Recent TruGap™ Experiences

INTRODUCTION

The objective of J&L's new TruGap product line is to improve the performance of the Valmet CD refiner systems, through increased refining efficiency.

The product was developed over a one-year period, using state of the art computer models coupled with advanced field measurements and manufacturing techniques.

In this paper we will begin by discussing the theory, followed by a brief description of the field testing before being concluded with some key results.

THEORY

The theory of the TruGap concept begins with the fibrous material between the refiner plates in the refining zone.

In a CD refiner, the refining action is primarily controlled by two independently controlled disc-gaps. The gap settings, (typically in the range between 0.8 – 2 mm) affect how much the material is strained between the bars as the rotor plates sweep over the stator plates. Reducing the disc gaps increases the strain in the material, and opening up the gap lead to a reduced strain of the material.

The wood pulp in the refining zone has a very nonlinear stress-strain relationship, Figure 1. As illustrated in the graph, there is an optimum strain for the refining zone. If the material is not strained enough (blue region), energy is wasted since little or no strain energy has gone into the material. On the other hand, if the material is strained too much (red region), the stress in the material will be too high for the fibers to withstand. Optimal conditions exist somewhere between these two regions.

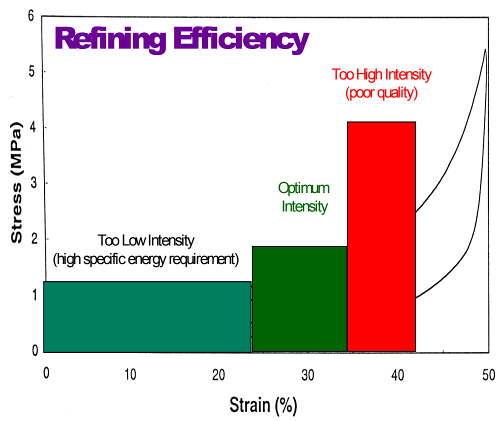


Figure 1. The stress in the fibrous material is a function of refining zone temperature, disc gap and the rate at which the load is applied. For each situation, there is an optimum strain (or disc gap) for maximum refining efficiency.

For optimum operation, the disc gap must be uniform both axially and radially. A misalignment of the drop-in assembly can adversely affect both quality and efficiency, Figure 2.

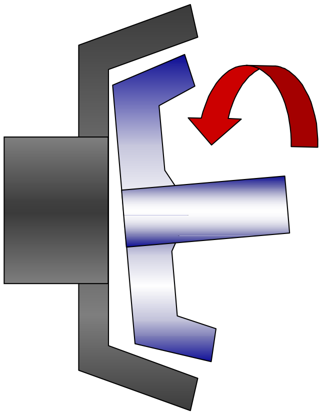


Figure 2. The Valmet RGP 70/76CD refiners are sensitive to alignment, since the conical zone will be affected by both radial and axial misalignments.

Waukesha, Wisconsin U.S.A.
Phone: 262-544-1890 • Fax: 262-547-8166
www.jlfiberservices.com

Similarly the refiner plates themselves can cause a non-uniform disc gap. Extensive finite element analysis (FEA) of the refiner plates show that the centrifugal load of the CD rotor plates can cause them to deflect significantly, Figure 3.

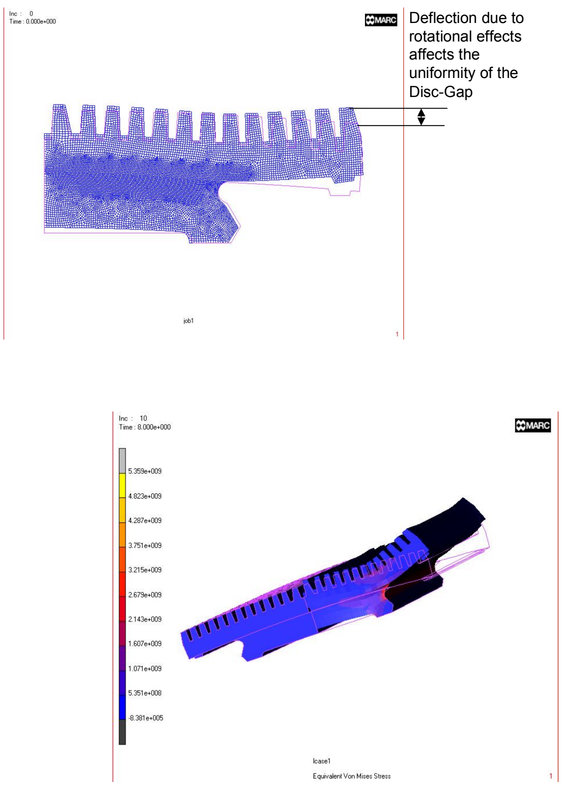


Figure3. FEA studies show that the centrifugal loads can affect the disc gap uniformity by as much as 25%.

J&L TruGap™ refiner plates minimizes this phenomena by:

- minimizing the deflections through FEA optimization of the weight distribution in the castings
- compensating for the remaining deflections during the grinding process.

By installing refining plates with a curvature that deviates from a true cone curvature during static conditions, a perfect cone (i.e. uniform disc-gap) can be achieved during operating conditions, Figure 4.

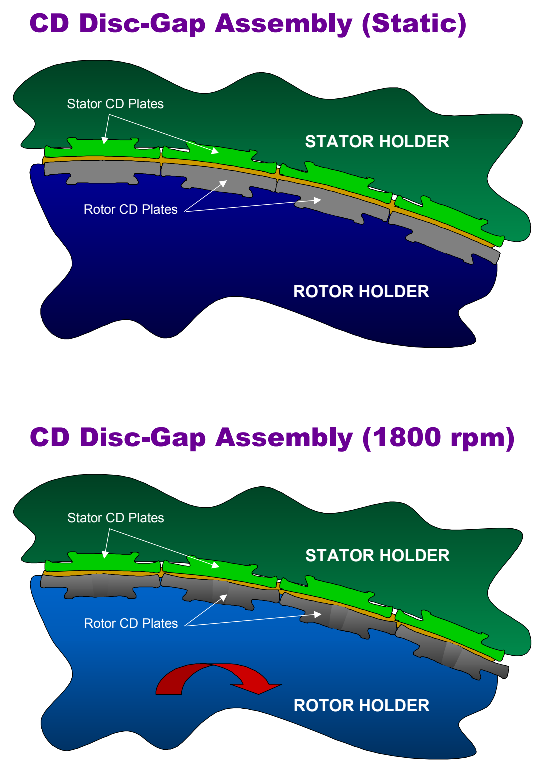
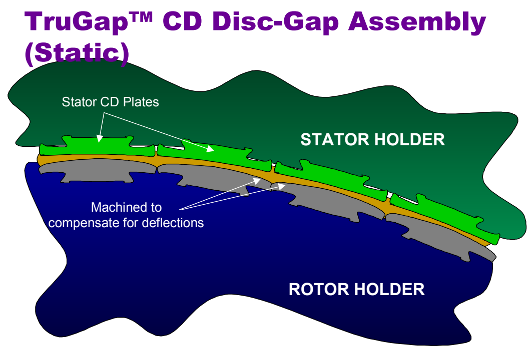


Figure 4a. Standard CD refiner plates. The plates are ground together in a circle forming a perfect cone during static conditions. However, at operating conditions, the plates deflect, causing a non-uniform disc gap

Waukesha, Wisconsin U.S.A.
Phone: 262-544-1890 • Fax: 262-547-8166
www.jlfiberservices.com

A *Measurable* Difference

J&L Fiber Services Product Case Study



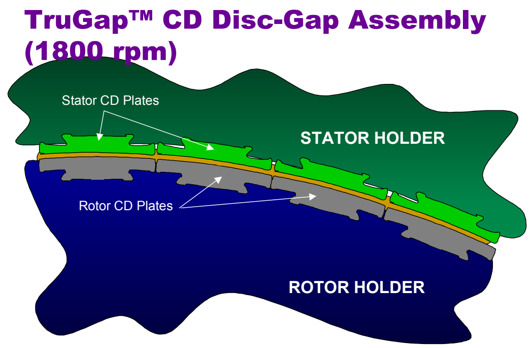


Figure 4b. TruGap CD refiner plates are machined to a curvature established using advanced computational tools such as FEA. Because of the compensated curvature, a perfect cone (and uniform disc gap) is formed during operational condition rather than in a stand still condition.

FIELD TESTING AND OPTIMIZATION

Several field tests have been performed in NA, on Southern Pine and on Spruce. To date the tests have only been conducted in primary positions, although trials are scheduled for secondary and reject positions.

In addition to the traditional evaluation techniques, we have made extensive use of the J&L SmartPlate system for evaluation as well as optimization.

SmartPlates can be compared to an "eye" inside the refiner, since it senses the refining conditions as a function of both time and spacial location, Figure 5.

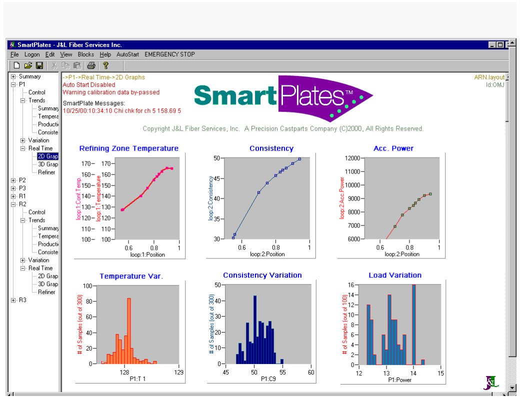


Figure 5 Typical SmartPlates information includes refining zone temperature, consistency, power etc. All variables are available from the inlet to the outlet of the refiner.

Figure 6 is a graph of the SmartPlate refining zone temperature as a function of segment position, for a "standard" plate profile (blue), and for the TruGap profile (red). The freeness level is the same for each line.

It is interesting to note that the temperature profiles are quite different, with the standard plates having the pressure peak in the flat zone, while the TruGap plates have the pressure peak in the CD zone.

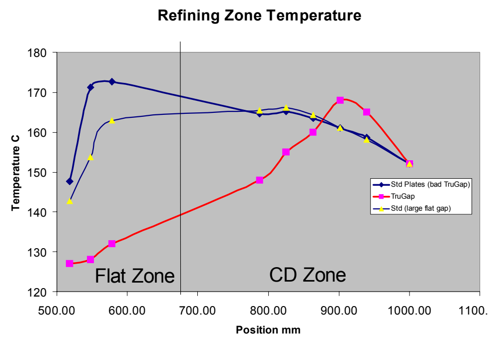


Figure 6. Refining zone temperature as a function of position. The standard CD plates (blue lines) have a significant power input and therefore a high temperature in the flat zone. The TruGap plates can be operated with increased energy input in the CD zone, which has shown to be more efficient for a given pulp quality.

J&L FIBER SERVICES
A PRECISION CASTPARTS COMPANY

Waukesha, Wisconsin U.S.A.
Phone: 262-544-1890 • Fax: 262-547-8166
www.jlfiberservices.com

A *Measurable* Difference

J&L Fiber Services Product Case Study

The difference in temperature profile is significant since it shows that the TruGap plates enable additional energy to be put in the CD zone. Mill optimization efforts clearly show that moving the refining action towards the periphery (i.e. CD zone) increases the efficiency of the process.

KEY RESULTS

Mill A

This mill produces standard newsprint from 60-70 %TMP and 30% ONP. The average production rate from the TMP mill is 600 ADMT/day from southern pine, over two RGP 76CD refiner lines, and two RGP 60 reject refiners. The objective for this mill is to *"Reduce energy wisely"*. This entails a reduction of the overall specific energy consumption of TMP produced, without sacrificing pulp or paper quality.

Table 1 lists the average specific energy requirements together with the average pulp quality.

Table 1.

		Std.	TruGap	
		Year Avg	Oct	Nov
Prod/line	ADMT/Day	300	300	320
SEC	MWh/Ton	3.47	3.26	3.07
CSF	ml	95	+/-5	+/-5
Long	%	31	+/-3	+/-3
Fines	%	425		

From the table it is clear that the TruGap refiner plate concept has a significant impact on the refining efficiency. At equal pulp quality a 6% -11% overall energy savings has been achieved, representing an annual savings of approximately $2.5 - 3 million USD. The optimization process is continuing, and we expect to have the TMP refining system optimized by 3/1/2001.

Mill B

This mill also produces standard NEWS from 80 %TMP and 20 % ONP. The average production rate from the TMP mill is 1000 BDMT/day from spruce, over two RGP 76CD refiner lines, and one or two RGP 76CD reject refiners.

Again, the main focus is to reduce specific energy, but an increase in production by 10% is another important goal. Table 2 compares the average pulp quality and specific energy requirements for standard and TruGap plates.

Table 2.

		Std.	TruGap
SEC	kWh/ton	2010.0	1850.0
Prod.	BDMT/d	487.0	490.0
Pri. CSF	ml	614.5	631.7
Sec. CSF	ml	242.7	232.0
Tear	mN-m2/g	9.3	9.6
Burst	kPa-m2/g	2.4	2.4
Tensile	N-m/g	43.8	43.8
Brightness	%	57.0	56.8

To date 5% energy savings has been achieved without any affect on the main line or overall TMP quality. Current efforts are focused on increasing the production to 550 t/day.

SUMMARY

The results obtained to date are very encouraging, with significant improvements in the refining efficiency. It is clear that significant savings or quality improvements are possible, without any capital investments.

However, each process situation is different, and the magnitude of the improvements may differ between applications. For example, it is clear that if one takes advantage of the improved refining efficiency (that is the reduced motor load), to increase the production over the line, the specific energy applied per ton of pulp produced will decrease even further.

Similarly, if the reduced motor load is used to improve quality, the improvement in efficiency may be reduced.

The key to the TruGap concept is that it is risk free to evaluate. The same or similar plate patterns with standard and TruGap profiles, can easily be evaluated and compared. This is especially true when outfitted with the SmartPlates technology.

J&L FIBER SERVICES
A PRECISION CASTPARTS COMPANY

Waukesha, Wisconsin U.S.A.
Phone: 262-544-1890 • Fax: 262-547-8166
www.jlfiberservices.com