Why does Canfor use a pilot refiner to evaluate pulps?

Since we started exclusively testing pulp using a pilot refiner, this is a question we have often been asked. The answer is simple, we believe that the pilot refiner gives us a better indication of how a given pulp or blend of pulps will actually perform in a paper mill, than we could get from using devices like PFI mills, Jokkro mills or Valley beaters. We encourage other pulp suppliers to do likewise.

Most readers of this web-site know how a pulp refiner operates, energy is applied to the pulp fibres by passing them between two surfaces separated by a narrow gap. One or both of the surfaces is rotating and both are covered in multiple fine patterns of bars. The energy applied to the refiner, rotational speeds, dimensions of the bars and distances between the plates are all known. The intensity with which the energy is actually applied to the fibres can be calculated.

When we consider how the standard laboratory instruments such as PFI or Jokkro mills operate, it is clear that we have no way to easily know how much energy they actually apply to the pulp, nor the intensity at which it is actually applied. The only parameter we measure is the number of revolutions. When dealing with properties such as tensile strength, the values obtained on PFI or Jokkro mills are usually very high, the devices are acting as "ideal" refiners. Needless to say, such values never appear in the papermill!

Several studies have been conducted to learn more about the mode of action of these devices, and to compare them with industrial and pilot refiners. In the case of PFI mills it was found that 6000 revolutions of the rotor is roughly equivalent to 1000 kWhr/t of pulp, almost 10 times what most refiners in a papermill might be expected to apply. What was more, the actual energy applied varied with the type of pulp.

Some results from one of these studies are shown graphically below. The first graph is a comparison of breaking length vs freeness for pulp refined on a PFI and on a conical Escher Wyss, the EW refiner was operated at specific edge-loads of 1 and 3 J/m. It is immediately obvious that the response of freeness and breaking length to the refining process is quite different. In Figure 2 the actual energy applied to the two types of device is plotted and again it is clear just how different the response of the pulp is to the applied energy. Why should that be?

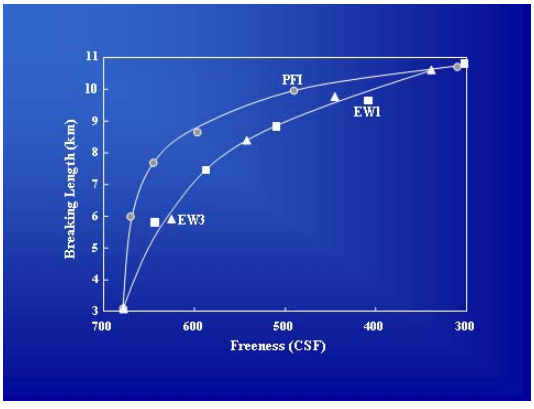


Figure 1

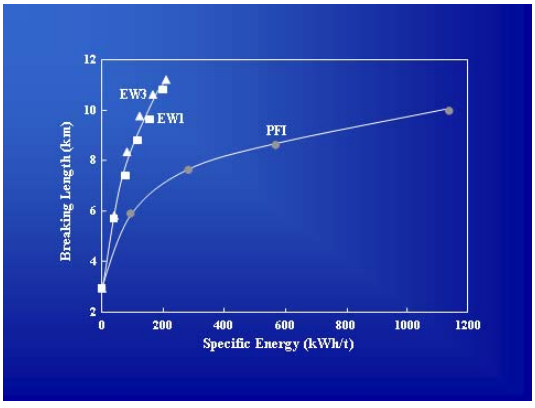
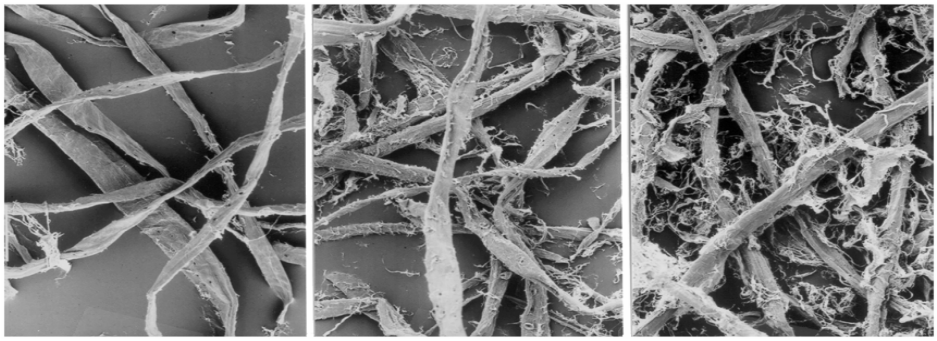


Figure 2

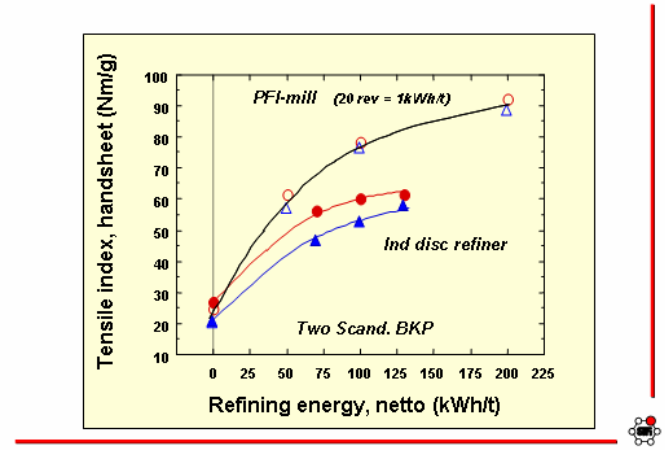
There are several reasons why, but one major one is that PFI and Jokkro types of devices tend to compress the fibres resulting in lots of internal fibrillation and very little fines generation or fibre cutting. Actual refiners are much more prone to cut the fibres with consequent creation of fibre debris and fines. This is illustrated in Figure 3 where the different responses of a Douglas fir fibre to PFI and conical refining are shown.



Unrefined fibre PFI mill 6000 revs E.Wyss 3J/m, 240 kWh/t

Figure 3

As a result of the different responses of fibre to the different refining approaches it is perhaps not surprising that the results from PFI and Jokkro are often misleading. A good example of this effect was illustrated in a paper from Dr. Mohlin of STFI. In this paper she shows how two pulps which gave promising results on a PFI mil ldelivered very different results when actually run in a paper mill.



Conclusions

So, PFI devices refine differently, have extremely low intensity, do minimum fibre shortening, and may not identify sub-standard pulp. In short they are very poor predictors of ultimate pulp performance. Pilot scale refiners avoid these drawbacks. So in 2001, Canfor explained to our customers that we were contemplating switching all testing from PFI to a pilot disk refiner (click here for details). Today all of our specifications have been revised to reflect the switch, and all our pulp testing and competitive analyses are done with the lab refiner.

References

1) R.J. Kerekes, Characterizing refining action in PFI Mills, TAPPI Journal, vol 4, No 3, pp 9-13 (March 2005)