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Archive of SID

CMP

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Archive of SID

CMT

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Statistical Data Mining

Jones

Load

Schweiger

Concora Medium Test

First-principals Modeling

- online

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SCA

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( )  
(on line)

TBKSA

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pH

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Tambour

Draw

Base Line Flow

Nordstrom

Off line

Winchell

Crofton

Retention Aids

Wet end instability

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Gyaneshwar

VieiraKlabin

Zhang

rosin

Grage

Munksund

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CMP

SPSS EXCEL

CMP

- Stock Preparation

Chemi Mechanical Pulping

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(Matlab)

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Collinearity

Variance Inflation Factor

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	/	/	/	/	-	pH (pulp in CMP tower)	CMP pH
	/		/	/	%	Cons.	CMP
	/				ml	C.S.F.	CMP
	/	/	/	/	gr/l	Total Na <sup>+</sup>	CMP
	/	/	/	/	%	Shive	CMP
	/	/	/	/	%	Yield	CMP
	/	/	/	/	%	Mesh28	CMP
	/	/		/	%	Mesh48	CMP
	/	/	/	/	%	Mesh100	CMP
	/	/	/	/	%	Fine	CMP
	/	/	/	/	km	Break.L. H. (hand sheet test)	
	/				mN	Tear H.	
	/				kPa	Burst H.	
	/	/	/	/	%	Bright. H.	
	/	/	/	/	%	Yellow. H.	
	/	/	/		%	Opacity H.	
	/	/	/	/	%	Cons. CMP ref.	
	/				%	Val. CMP ref.	CMP
	/				°C	T. CMP ref.	CMP
	/				kW/h	Load CMP ref.	CMP
	/	/	/		%	Cons. BKP ref.	

					kW/h	load BKP ref.	
	/				%	Val. BKP ref.	
	/				%	T. BKP ref.	
	/				%	CMP ratio	CMP
	/				%	BKP ratio	
					%	Broke ratio	
	/				%	Clay ratio	
	/	/	/		%	Dye ratio	
	/	/			L/min	Ret. Aid	
	/	/	/	/	%	Blend cons.	
	/	/	/	/	%	Machine cons.	
	/	/	/	/	%	Broke cons.	
	/				%	Stock Valve	
					L/min	Fan p. ADD	
					r/min	RPM f. p.1	
					%	Out. f. p.1	
	/	/	/	/	bar	G2	
	/	/	/	/	bar	G3	
	/	/	/	/	bar	G4	
	/				°C	T. deculator	
					mm	L. deculator	
	/	/	/	/	bar	PD deculator	

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					mbar	Vac. deculator	
					r/min	RPM f. p. 2	
	/				%	Out. f. p. 2	
	/		/	/	-	pH screen	pH
	/	/	/		bar	No.1 PD screen	
	/				r/min	RPM sa.	
	/		/		%	W.W. ch. Valve	
	/				%	Saveall d.r.	
					L/min	Stock sa.	
	/				L/min	W.W. sa.	
	/	/	/	/	%	Recovery co. sa.	
	/	/		/	%	Pre. Ref. Cons.	
					ml	Pre Ref. CSF	
	/	/		/	%	After Ref. Cons.	
					ml	After Ref. CSF	
	/	/	/	/	%	Level B. Cons.	
	/				ml	Level B. CSF	
	/	/	/		-	Head. pH	pH
	/	/	/	/	%	Head . Cons.	
	/				ml	Head. CSF	
	/	/	/	/	%	W.W Cons.	
	/				%	First pass ret.	



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	/	/	/	/	%	Long Fi. Cons.	
	/				ml	Long Fi. CSF	
	/	/	/	/	bar	Air P. H.	
					mm	Head. level	
		/	/	/	mm	Slice Open H.	
	/				m/min	Speed Wire	
	/	/	/		m/min	Rush/Drug	
	/				kPa	Burst	
	/				mN	Tear MD	
	/				mN	Tear CD	

G3

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$$\text{Burst} = 173.810 + 0.961 \text{ Mesh48} + 0.320 \text{ Burst H.} + 2.152 \text{ Cons.} - 1.688 \text{ Opacity H.}$$

$$R^2 = 0.475 \quad \text{Adjusted } R^2 = 0.47$$

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$$\text{Burst} = .241 \text{ Mesh48} + .212 \text{ Burst H.} + .187 \text{ Cons.} - .180 \text{ Opacity H.} + .126 \text{ Mesh100} - .100 \text{ pH} - .089 \text{ Yield} + .137 \text{ Tear H.} - .083 \text{ TotalNA}^+$$

$$R^2 = 0.52 \quad \text{Adjusted } R^2 = 0.50$$

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G3

(G3)

pH

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G1

G3

G2

Burst					
	Mesh 48				
		Tear H.			
			Burst H.		
				Break.L. H.	
					Opacity H.

Burst					
	G3				
		Out f.p. 2			
			Saveall d.r.		
				Stock sa.	
					Ref.Aid

Burst				
		Rush/ Drug		
			Slice Open H.	
				Head. level
				Air P. H.

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Burst= 135.515 -188.566 G3 -0.393 Clay + 147.622 G3<sup>2</sup> + 3.954 Cons.BKP ref. + 41.466  
pHScreen -1.167 Out.f.p.2 + 1.987 StokValve  
R<sup>2</sup>= 0.60 Adjusted R<sup>2</sup> = 0.59

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Burst= -0.553 G3 -0.241 Clay -0.156 Stok sa. + 0.082 Cons.BKP ref.+ 0.379 pH Screen  
-.491 Out.f.p.2 -.102 T.BKP ref. -.171 RPM sa. + 0.086 load CMP ref.  
R<sup>2</sup>= 0.60 Adjusted R<sup>2</sup> = 0.59

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Burst = 168.9 - 221 G3 + 163 G3<sup>2</sup>  
R<sup>2</sup>= 0.42 Adjusted R<sup>2</sup> = 0.419

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G3= 0.191 LoadBKPref. + 0.425 Outf.p.2 -0.160 WWch.Valve -0.247 T.deculator  
-0.234 RPM sa. -0.119 Val. BKP ref. -0.164 StokValve 0.108 Saveall d.r.  
R<sup>2</sup>= 0.865 Adjusted R<sup>2</sup> = 0.864

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Burst = 12.700 + 0.206 Out.f.p.2 + 5.623 pH Screen + 0.380 StokValve + 0.054 Saveall d.r.  
+ 0.079 Stock sa. + 0.064 Clay + 0.020 RPM f.p.2 + 0.480 WWch.Valve  
+ 0.399 Ret.Aid + 0.863 pH Screen + 0.015 Brok ratio  
R<sup>2</sup>= 0.60 Adjusted R<sup>2</sup> = 0.59

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Burst = 181.8 -1.69 Rush/Drug -3.49 SliceOpenH. -51.683 AirP.H.  
Burst = -0.475 Rush/Drug - 0.259 SliceOpenH. - 0.206 AirP.H.  
R<sup>2</sup>= 0.461 Adjusted R<sup>2</sup> = 0.459

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Burst= 400.396 -0.724 Fine -3.686 pH Screen -0.048 loadCMPref. -0.585 Rush/Drug  
-0.064 Long.Fi.CSF -0.075 AfterRef.CSF -17.206 LevelB.Cons. -0.373 Saveall d.r.  
-3.256 SliceOpen.H. -36.191 Head.Cons.  
 $R^2 = 0.75$  Adjusted  $R^2 = 0.71$

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Burst= -0.254 Fine -0.200 pH Screen -0.324 loadCMPref. -0.195 Rush/Drug -0.151 Long.Fi.CSF-  
0.157 AfterRef.CSF -0.173 LevelB.Cons. -0.200 Saveall d.r. -0.287 SliceOpen.H.  
-0.190 Head.Cons.  
 $R^2 = 0.75$  Adjusted  $R^2 = 0.71$

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/	CMP	pH	/
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Tear MD = -0.126 Ret.Aid -0.519 Saveall d.r. + 0.326 Cons.CMPref. -0.310 Clay  
-0.213 RecoveryCon.Sa. -0.129 Broke  
 $R^2 = 0.46$  Adjusted  $R^2 = 0.45$

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Tear MD= -0.363 AirPre.H. -0.365 burst + 0.291 StokValve + 0.306 totalNA<sup>+</sup> -0.743 Ret.Aid  
-0.228 W.W. sa. + 0.383 SliceOpenH. -0.247 Fine + 0.152 Head. pH  
 $R^2 = 0.63$  Adjusted  $R^2 = 0.59$

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Tear CD= -0.491 Saveall d.r. -0.343 Recovery co. sa. -0.389 Clay + 0.158 BlendCons.  
-0.104 Stok sa. -0.081 Broke ratio  
 $R^2 = 0.45$  Adjusted  $R^2 = 0.44$

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Tear CD= -.478 Saveall d.r. -.342 Recovery co. sa. -.346 Clay + .159 BlendCons.  
-.096 Stok sa. -.126 Broke ratio + .151 pH Screen -.128 Dye ratio  
+ .138 T.deculator  
 $R^2 = .472$  Adjusted  $R^2 = .467$

: CMP

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CMP

(G3)

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## Development of statistical models for predicting burst and tear strengths of newsprint in MWPI

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### Abstract

Paper production lines have got many process variables and wide variety of operations. The overall objective in pulp and paper mills is to meet the specified quality and production targets while minimizing operation costs. Today in order to accurate, cheap and fast control of production lines, different kinds of models are being developed. Using real data of CMP tower, stock preparation, and paper machine wet-end variables of MWPI (Mazandaran Wood and Paper Industries) recorded during 2005 and part of 2006, four data set containing 72 process variables corresponding to the newsprint burst and tear strengths were prepared. The most influential variables and statistical predictive models for newsprint burst and tear strengths were generated using correlation and multiple regression. Several suitable models were developed to predict and control newsprint burst strength. The most influential variables to the burst strength were the amount of fibers remained on the 48mesh screens, stock pressure in the third group cleaners, output of second fan pump, save-all drainage rate, rush and drug ratio and head box slice opening degree. Process variables showed low correlation to the tear strength and few models were developed. Flow of retention aids, save-all drainage rate and clay ratio were the most effective variables to the newsprint tear strength.

**Keywords:** Pulp, Statistical models, Tear strength, Burst strength, Newsprint, Correlation, Multiple regression

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