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CORRELATION: PULMAC SHIVE DENSITY VS QS AUTOSCAN LENGTH
THERMO-MECHANICAL BLEACHED HARDWOOD PULP

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AIM: The aim of this investigation is to determine the correlation, if any, between reported QS AutoScan Fibre Classifier length results and percent shive content by weight as determined using the QS FibreScreen, a masterscreen, in accordance with TAPPI standard practice, T274 SP13.

EQUIPMENT: Two major testing apparatus were utilized: the QS FibreScreen, a MasterScreen-type instrument compliant with TAPPI T274 sp13, and the QS Fibre AutoScan, an optical instrument designed to determine and classify dimension data of particles passing through a proprietary imaging flow cell in a laminar aqueous stream. The laminar stream directs particles through a one square centimeter area of interest in such a way as to minimize out-of-plane orientation. This keeps the entire particle stream in sharp focus and greatly reduces length measurement error. The slurry passing through the laminar flow cell is brought to a very low consistency so as to prevent the fibrous particles from over-lapping or clumping. Typical sample size is about 1 gram diluted to 0.01% consistency in a 20 litre capacity feed tank. This will yield a measurement of about 20,000 fibrous particles in 15 minutes. Using a heavier grammage and more dilution water will permit up to 100,000 particles to be imaged and classified at a cost of adding several more minutes to the testing time

METHOD: QS Fibre received two hardwood pulp lots from a TMP Mill. Each lot had an air dry weight of about 1 KG. One pulp lot was relatively densely-caked and was characterized by a slightly yellowish hue (YL). The other was less densely caked and was of a whiter colour (WH). Ten air-dry grams of YL and WH pulp were then disintegrated and diluted in separate buckets to 0.1% consistency.

FibreScreen: After preliminary ranging to determine a sample size and screenplate combination that would yield significant and repeatable retentions (screenplate rejects). It was determined to use a .003 (75 micron) screenplate with a 10 gram (air-dry) sample size.[1] Seven proportion-controlled blended samples were prepared and shive content determined as per TAPPI T274 SP13:

	YELLOW (YL)			WHITE (WH)			RETENTIONS
Table A							
Test	Percent	Volume (Litres)	Gms	Percent	Volume (Litres)	Gms	Shive (gms)
1	100	2.50	10	0	0	0	0.146
2	80	2.00	8	20	0.50	2	0.132
3	60	1.50	6	40	1.00	4	0.127
4	50	1.25	5	50	1.25	5	0.116
5	40	1.00	4	60	1.50	6	0.103
6	20	0.50	2	80	2.00	8	0.106
7	0	0	0	100	2.50	10	0.089

[1] The shive fraction analyzed is determined by the selection of screenplate slot width – in this case .003 in or 75 microns. Fibreline processes will equally act on all pulp fractions so for the purposes of establishing correlations, the shive fraction is selected for convenience : with a .003 screenplate less sample is required to generate a significant fraction of shives which will be sensitive to changed experimental conditions without a requirement for ultra-precise measuring instruments and procedures.

AutoScan: Seven proportion-controlled blended samples were prepared and processed through the AutoScan. The following data filters were applied:

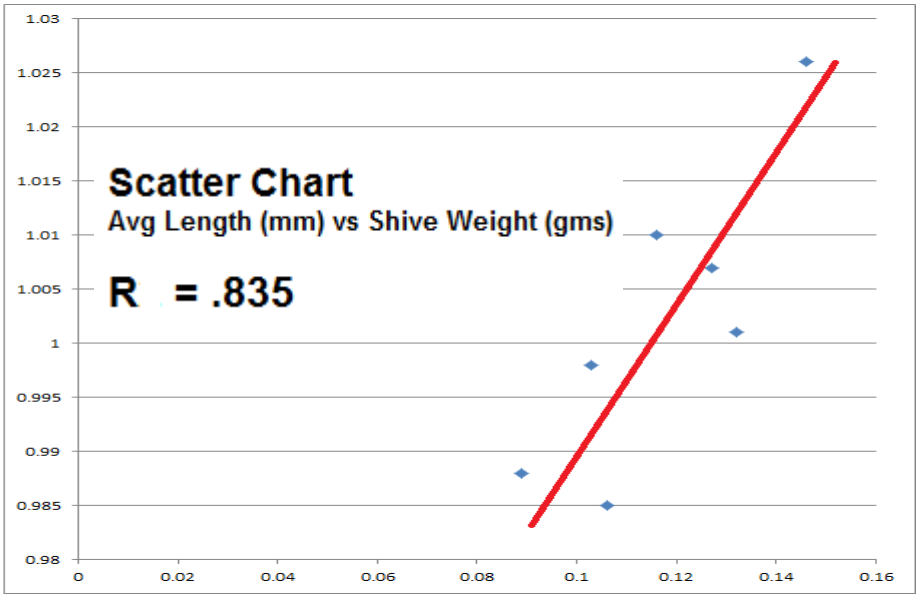
Length: Images less than .2mm and greater than 4mm in length were excluded
Area: Images less than .02 and greater than 1.5 mm^2 were excluded.
Aspect: Images whose length was less than ten times width were excluded.

YELLOW (YL) **WHITE (WH)** **AVG L**

Table B

Test	%	Vol (ml)	gms	%	Vol (ml)	gms	(mm)
1	100	250	10	0	0	0	1.026
2	80	200	8	20	50	2	1.001
3	60	150	6	40	100	4	1.007
4	50	125	5	50	125	5	1.010
5	40	100	4	60	150	6	0.998
6	20	50	2	80	200	8	0.985
7	0	0	0	100	250	10	0.988

Figure 1



DISCUSSION: The experimental data confirm a definite correlation between a blended hardwood TMP pulp's changing average fiber length and shive content. While this changing length was artificially established by proportionally blending two pulps, the same sensitivity should be realized when monitoring production. So AutoScan could be a useful and cost-effective means to keep tabs on shive levels

Figure 2 Length Histogram

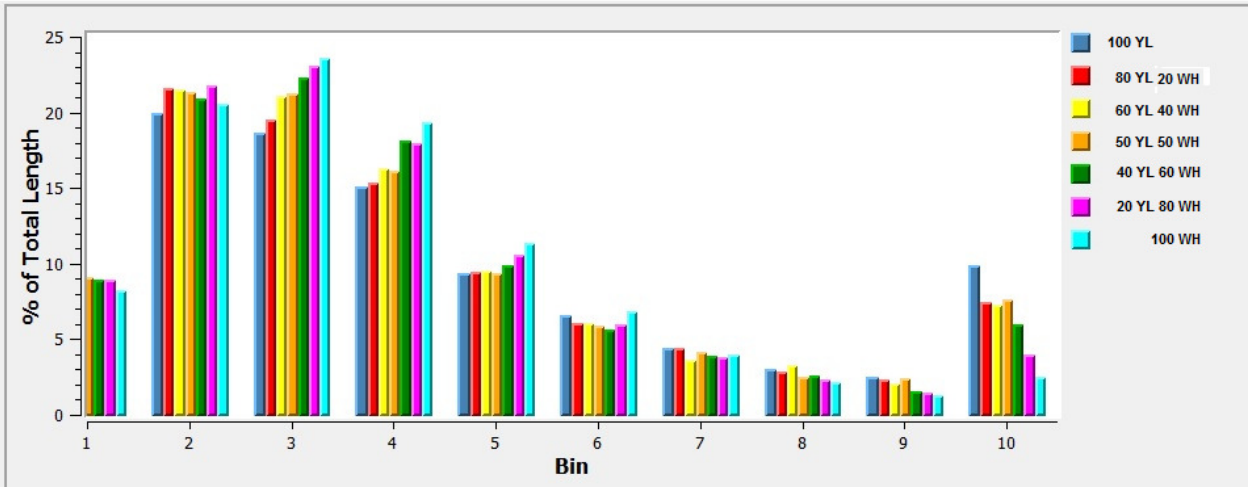


Figure 2 gives an interesting display of changing length distributions for AutoScan tests 1 through 7 as the percent composition of YL pulp is reduced down to zero from 100% and the percent composition of WH pulp is increased from zero to 100%.

The percent composition of particles at the longer end of the range tend to decrease as the percent of WH pulp is increased while the percent composition of particles at the smaller end tend to increase. The histogram presentation of the data suggests why the correlation coefficient relating average fibre length to shive density is not higher than it is. The impact on average length by the increased presence in shives in the samples used is attenuated by a corresponding increase in the number of smaller particles.

However a clearer relationship is found at the long end of the scale. All particles greater than 2 mm in length are reported in Bin 10. All particles between 0.2 mm and 0.7 mm in length are reported in Bin 1. The other particle lengths are evenly allocated to bins 2 through 9 (bin size is determined and set by the user manager).

Figure 3 Bin 10 Results Percent of total number vs Shive Wt

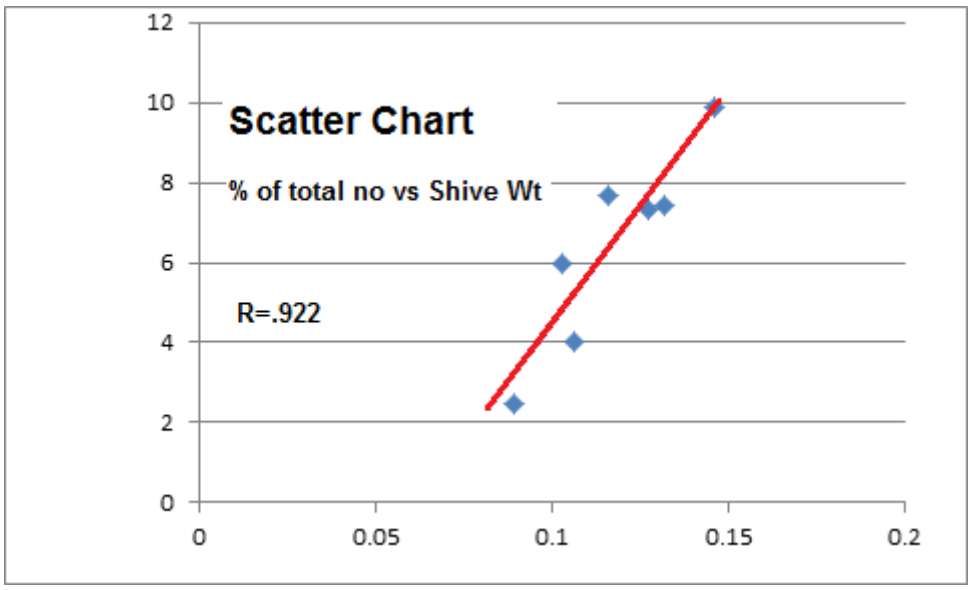


Figure 4 Bin 10 Results % of Total Length vs Shive Wt

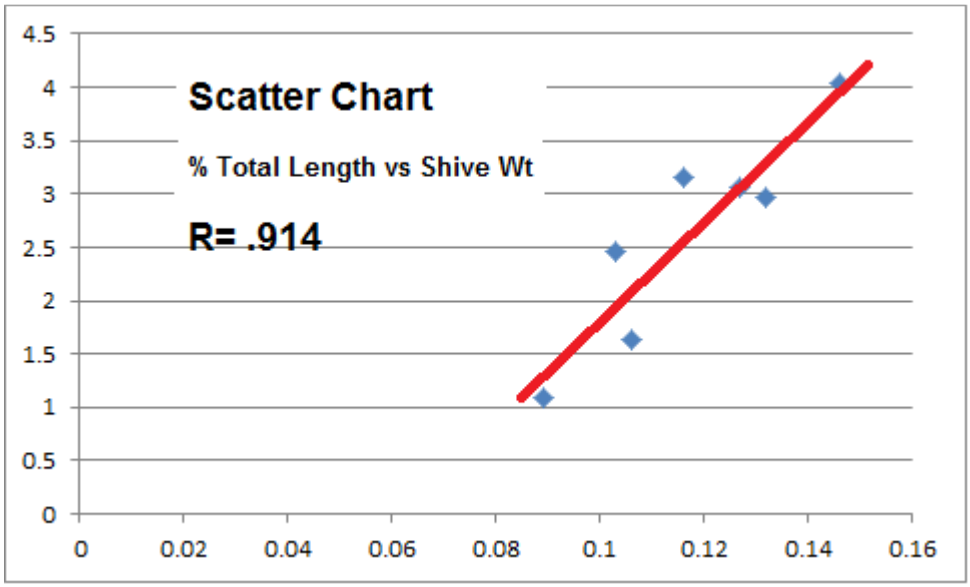


Figure 3 and 4 further bring out the evident shifting in size distributions as the composition of WH pulp is increased and that of YL pulp is decreased. If we look at just the particles grouped into the last Bin (between 2 and 4 mm in length), we see a marked correlation (R=.922) between the number of particles grouped in Bin 10 as a percent of the total number of particles grouped in all the Bins and shive weight (Figure 3). We see almost as strong a correlation (R=.914) between the contents of Bin 10 as a percent of the total length of particles grouped in all the Bins together (Figure 4).

CONCLUSION: The QS Fibre AutoScan is sensitive to changing shive content.