Preliminary study on the potential of improving pulp quality and energy efficiency in a South African TMP mill

Presented at the TAPPSA National Conference and Exhibition 19-20 October 2010, Durban, South Africa

Jonas Johakimu[1], Tammy Bush[2]

1. Senior Engineer, CSIR Natural Resources and the Environment, Forestry and Forest Products Research Centre, P.O Box17001, Congella Durban
2. Research Group Leader, University of KwaZulu –Natal/ CSIR Natural Resources and the Environment, Forestry and Forest Products Research Centre , P.O Box17001, Congella Durban (corresponding author: jjohakimu@csir.co.za)

Introduction

The limited softwood supply that occurred in South Africa during the past years coupled with the recent hikes in energy costs have seriously threatened the competiveness of the Thermo-mechanical pulping mills (TMP). The development of innovative solutions that substantially reduce the energy consumption while maintaining pulp quality is therefore critical. In the TMP process, refining is performed to produce pulp. However, the pulp formed is characterised by a heterogeneous mixture of fibres with different dimensions, e.g. thin and thick walled fibres as well as short and long fibres. The TMP pulp furnish requires minimal amounts of fines to avoid poor drainage. Therefore additional fibre separation in the subsequent processes is required. In addition, excessive thick walled fibres affect the final paper product quality (e.g. linting problems). In principle effective fibre separation systems is achieved when screens and Hydrocylones are used in combination (1,2). Screens separate the fibres according to fibre length while the Hydrocyclone separates fibres according to density (Fig 1). The combination of the two, e.g. screens used to remove shives and bigger wood particles and the Hyrocyclone for separating thick and thin-walled fibres have been acknowledged as a best practice of improving pulp quality and energy efficiency in Scandanavian TMP mills (1,2). To understand the limitations and to identify opportunities for optimisation of the South African TMP process, the existing refining and screen fractionation practices a local TMP mill was assessed. The ultimate goal is optimal utilisation of the scarce softwood resources to improve the product quality and refining energy efficiency.

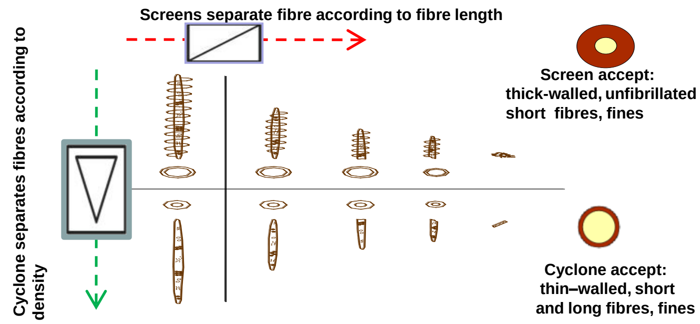

Fig 1: Principle of fibre separation in screens and in Hydrocyclones respectively (Source: Noss AB). Short unfibrillated and thick–walled fibres are present in screen accept. In Hydrocyclone only thin-walled short and long fibres are present in the accept stream.

Experimental

The experimental work examined two issues.: 1) Limitations of the refining process – mill feed pulp samples were fractionated and 2) Efficiency of the mill screen fractionation process – mill accept samples from 0.18 slot screens were fractionated. The fractionation trials were carried out using the Noss Hydrocyclone Canister rig (Fig 2). The rig was connected to a low consistency flow system. The feed consistency was 1%, feed flow 100 -110 litres / min, operating pressure of 2-2.3 bar at a pre-determined optimal reject ratio of 22%. Pulp mass accept and reject rates (%) were 66 and 34, respectively. The feed flow and pressure were according to specifications supplied by Noss AB. Fibre morphology analyses were done using Kajaani and freeness tests were performed according to the Canadian standard freeness test method..

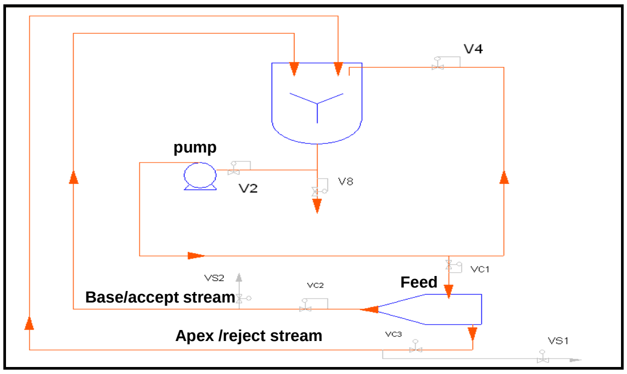

Fig 2: Process flow diagram for the fibre fractionation trials using the Noss Hydrocyclone canister rig at CSIR –FFP Laboratory

Results

(1) Effect of Hydrocyclone fractionation of mill feed

Table 1: Effect of fractionation on mill feed pulp samples

Pulp sample	Freeness (ml CSF)	Pulp mass (as % of feed)
Mill feed - control	189	100
Base/accept - LB	18	34
Apex/reject - LA	547	66

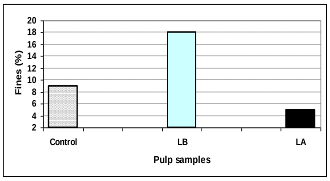

Fig 3:Fines in pulp samples

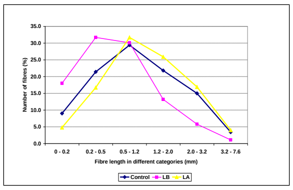

Fig 4: Fibre length distribution

(2) Fractionation of mill accept pulp samples from 0.18 mm slot mill screens in Hydrocyclone

Table 2: Effect of fractionation on mill accept pulp samples

Pulp sample	Freeness (ml CSF)	Pulp mass (as % of feed)
Mill accept - (MA) - control	70	100
Base/accept - LB (MA)	28	34
Apex/reject - LA (MA)	256	66

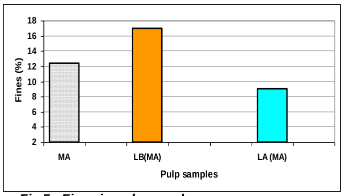

Fig 5: Fines in pulp samples

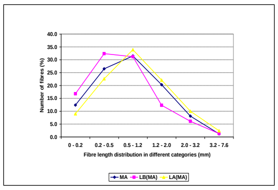

Fig 6: Fibre length distribution

Summary

Under the current mill refining practices, the mill is introducing too much refining energy into the fibre. The lower levels of freeness for the accept samples (18 vs. 90 CSF ml required) and the higher amounts of fines confirms this (Table 1& Fig 4). The mill's screen fractionation process has limited efficiency. Substantial amounts of thick-walled fibres are present in the mill accept pulp samples (i.e. 66% by mass of the mill accept has a freeness of 256 ml CSF (Table 2)). The benefits of adding a Hydrocyclone to the fractionating system for TMP pulp has been demonstrated. The information revealed in the study may be used as benchmark for evaluating alternative ways of optimising the TMP process. One approach could be a single stage refining followed by a screen and Hydrocyclone fractionation (2).

References

1. **Oleg S and Bergström B (2005).** The effect of Hydrocyclone fractionation on mechanical pulp drainability and freeness, Noss AB (Sweden) IMP Conference in Stockholm on 30th march 2005 (Sweden). Pp 1-9.

2. **Alexandre et al., (2010)**. Optimum r refining of TMP pulp by fractionation after the first refining stage, Appita J. 63: 308 – 314.

Acknowledgement: We would like to thank the laboratory technical staff at CSIR-FFP for their assistance in conducting the trials as well as Dirk Strobl (NOSS AB) and Casper Nice (PAMSA) for their assistance on the trial logistics.