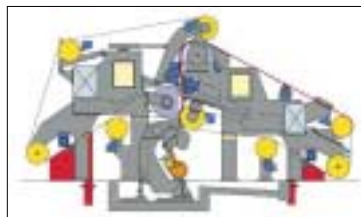


Figure 2. The DuoFormer TQv is a vertical gap former for fast machines and all major grades.

The DuoFormer TQv (vertical gap former) shown in Figure 2, is Voith Paper’s forming system for fast machines and all major graphic paper grades. This is a roll-blade gap

former consisting of a forming roll in the bottom position followed by a section with counter blades (D-section). The blade section consists of a suction box in the top position and pneumatically loaded forming blades in the bottom position. While initial dewatering over the suction form roll ensures good retention, the following counter blade section generates continuously increasing and high frequency pulsating drainage pressure, creating optimum formation.

In most cases, Herzog notes, gap formers can be installed on existing fourdriniers (as horizontal gap formers), as depicted in Figure 3. “Or,” he adds, “existing gap formers can be retrofitted with these key components of a roll-blade gap former to improve the quality of the paper.”



Figure 3. Generally, gap formers can be installed on existing fourdriniers as horizontal gap formers, or existing gap formers can be retrofitted with the key components of a roll-blade gap former to improve paper quality.

The minimum operating speed for gap formers is approximately 2,600 fpm, Herzog points out. This speed is required to create sufficient hydro dynamical forces for proper dewatering. While the furnish has a major impact on the sheet properties, e.g. formation, “excellent performance of the DuoFormer TQv has been proved on many installations and pilot trails for various paper grades. Significant formation improvements were achieved when upgrading a fourdrinier to a gap former,” he says.

However, hybrid formers, such as the DuoFormer D (see Figure 4), can also provide significant improvement in product quality, Herzog

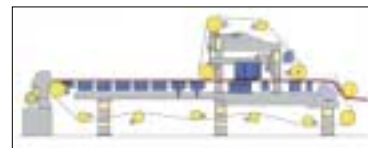


Figure 4. Hybrid formers, such as the DuoFormer D can provide significant improvement in product quality

explains. This unit also uses the counter blade concept in the forming zone with a multi compartment vacu-

um box in the top wire and pneumatically loaded forming blades in the bottom wire.

These units can easily be retrofitted onto existing fourdriniers. The maximum speed for these formers using a pre-drainage table, is approximately 4,000 fpm. This is due to the difficult control of hydrodynamic forces at the foils (stock jumps) and the friction created between the free suspension surface with the air, Herzog explains.

Press section

“Shoe presses have long been a key component in new production machines as well as for machine rebuilds to maximize or increase production capacity,” Herzog points out. “Following the first installation in the early 1980s, shoe presses have found applications on virtually all paper grades, from packaging papers, board, graphical papers, and pulp dewatering machines to tissue machines. For today’s new lines, these presses are designed to operate at speeds up to and beyond 6,500 fpm.”

Requirements for the press sections of graphic paper machines include highest possible dryness, bulk-preserving dewatering with good sheet structure and surface properties, optimum two-sidedness with regard to roughness, and oil absorption, along with high runnability and maximum availability, Herzog says.

He explains that two basic shoe press configuration are being considered in today’s rebuild and/or new pro-

duction lines for graphic papers, depending on the sheet property requirements and machine speed. As examples he cites a DuoCentri NipcoFlex press with a shoe in the third position (followed by a fourth roll press nip, if required to meet two-sidedness and print properties), or a Tandem NipcoFlex press with two shoe presses in a row.

Continuing with example applications, Herzog says that “with newsprint grades, DuoCentri NipcoFlex presses can be applied for speeds up around 5,500 fpm. For new machines with design speeds of or above 6,500 fpm, the Tandem NipcoFlex press with three felts and a belt in the second bottom position is a concept that ensures proper press performance.

“If speed and basis weight fall into a specific range, e.g. 4,000 fpm on 80-g/m² copy paper, a single NipcoFlex shoe press (one nip only) can also be considered. The design load for most of today’s shoe presses is still 6,000 pli,” Herzog notes.

Steam boxes can be installed either on the suction press roll (in case of a DuoCentri NipcoFlex press, for example) or beneath the second press top felt after the suction transfer roll in a Tandem NipcoFlex arrangement. In conjunction with the “mechanical” press nip, the press sleeves (Voith’s QualiFlex sleeve, for example) and the press fabric are major contributors to the optimum performance of a shoe press section, Herzog concludes.

PAPER MACHINE REBUILD SCENARIOS

The following two paper machine rebuild analyses are for an existing 330-in (wire) early 1970s vintage newsprint machine designed for 3,000 fpm on 48 g/m²-newsprint with a 100% TMP furnish. The fourdrinier machine has a hydraulic headbox with slice lip profiling, roll type top hybrid former, press section with three straight through presses, a dryer section of 50-plus dryers with two uni-run sections and no stabilization, a four-roll calender stack, and a pneumatically controlled reel.

Scenario 1

Rebuild Goal: to produce coated and uncoated mechanical papers up to 70 g/m², coated at machine speeds of 3,300 – 3,400 fpm.

Wet End

The wet end will have a MasterJet hydraulic headbox with ModuleJet dilution profiling for improved CD basis weight profiles. The headbox uses Profilmatic M auto mapping CD basis weight control.

The existing top former will have a DuoFormer D section with adjustable formation blades for improved formation and improved Z-direction uniformity. The primary framework and cantilever beams are retained for cost efficiency. The existing forming zone is replaced with a top dewatering box and a bottom formation box from the DuoFormer D technology.

Press

The press section is modified to a NipcoFlex shoe press and steam box, providing the 4%-plus dryness increase needed for the machine speed increase. It is configured to substantially

increase dryness at the first open draw for improved runnability while providing a bottom felted last press for quality enhancement. To reduce costs, the double duty of the existing couch pit pulper is retained for combined use as couch pit and press pit pulper.

Dryer

The dryer section is reconfigured and dryers relocated to allow room for the film coater and after drying. The reduced length of the press section allows a three-dryer uni-run section to be added after the press. This shorter section provides improved draw control and better runnability. DuoStabilizers are added in all three uni-run sections for sheet stabilization at higher machine speeds.

Finishing

A SpeedSizer film press is added to apply up to 10 g/m² coat weight per side simultaneously. It uses grooved or smooth rods and is capable of applying coating up to 65% solids. With large diameter smooth rods, CD coatweight profile is controlled automatically by Profilmatic C. The coater is followed by a compact ModuleDryer system and infrared drying is added as needed.

Modern hydraulics and a control system with hydraulic loading and relieving cylinders are installed on the calender. This allows the calender to be operated in a load or relieve condition for operation in a single nip or four-roll configuration. An optional configuration could be a new single-nip calender with a self loading Nipcorect roll in the bottom position.

To handle the new paper qualities and the desire for increased parent roll diameters at the reel, a new TR reel section is proposed. The existing reel drum is re-used and modified for use in the new reel. Servo hydraulic controls, including primary arm spool relieving, are used for precise nip control during the winding process.

Scenario 2

(Similar base machine but with more drying capacity and kraft pulp availability)

Rebuild Goal: to produce 60 g/m² LWC offset grades at 4,200 fpm with online coating and calendering.

Wet End

Same headbox configuration as in Scenario 1.

The existing foudrinier will be rebuilt to a Voith DuoFormer TQm horizontal gap former. This former has a bottom forming roll followed by the top dewatering box and bottom formation box from the DuoFormer D hybrid former.

Press

The press is reconfigured to have a Voith NipcoFlex shoe press and steam box. The new section will consist of a three-nip cluster press with a shoe press in the third position (e.g. DuoCentri NipcoFlex). The press is configured such that there are no open draws until after the third press nip where the sheet is mid- to upper-40% solids. This substantially increases dryness at the first open draw for improved runnability while providing most of the additional drying capacity required for the rebuild.

Dryer

The dryer is reconfigured into three single tier sections with a short three-can section after the press. This shorter section allows for improved draw control and better runnability. The three single tier sections are followed by two sections of double tier dryers. In the single tier section, the bottom dryers are drilled and DuoStabilizers are added for complete sheet support throughout the single tier sections. Threading doctors and blow pipes in the double tier sections allow the complete pre-dryer section to be threaded without ropes.

Finishing

The dry end after the dryers is completely removed and extended to make room for the finishing equipment to make on-line LWC. A new single nip pre-calender is installed incorporating a Nipcorect roll in the bottom position.

A SpeedSizer film press is added to apply up to 10 g/m² coat weight per side simultaneously. As in Scenario 1, the film press can use grooved or smooth rods and is capable of applying coating up to 65% solids. It is followed by a ModuleDryer for space efficiency. Infrared drying is added as needed.

Following a short after dryer section, an eight-roll Janus MK2 on-line calender provides final sheet quality. Calender rolls are arranged in an inclined manner, which is easier to integrate into existing installations and improves the web run, accessibility, and structural parameters of the calender.

Reel

The final product quality and parent roll diameters necessitate winder-like control of the paper at the reel. Voith's Sirius reel provides control of the winding process with two center wind assists and direct nip load generation with its SensoRoll technology. A horizontally actuated drum provides the uniform nip load with no transfers. This combined with new larger reel spools and the centerwind assists ensure optimum density build-up and uniform wound-in tension with little layer displacement. ■