Mill Scale Trial of Selective Refining of TMP Long Fiber Fractions

Executive Summary

The trial proved that we could operate a process removing fines using small holes screening and refining of only the long fibers at mill scale production level. The pulp and paper quality were quite similar if not equal to the normal operation of the mill. We removed 9% of fines that were never refined again and saved 11% of the total refining energy.

Bowater Mersey Paper Company Ltd (BMPC) is an integrated mill producing both newsprint and book paper. The purchased wood chips are converted to pulp using thermo-mechanical pulp (TMP) refiners in the TMP plant at BMPC. Pulp with consistent quality must be provided to the paper machine to meet customer requirements. The high energy consumption of the TMP process hinders the reduction of both manufacturing cost and carbon footprint.

There have been many efforts to reduce the electricity consumed in the TMP process while maintaining the pulp quality. One way is to modify wood chips either mechanically or chemically before refining and the other way is to modify the refining system such as RTS and Thermopulp process. Recently the role of low consistency refining has been emphasized to reduce the total refining energy.
Introduction

The research of selective refining at the University of Quebec Trois-Rivieres (UQTR) is a recent and unique approach that shows promise of 15-20% energy savings while maintaining pulp quality. In their research, fines were removed from the primary pulp and long fiber fractions were refined separately. Combining the fines and the refined long fiber fractions provided the same pulp quality with reduced refining energy. Applying this concept at mill-scale would create risks in both production loss and process uncertainties. A previous trial (June 9, 2010) at BMPC confirmed the capability of the mainline refining process to produce the primary refined pulp required for the downstream process. It was then proposed to conduct a mill scale trial to replicate the concept of selective refining of TMP long fiber fractions.

Experimental

Description of the mill

The Mersey Paper Company was established in 1929 as a newsprint mill at Liverpool, Nova Scotia, to access its deep, ice-free harbor, the hydroelectric capacity of the Mersey River, and the abundant, high-quality wood supply of Nova Scotia, Canada. Today, Bowater Mersey Paper Company Limited (BMPC) comprises the Mersey paper mill, Oakhill sawmill, 234,000 hectares of Company-owned land, and Brooklyn Power Corporation, a wholly-owned subsidiary that operates a 28 MW biomass-fired cogeneration power plant.

The two-machine mill employs 280 people and produces 240,000 metric tons of newsprint and book grade paper annually. Through its eight decades, the Mersey mill has maintained its global focus. Major capital investments in the last three decades have established a solid base of quality operating equipment at the mill, while its Woodlands operations sought and achieved ISO 14000, SFI and FSC Certifications to meet customer requirements for the company’s products made from sustainable managed woodlands. In total, over 70 countries have been supplied with newsprint produced at the Mersey mill.

Description of the TMP plant

Purchased northern softwood chips are converted to pulp using thermo-mechanical pulp (TMP) refining. Since 1989, BMPC has had Valmet CD70 refiners, eight in total, comprising three mainlines of 2-stage refining and two lines of reject refining (one line is spare). In 1998, tertiary low consistency refining was added to the mainline refining using three Andritz Twin-Flo 42/48 refiners. The screen room operation comprises four Hooper 2600 PSV screens used for primary screening and one Valmet TAP 450 screen used for secondary screening. There are no stock cleaners in the pulp mill. Hydro-sulphite bleaching of pulp after two GL&V (Dorr-Oliver) disc thickeners and 500 tons High Density pulp storage tower complete the process.

Description of the changes made for the trial

Figure 1 shows the modified process for the trial. The changes for the trial are shown as red color. For the trial, a post refiner was shut down and a secondary refiner was...
idled by operating with widest possible gap. Pulp from the primary refiner passing through the secondary refiner goes to the latency chest, and then goes to the secondary screen where fines are removed in the accepted pulp stream. The rejects (long fiber fraction) goes through the rejects refiner and then combines with the fines removed from the secondary screen. The operation of a paper machine such as wet-end vacuum and wire speed was also changed during the trial.

During the trial, about 115 tons of the trial pulp were produced at the TMP plant and the pulp was used to produce trial paper for both book paper and newsprint on No.1 paper machine. Paper was also produced with transition pulp which impacted the paper machine operation and the paper properties. In order to reduce the risks in paper machine operation, the trial was conducted while No.2 paper machine was shut down for 14 hours to complete planned maintenance. By conducting this trial, results would be determined whether the specific energy consumption (SEC) of the refiners could be reduced while maintaining pulp and paper quality. The trial could have resulted in producing lower quality paper, and the refiners, screens and the paper machine may have experienced operating difficulties.

**Results and Discussion**

**General observations of the TMP operation**

The TMP line 2 was shut down initially on October 21, 2010 to change the process control logic to allow the secondary refiner to be idled (i.e. operated at minimal load) while still conveying primary refiner stock to No.2 latency chest. Then the line was operated 10.5 hours for the trial. The target load of the primary refiner for the trial was about 10.5-11 MW and the actual load of the primary refiner was about 10.6 MW. Reject refiner load was about 10.2 MW and this was also in the range of the target (8.5 -10.5 MW).

During the trial, the loads on the refiners were adjusted to reach the target final freeness. The screen was fed at the normal consistency without any operational problems throughout the trial. The paper machine produced paper from the trial pulp, including pulp made while transitioning to the modified process. Drainage slowed with increased fines but the machine continued to be operated by reducing the dosage of retention aid chemical.

**Screen operation**

The screen did not suffer any plugging during the whole trial even when we increased the feed flow by a factor of two at the end of the trial. The rotor load was around the normal operating range. We did change the volumetric reject rate and observed no significant change in the mass reject rate. The only change observed was that the rotor load increased when we decreased the volumetric reject rate. These facts would suggest that the amount of material accepted was simply dependent on the hole opening size and rotor foil geometry/speed. (The volumetric reject rate controls only where the water is sent, not the fibers.) The amount of accepted fines from the screen was in the range of 9% by mass.

**Specific energy consumption**

Figure 2 compares the refining specific energy consumption between normal operation before and after the trial (blue symbols) for a long period of time with the results from the trial (pink symbols) and a control run done the same day of the trial with the normal operating arrangement (black symbols).
We can conclude that the trial run reduced the specific energy consumption by 11% at the normal operating final freeness.

**Mass balance and pulp quality**

We took pulp samples during the trial and tested them for quality (Table 1). We can clearly see from the Bauer McNett around the screen that only fines were accepted and moved forward. There was still a significant amount of fines (P200) left in the rejects from the screen that could be further removed in a second stage of screening.

**Hand Sheet Comparison**

The trial pulp has a lower long fiber fraction (R48 of 53% compared to a control value of 55.5%) and a higher fines content (P200 of 31% compared to a control value of 28.5%). The differences in hand sheet properties are small between the trial pulp and the reference pulp. The trial pulp results indicate bonding is lower, tear index is better and optical properties are better.

**Paper quality produced**

We can see similar results from the paper produced on No.1 paper machine during the trial vs. Control (Table 2). Most paper properties are equal (less than 2% difference) except for the porosity (trial paper 13% lower), TEA CD (trial paper 6% higher), TEA MD (trial paper 10% lower) and tensile CD (trial paper 4% higher). The difference in the TEA might be more related to the formation/orientation of the fibers in the paper than anything else.

**Visual quality of the fines in the process**

Pictures were taken of the fines at different places in the process to try to see differences (Fig. 3). We can see some clear differences in the different streams. The accepted stream from the screen contains a much larger fraction of fibril like material. This fraction is so large that it is hiding the flake like material that is also accepted. We can also see that there is still a fair portion of fibrils and flakes in the rejected stream from the screen.
Conclusions

The trial proved that we could operate a process achieving fines removal by screening with small holes and refining of the long fibers only at mill scale production level. The pulp and paper quality were quite similar if not equal to the normal operation. We removed 9% of fines that were never refined again and saved 11% of the total refining energy. Including a second stage of screening would increase the fines removal and thus further reduce the refining energy.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers.

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We are committed to moving our customers’ performance forward.

Figure 3. Visual comparison of fines at different process stages