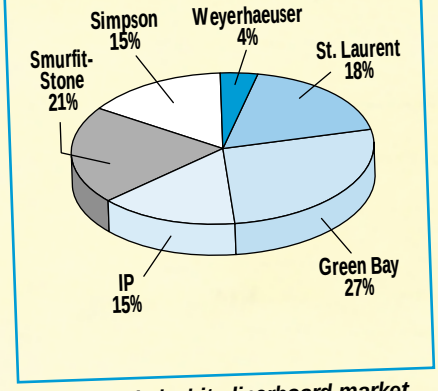
GREEN BAY PACKAGING'S JOURNEY TOWARD CONTINUOUS IMPROVEMENT: REBUILD OF PM 2

BRUCE NETHERTON AND KARI SAVOLA

FORMAL PROGRAMS STRESSING THE NEED FOR GREATER product quality and better quality control became a familiar feature in the business landscape in the early 1980s. Green Bay Packaging began its quality journey with a formal program based on the Crosby system, thereafter moving on to the Deming philosophy and finally merging both approaches in a unique combination that reflected the company's culture.

The quest for continuous improvement remains an ongoing process at the company's mill in Morrilton, AR. This small, privately owned facility is the largest producer of mottled white grades in the United States, accounting for 27% of the market, as seen in **Fig. 1**. The mill became ISO 9002 certified in October 1995. The rebuild of their No. 2 paper machine (PM 2) in 1998 was the next step in their journey.



1. U.S. mottled white linerboard market, based on 1999 estimate of 1.1 million tons

QUALITY IMPROVEMENT JUSTIFIED THE REBUILD

In mid 1996, Green Bay Packaging decided to upgrade the No. 2 paper machine at its Arkansas Kraft Division in Morrilton, AR. PM 2 has a trim width of 166 in. and produces white top linerboard at basis weights of 26–69 lb/1000 ft^2 (127–337 g/m^2) at speeds approaching 2000 ft/min (10.2 m/s) for the lighter weight grades. Before the rebuild, the white top was produced with a secondary headbox and a Bel-Bond unit. This top ply was 100% deinked stock and had a basis weight of about 14 lb/1000 m^2 (68 g/m^2). The base ply consists of pine pulp and broke.

The decision to rebuild PM 2 was driven by the need to keep pace with the continuous improvement of the white-top grades in the U.S. market and to accommodate the shift from mottled white grade to white top by the mill's direct competitors. The mill solicited proposals from major paper machinery suppliers, each of whom submitted design proposals that could achieve the mill's desired sheet specifications and appearance. The Valmet design was selected, and the components for the PM 2 rebuild were ordered in April 1997, with S.J. Baisch doing the engineering.

There was no time to run pilot machine trials to evaluate the available forming methods, so the wet-end concept had to be decided based on existing machines producing white-top linerboard. In the domestic market, the competition included machines such as St. Laurent's PM 2 with two fourdriniers; IP's PM 3 in Mansfield, LA, also with two fourdriniers; and Smurfit-Stone's recently rebuilt PM 1 in Brewton, AL, equipped with a gap former for the top ply. The European market, although not direct competitors, is served by machines

owned by Metsa-Serla (Kemi, Finland), SCA (Munksund, Sweden), and Smurfit-Stone (Cellulose du Pin, near Bordeaux, France), all producing the white top using minifourdriniers equipped with MB formers. All of these machines were Valmet rebuilds with either an extra-long minifourdrinier or, when space was limited, a combination of minifourdrinier and MB former. The St. Laurent mill, for example, had enough real estate to opt for a 44-ft minifourdrinier without the need for a MB former.

SCOPE OF PM 2 REBUILD

The scope of the PM 2 rebuild is illustrated in **Fig. 2**. The wet end was rebuilt by extending the base fourdrinier and replacing the secondary headbox and upper dewatering unit with a minifourdrinier and MB former.

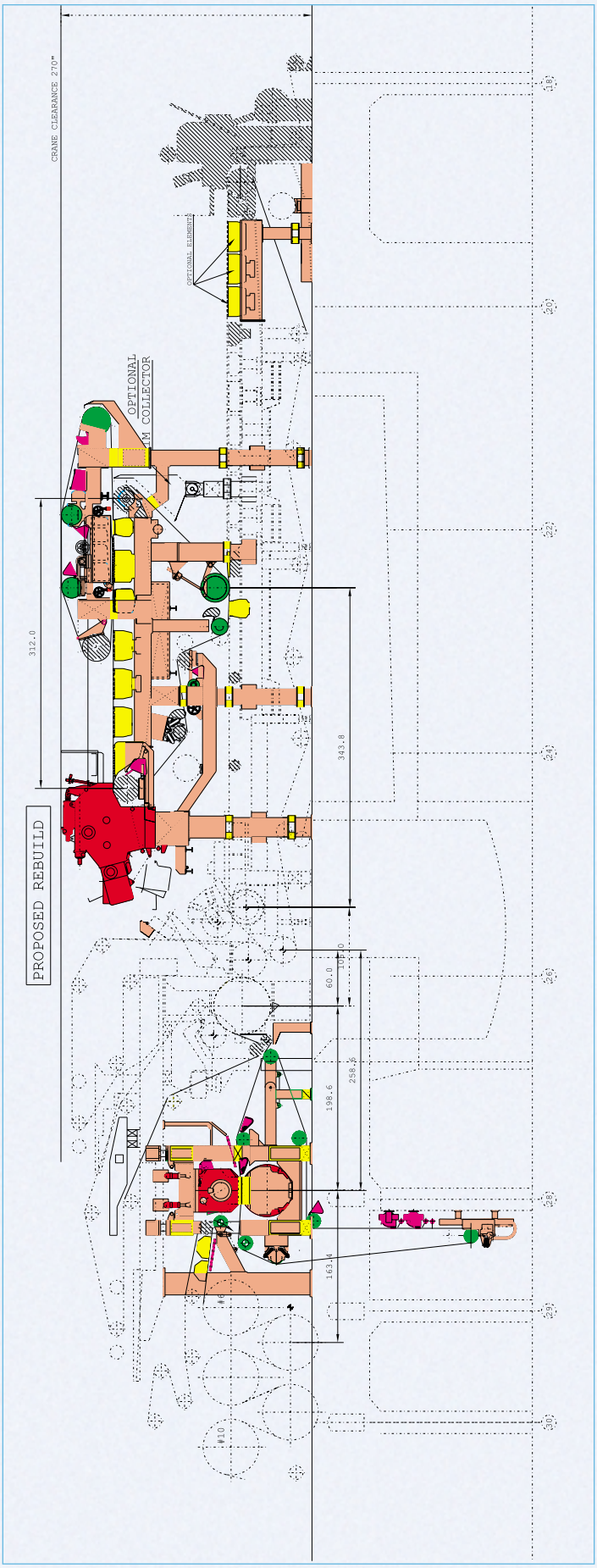
The goals of the rebuild—based on 42-lb (205 g/m^2) sheets—were to:

- Improve smoothness
- Improve ring crush
- Improve sheet formation
- Reduce white fiber usage while maintaining brightness levels.

The base fourdrinier on the rebuilt machine was extended by 13 ft, providing a total drainage length of 36 ft on the base ply ahead of the combining roll. Further extension of the fourdrinier was limited by the need to preserve maintenance access behind the headbox without relocating the refiners. Nevertheless, the fourdrinier extension allowed the existing Voith W-type hydraulic headbox to be relocated closer to its optimum range, which improved formation of the base ply.

Lack of space ruled out the use of a long minifourdrinier for the top ply. Instead, the mill had to go with a 26-ft minifourdrinier combined with a MB former. Moreover, the crane height necessitated a low-profile arrangement for both the minifourdrinier and particularly the MB former, as seen in Fig. 2. Previously, Valmet had provided a low-profile MB former with four topside vacuum boxes at the ENSO mill in Kaukopaa, Finland. This configuration served as the design basis for the Morrilton MB former. **Figure 3** shows the MB former on the rebuilt PM 2.

A new style of trim-removal equipment from the minifourdrinier was incorporated into the design. Trim removal is usually accom-



2. Scope of the PM 2 rebuild

3. MB former

4. SymBelt press section

plished by placing skiving showers on the horizontal part of the minifourdrinier, which requires removal of one foil and replacement with a saveall pan. Because maximizing the drainage length ahead of the MB former was critical, this trim collection system could not be used. Instead, the mill chose to use a system located on the vertical run of the mini wire, as was done at the Cellulose Du Pin mill.

The new headbox for the top ply was the proven SymFlo T design that has been on the market since the late 1980s. It was determined that a headbox dilution option was not necessary. The SymFlo T is a two-element box with two rows of tubes in both the manifold and the turbulence generator sections. The system placed in the Morrilton mill was designed to handle stock consistencies of 0.40–0.45%.

Figure 4 shows the press section on the rebuilt machine. The mill decided to keep the existing Twinver press, a Combi suction press off the wire with a second top-felted press on the center roll. Press loads for the first two nips were 500 and 1000 pli, respectively. The disadvantage of the Twinver press arrangement was the application of two press felts on the white top side of the sheet. To overcome the felt-marking effect in the first two top-felted nips over the center roll, the third SymBelt press nip was bottom-felted only.

The press design was a TS portabar with C-frame for easy felt changes. Five dryers had to be removed from the first dryer section to allow installation of the SymBelt press nip. Four of the five cylinders were relocated to the position previously occupied by the breaker stack, which was removed from the machine during the rebuild. The press was designed for 6000 pli and was the first no-tilt, no-zone-control design by Valmet. It was also designed so that a future top felt could be added if needed.

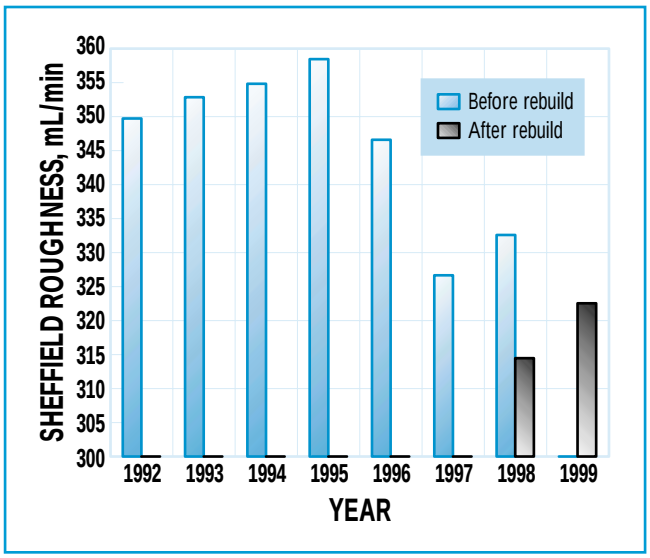
At the dry end, the existing gate-roll size press was left in place along with the existing single-nip calender. If further work on the dry end becomes necessary, it will be carried out in a separate Phase II.

The total machine outage for the rebuild was 26 days, with the machine starting up in June 1998.

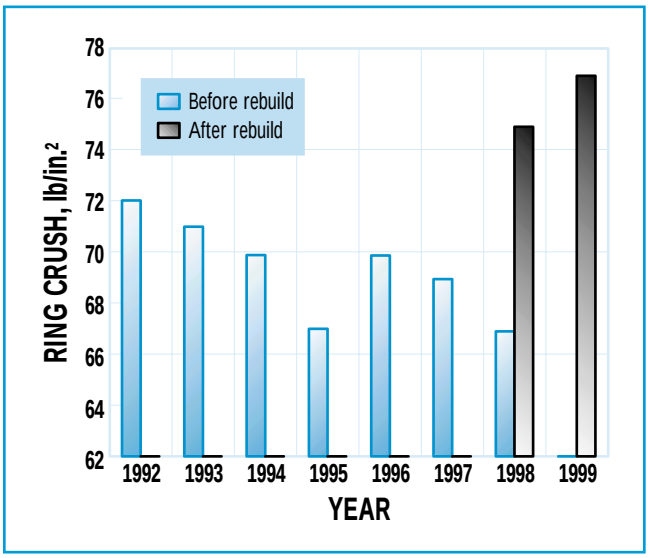
PERFORMANCE

Figure 5 shows smoothness data since 1992. Sheffield roughness has been reduced from a high of close to 360 mL/min in 1995 to a low of 300 mL/min in 1998 after the rebuild. Roughness increased slightly in 1999 due to lack of screening systems and partially unloading the press to enhance surface appearance.

Figure 6 shows ring-crush data since 1992. Ring crush (measured in the cross-machine direction) improved from the high 60s on 42-lb (205 g/m^2) sheets to the high 70s after the rebuild, even when running burst-strength-based grades. Ring-crush values up to twice the basis weight can be obtained on high-performance grades when ring crush is the surrogate parameter.

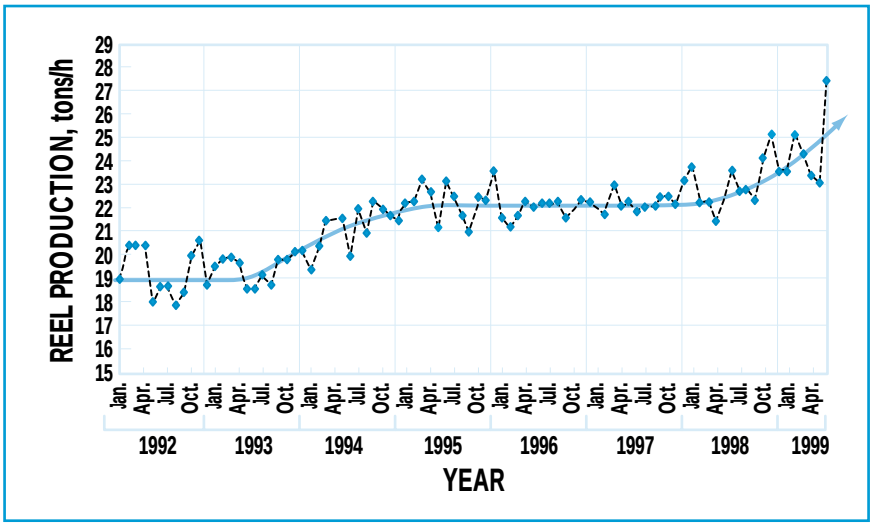


5. Smoothness improvement after rebuild



6. Ring-crush improvement after rebuild

Brightness has increased since the rebuild, but this may be more a function of a change in furnish to the headbox. Burst strength, while not an item specifically cited in the performance warranty, has improved by 11% on 42-lb (205 g/m^2) sheets. Production rates have also increased, as seen in **Fig. 7**. Instantaneous reel rates have moved from 22 tons/hour (164 in. at reel) before the rebuild to 26–27 tons/hour. The use of white fiber has decreased while maintaining good brightness and opacity.



7. Instantaneous production improvement after rebuild

CONCLUSIONS

The rebuild of PM 2 was completed on time and under budget, and the upgraded machine met all performance criteria, as seen in **Table I**. With the rebuilt PM 2 operating as planned, Green Bay Packaging is ready to proceed in its quest for continuous improvement. TJ

Netherton is vice president of engineering and expansion, Green Bay Packaging, Morrilton, AR 72110-0000. Savola is sales manager, board machines, at Valmet Corp., 12933 Sam Neely Rd., Charlotte, NC 28241.

Category	Guaranteed performance	Actual performance
Sheffield smoothness	30-point improvement (from 336 test base)	295 mL/min
Ring crush	15% improvement (from 68.5 test base)	82.5 lb/in.^{2}
Moisture from shoe press	4-point improvement (from 40.27% test base)	46.7%
Brightness	…	69.5%
Formation	0.75 (g/m)$^{1/2}$	0.70 (g/m)$^{1/2}$
White fiber usage	10% less (including trim savings)	10.25%
Production	615 tons/day (instantaneous)	621 tons/day
Sleeve life	180 days (over 12-month average)	Jury still out

I. Guaranteed and actual performance of the rebuilt PM 2