

Z-Span Testing For Better Papermaking Quality Pulp

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Z-Span
Technology

Monitoring, Optimizing & Troubleshooting Pulp Mill Operation for Papermaking Quality of Pulp.

- **Rapid Test**
- **Repeatable Test**
- **Test that Predicts**

Z-Span Strength Testing



Presentation Outline

- **What are Z-Span Strength Numbers?**
- **How are Z-Span Strength Numbers Generated Rapidly and Repeatably?**
- **How well do Z-Span Strength Numbers Predict the papermaking quality of eucalyptus pulp?**



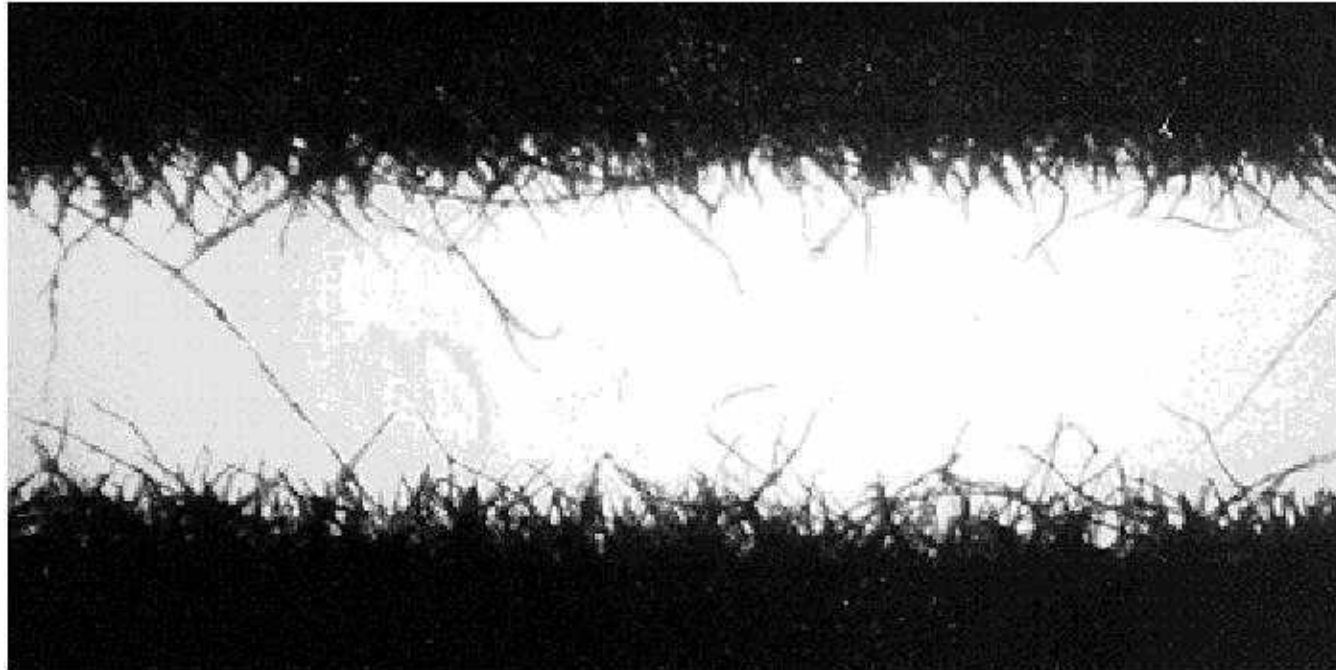
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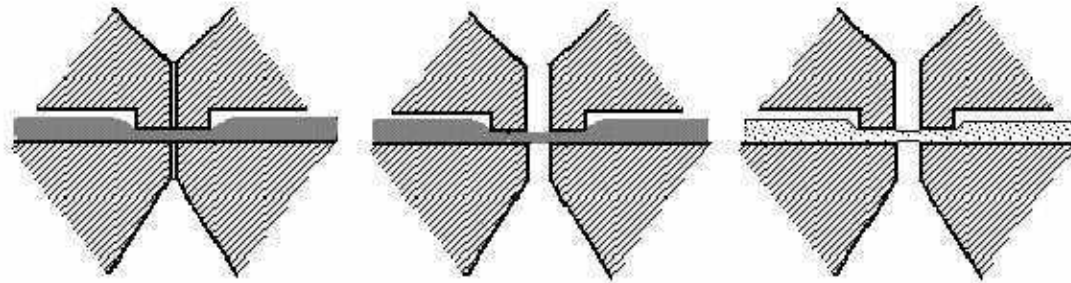
Standard Tensile Test-Paper Failure



Zero Span Tensile Test-Fiber Failure



What are Z-Span Strength Numbers?



(Fiber
Movie)

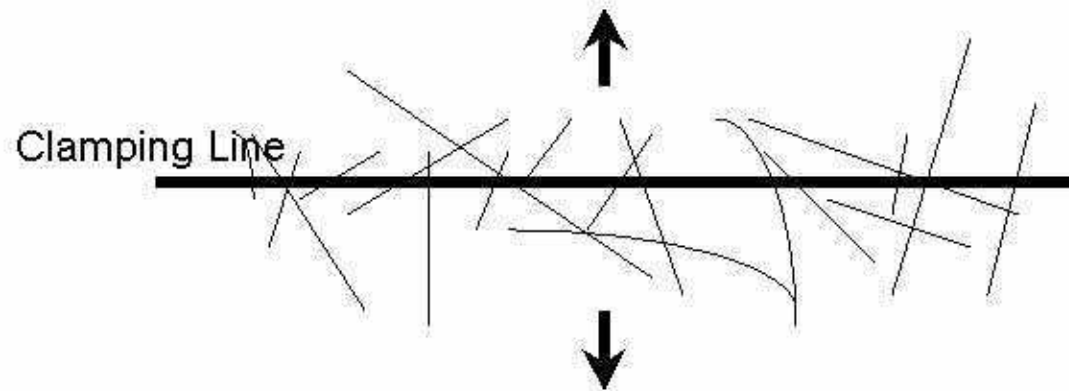
Wet Zero Span (0.0003mm) Wet Short Span (0.40 mm) Dry Short Span (0.40 mm)



FS Number

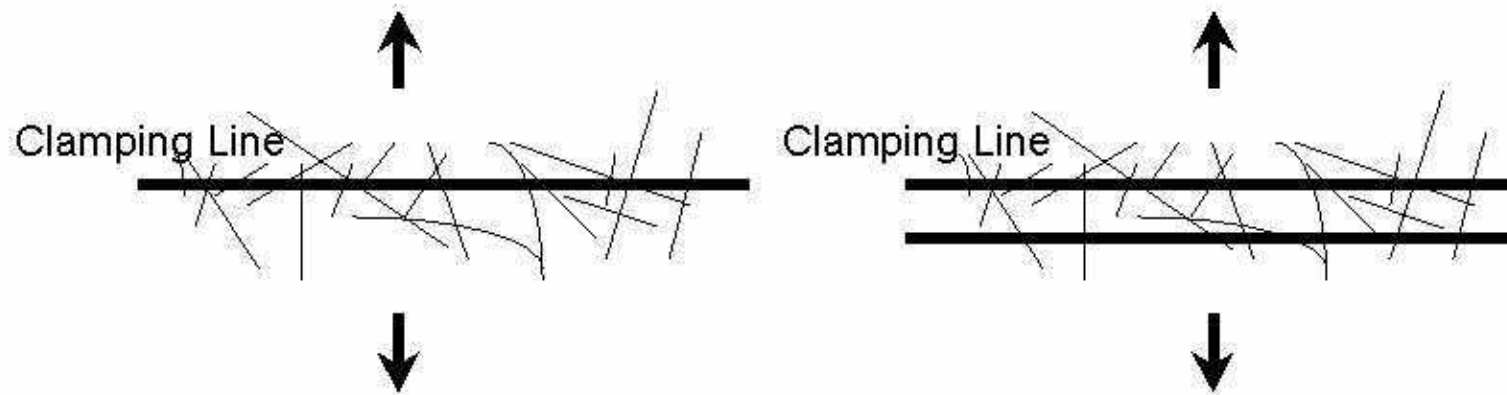
= Avg. of Wet Zero Spans

$\frac{\text{Actual Basis Weight}}{\text{Target Basis Weight}}$



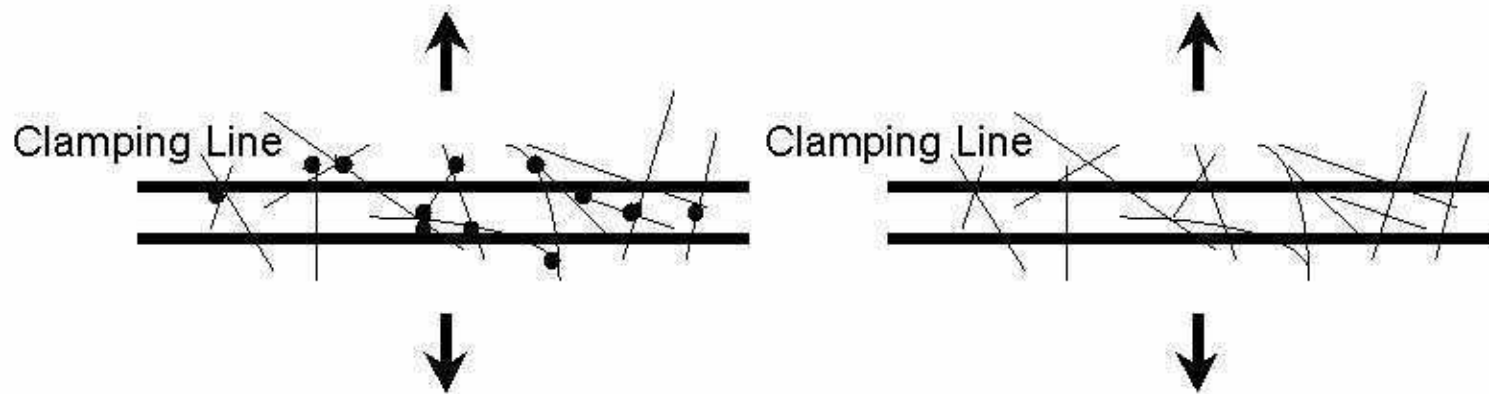
L Number

$$= \frac{\text{Avg. of Wet Short Spans}}{\text{Avg. of Wet Zero Spans}}$$



B Number

$$= \frac{\text{Avg. of Dry Short Spans}}{\text{Avg. of Wet Short Spans}}$$



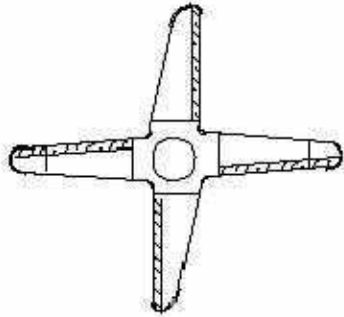
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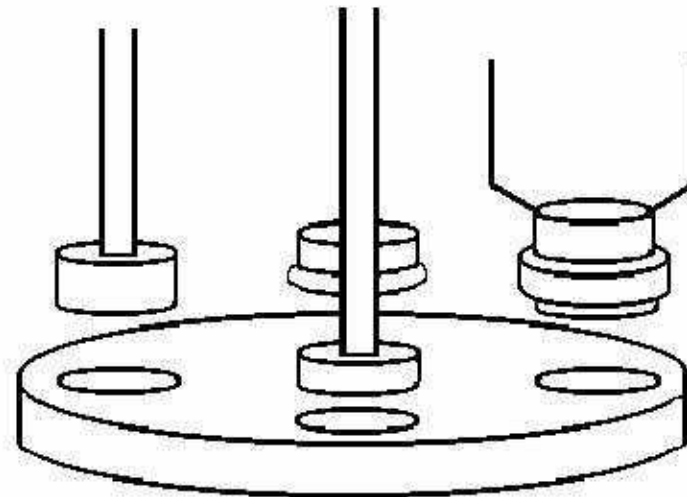


Z-Span Strength Testing System

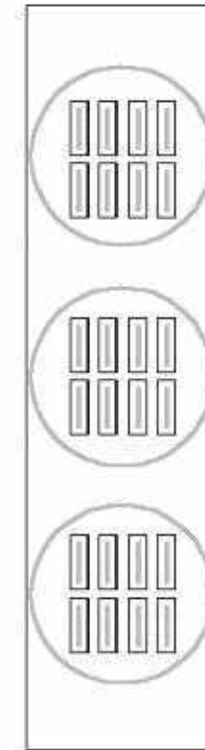
(Sheet former & Tester Movie)



“Blending”




“Sheet Forming”



“Testing”



Rapid and Repeatable

- **less than 1/2 hour to run a test**
 - **5 Tests per Hour**
 - **Coefficient of Variation of less than 2.5% among shift testers**
 - **72-100 Tests every 24 hours**
- 

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Sample Description (Bleaching sequence and Beating)

O-D-Eo-D	#1- Unbeaten	#2-PFI to ~ 400 CSF
O-D/C-Eo-D (DC=75:25)	#3- Unbeaten	#4-PFI to ~ 400 CSF
O-D/C-Eo-D (DC=50:50)	#5- Unbeaten	#6-PFI to ~ 400 CSF
O-C-Eo-D	#7- Unbeaten	#8-PFI to ~ 400 CSF
O-A-Z-Eop-D1-D2	#9- Unbeaten	#10-PFI to ~ 400 CSF
O-A-Z-Q-P	#11-Unbeaten	#12-PFI to ~ 400 CSF
O-A-Z-Xq-P	#13-Unbeaten	#14-PFI to ~ 400 CSF

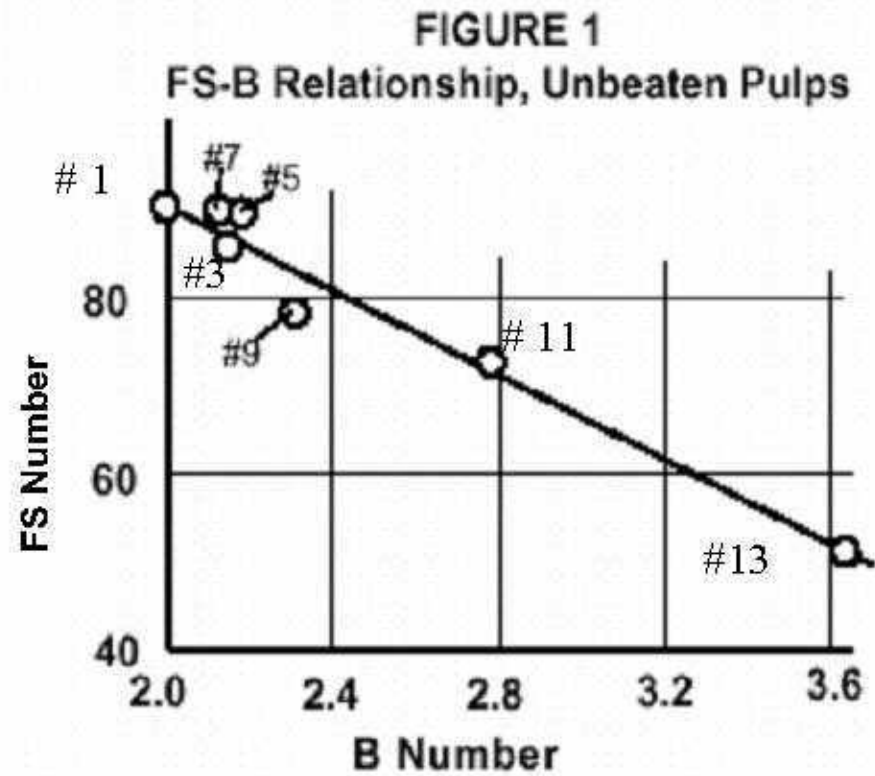
Data

Sample	<u>Pulmac Z-2 Data</u>			<u>Physical Data</u>					TAPPI	PFI	Air	OPA-
	<u>FS</u>	<u>L</u>	<u>B</u>	<u>CSF</u>	<u>Bulk</u>	<u>Tens.</u>	<u>Burst</u>	<u>Tear</u>	<u>Visc.</u>	<u>Revs</u>	<u>Res.</u>	<u>city</u>
#1*	90.5	0.37	2.01	572	2.07	35.8	1.5	7.4	16.2	0	0.8	80.8
#2	88.0	0.32	3.25	405	1.47	94.4	6.0	12.2	16.2	2500	12.7	73.7
#3	85.5	0.35	2.17	563	2.12	36.0	1.4	6.4	15.5	0	0.8	81.3
#4	86.5	0.29	3.62	424	1.55	87.1	6.2	12.0	15.5	1800	10.7	75.5
#5	89.3	0.35	2.19	582	2.09	35.5	1.4	7.0	14.1	0	0.8	80.5
#6	88.9	0.29	3.47	405	1.51	92.0	6.4	13.3	14.1	1850	21.6	74.8
#7	89.4	0.36	2.13	572	2.08	36.1	1.6	7.2	14.3	0	0.9	80.1
#8	83.3	0.30	3.56	396	1.49	89.1	6.3	12.3	14.3	1900	24.2	74.8
#9	78.9	0.34	2.31	544	2.06	38.8	1.6	6.9	11.2	0	1.0	80.2
#10	80.8	0.29	3.76	396	1.47	93.7	6.7	11.9	11.2	1950	24.4	74.1
#11	72.1	0.34	2.79	544	2.04	41.2	1.8	8.0	8.7	0	1.0	80.4
#12	68.2	0.32	4.06	424	1.54	87.4	6.1	10.8	8.7	1350	11.6	75.8
#13	51.9	0.34	3.63	526	1.92	44.7	2.0	7.5	8.0	0	1.6	80.3
#14	47.9	0.29	5.47	405	1.46	88.3	5.6	8.7	8.0	1300	25.6	75.6

Unbeaten

Sample	FS	L	B
#1*	90.5	0.37	2.01
#7	89.4	0.36	2.13
#5	89.3	0.35	2.19
#3	85.5	0.35	2.17
#9	78.9	0.34	2.31
#11	72.1	0.34	2.79
#13	51.9	0.34	3.63

FS vs B Number

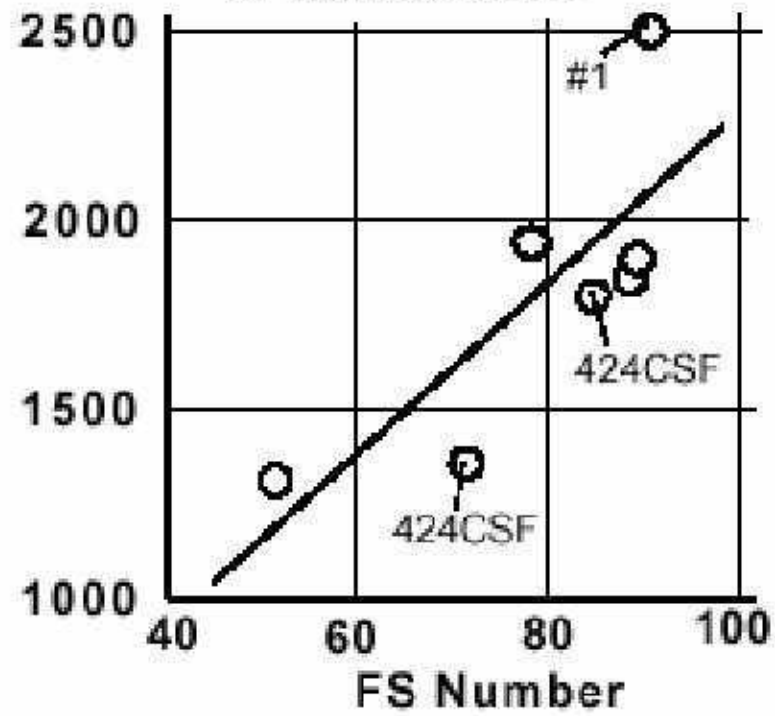


Lab Refining Data

Sample	FS	L	B	CSF	Revs	Burst	Tensile	Tear	Bulk	Air Res.	Opacity
#1,2	90.5	0.37	2.01	405	2500	6.0	94.4	12.2	1.47	12.7	73.7
#7,8	89.4	0.36	2.13	396	1900	6.3	89.1	12.3	1.49	24.2	74.8
#5,6	89.3	0.35	2.19	405	1850	6.4	92.0	13.3	1.51	21.6	74.8
#3,4	85.5	0.35	2.17	424	1800	6.2	87.1	12.0	1.55	10.7	75.5
#9,10	78.9	0.34	2.31	396	1950	6.7	93.7	11.9	1.47	24.4	74.1
#11,12	72.1	0.34	2.79	424	1350	6.1	87.4	10.8	1.54	11.6	75.8
#13,14	51.9	0.34	3.63	405	1300	5.6	88.3	8.7	1.46	25.6	75.6

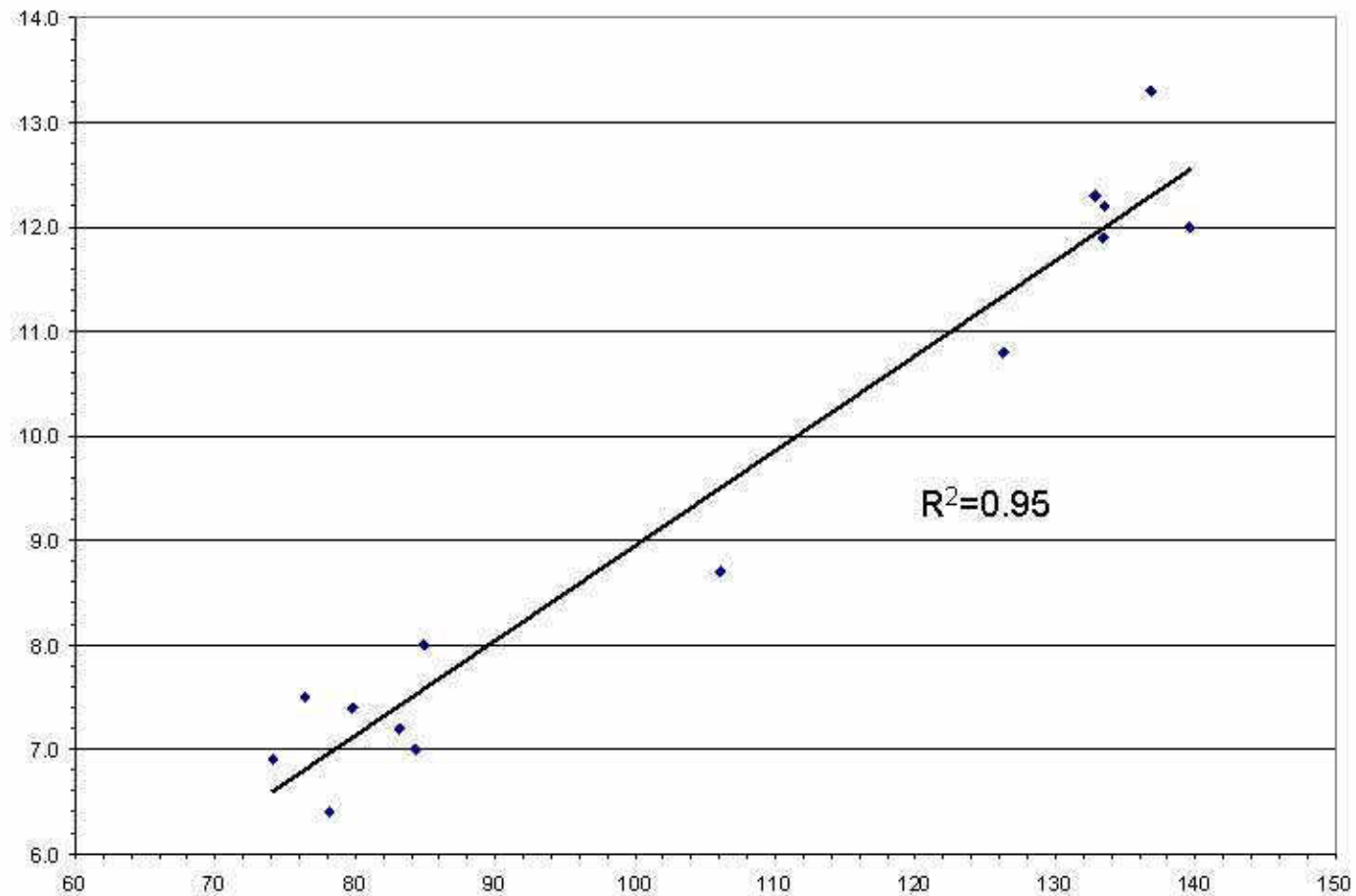
FS vs Energy

FIGURE 2
FS correlation with PFI Revs
to Constant CSF



Multiple regression relationship between Z-Span Strength numbers and Tear

$$\left(\frac{FS^{1.45} * L^{0.84} * B^{1.41}}{111} \right)$$



Conclusion

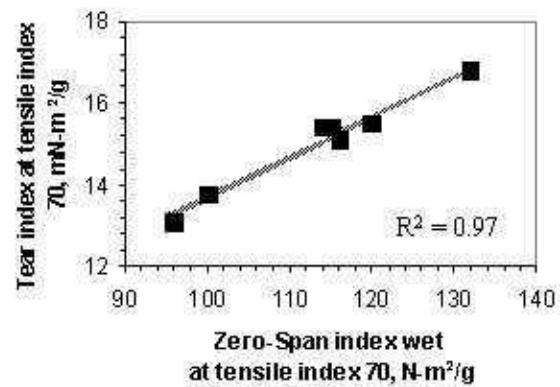
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- **Z-Span Strength Numbers are Generated Rapidly and Repeatably**
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Troubleshooting Pulp Mill Operation
for Papermaking Quality.**



A Comparison of re-wet to dry zero span tensile strength

Re-wet zero-span vs Tear @ contant tensile



Dry zero-span vs Tear @ contant tensile

