National Institute of Standards & Technology

Report of Investigation

Reference Materials

8495-Northern Softwood Bleached Kraft Pulp

8496-Eucalyptus Hardwood Bleached Kraft Pulp

These Reference Materials (RMs) are intended primarily for use in fundamental studies on the properties of fibers and paper sheets. The RMs provide samples so that investigators in different laboratories can be assured that they are investigating the same materials. The materials selected for these two RMs are bleached dried lap pulp each from a single lot of a standard commercial production run. Each RM package consists of ten standard lap sheets. Each sheet weighs approximately one pound bone dry. The ten sheets are hermetically-sealed in a film foil barrier bag and packaged in a 200 pound C flute carton with dust flaps. The carton is "H" taped to eliminate dust and light penetration. Each carton of ten sheets weighs approximately five kilograms. The materials were selected for the two RMs because of their differing fiber size, differing papermaking properties, and similarity to commercially available materials.

RMs 8495 and 8496 were developed and prepared with input and support from the Pulp Material Research Committee (PMRC), a sub-committee of the Fundamental Research Committee.

The two RM pulps were donated by Aracruz Celulose S.A. and The Procter and Gamble Cellulose Company. It is anticipated that there will be sufficient quantity of the RMs to supply the needs of the research community for at least ten years. In order to ensure this intent, it is requested that users exercise discretion in ordering and consuming these materials. Please keep in mind that the RMs are intended for use in fundamental properties measurements and not for use in calibration of beaters, refiners, physical test equipment, and the like.

At this time no extensive property measurements have been made on these materials beyond ensuring that they were within the control limits of the normal production run. A measurement error study is in progress with participation by international paper technical laboratories. As results become available, they will be published and added to this report. The attached tables list the currently available test results reported by Aracruz and Procter and Gamble Cellulose.

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Approximate Composition & Properties of the RMs

RM	8495	8496
Source of Pulp	The Procter & Gamble Cellulose Company P.O. Box 8407, Memphis, Tennessee 38108 USA	Aracruz Celulose S.A. Rua Lauro Muller 116-40th Floor RJ 22290 Rio De Janerio, Brazil
Site of Manufacture	Grande Prairie Pulp Mill, Alberta, Canada	Aracruz Pulp Mill-Espirito Santo, Brazil
Trade Name	Grande Prairie Softwood Kraft Pulp	Aracruz Eucalyptus Hardwood Kraft Pulp
Synonyms and Description	Bleached Northern Softwood Kraft Pulp	Bleached Eucalyptus Sulphate Pulp
CAS NO.	65996-61-4	65996-61-4

RM 8495 NORTHERN SOFTWOOD BLEACHED KRAFT PULP

PULP CHARACTERISTICS-

LAP SHEET	
Dryness, %	91
Ream Weight, g/m^2	355
Thickness, mm	0.937
Density, kg/m^3	718
Brightness, % ISO	90.2
Brightness Reversion, %	90.2
Dirts, Large/Small	3 / 20

HANDSHEET	
Brightness, % ISO	
Reversion	
Color CIE, L	
a	
b	
Color HUNTER, L	
a	
b	

FIBER ANALYSIS	
Species	68% White Spruce 32% Lodgepole Pine Trace of Balsam Fir
Length - weighed average, mm (Kajaani FS100)	
Coarseness, mg/100m	
Fibers per gram (x 10^6)	

FINES	
Britt jar, %	
Through 200 mesh, %	
CLARK CLASSIFICATION	
% Retained on 8 Mesh	0
14 Mesh	38.2
30 Mesh	68.2
100 Mesh	95.8
Through 100 Mesh	4.2

RM 8495 NORTHERN SOFTWOOD BLEACHED KRAFT PULP

PULP CHARACTERISTICS - Continued

CHEMICAL ANALYSIS		
pH		6.85
Electrolytic Conductivity, μS/cm		
Viscosity, cps		21.43
Pentosans, %		7.03
Alpha Cellulose, %		87.33
Beta Cellulose, %		2.64
Gamma Cellulose, %		10.03
Extractives, % DCM		0.12
Ash, mg/kg		.15
Silica, mg/kg		187
Carboxyl, meq/kg		31.6
Trace metals, mg/kg		
	Fe	3.4
	Na	
	Al	
	Ca	175.9
	Mg	
	Cu	

REFINER CURVE FOR RM 8495 NORTHERN SOFTWOOD BLEACHED KRAFT PULP PFI BEATING CURVE - TAPPI STANDARD

Water source = Memphis City Tap Water

Revolutions	0	2500	5000	7500	10000
Schopper-Riegler, SR					
Dynamic drainage, seconds					
Water Retention Value, %					
Freeness - CSF, ml	681	579	440	330	244
Apparent density, kg/m3	568	731	777	793	806
Bulk, cm3/kg					
Air resistance - Gurley, s/100ml	1.7	19.0	90.3	171.0	309.8
Light scattering, m^2/kg					
Roughness - Bendtsen, ml/min					
-Parker (810), μm					
-Parker (820), μm					
Tensile Index, Nm/g	32.6	103.4	115.2	119.0	123.0
T.E.A., J/g					
Burst, $kPam^2/kg$	1.9	8.4	9.6	9.7	9.9
Scott bond, Nm/g					
Tear, Nm^2/kg	22.9	11.0	9.7	9.0	8.9
In Plane Tear Resistance					
Stiffness, (L&W)					
Stiffness, (Taber)					
Elongation, %					
Capillarity Klemm, mm/10 min	158.8	95.3	63.5	47.7	31.7
Opacity, %	78.7	67.2	63.1	62.1	60.2
Zero Span Tensile, Nm/g					

RM 8496 EUCALYPTUS HARDWOOD BLEACHED KRAFT PULP

PULP CHARACTERISTICS

LAP SHEET

Dryness, %	91
Brightness, % ISO	90.8
Dirts, mm^2/kg	0.68
Viscosity, dm^3/kg	818

HANDSHEET

Brightness, % ISO	91.6
Reversion	0.449
Color CIE, L	98.06
a	0.078
b	2.59
Color HUNTER, L	97.71
a	-0.33
b	2.91

FIBER ANALYSIS

Species	>90% Eucalyptus Grandis Natural Hybrids
Length - weighted average, mm (Kajaani FS100)	0.65
Coarseness, mg/100m	9.5
Fibers per gram (x 10^6)	19.42

FINES

Britt jar, %	7.5
Through 200 mesh, %	>10

CHEMICAL ANALYSIS

pH		5.5
Electrolytic conductivity, $\mu S/cm$		13.8
Pentosans, %		16.7
Extractives, % DCM		0.16
Ash, mg/kg		1244
Silica, mg/kg		18.7
Trace metals, mg/kg		
	Fe	2.24
	Na	395.7
	Al	1.4
	Ca	56.7
	Mg	66.8
	Cu	0.09

REFINER CURVE FOR RM 8496 EUCALYPTUS HARDWOOD BLEACHED KRAFT PULP
PFI BEATING CURVE - SCAN STD

Water source = Distilled (ISO standard)

Revolutions	0	500	1500	3000	5000
Schopper-Riegler, SR	27.5	32.0	37.0	47.5	66.5
Dynamic drainage, seconds	7.2	8.2	9.7	15.5	38.3
Water Retention Value, %	153	158	174	204	219
Freeness - CSF, ml	392	348	307	233	145
Apparent density, kg/m^3	538	592	647	703	753
Bulk, cm^3/kg	1.86	1.69	1.54	1.42	1.33
Air resistance - Gurley, s/100ml	2.1	3.8	8.0	21.1	87.0
Light scattering, m^2/kg	43.7	39.4	35.1	31.4	27.7
Roughness - Bendtsen, ml/min	209	155	118	96	58
-Parker (810), μm	5.6			4.2	
-Parker (820), μm	5.2			3.9	
Tensile Index, Nm/g	27.9	44.8	61.2	77.0	86.6
T.E.A., J/g	0.41	0.90	1.46	2.11	2.53
Burst, $kPam^2/kg$	1.5	2.5	3.7	5.1	6.5
Scott bond, Nm/g	1.6		5.1	7.4	
Tear, Nm^2/kg	4.3	6.5	8.3	9.1	9.3
In Plane Tear Resistance	4	15	84	216	1030
Stiffness, (L&W)	13.0		13.1	12.6	
Stiffness, (Taber)					
Elongation, %	2.0	2.8	3.4	4.0	4.4
Capillarity Klemm, mm/10 min	9.2		5.1	4.6	
Zero Span Tensile, Nm/g	119		129	132	

REFINER CURVE FOR RM 8496 EUCALYPTUS HARDWOOD BLEACHED KRAFT PULP
PILOT PLANT REFINER

Water Source = mill tap water

Energy input, kWh/t	0	10	20	30	40	50	60	70
Schopper-Riegler, ° SR	23.1	26.1	29.0	31.7	34.2	36.7	39.0	41.1
Dynamic drainage, seconds	6.6	6.8	7.3	8.2	9.5	11.1	13.0	15.4
Water Retention Value, %	153	158	164	169	174	179	184	190
Freeness - CSF, ml								
Apparent density, kg/m^3	527	545	562	578	592	606	618	628
Bulk, cm^3/kg	1.90	1.83	1.77	1.73	1.68	1.65	1.61	1.59
Air resistance - Gurley, s/100 ml	1.6	1.9	2.6	3.8	5.5	7.6	10.3	13.4
Light scattering, m^2/kg	44.4	43.1	42.0	41.1	40.3	39.6	39.1	39.7
Roughness - Bendtsen, ml/min	250	216	186	162	142	128	118	114
- Parker (810), um								
- Parker (820), um								
Tensile Index, Nm/g	24.7	29.1	33.2	37.1	40.8	44.2	47.4	50.3
T.E.A., J/g	0.362	0.496	0.629	0.763	0.896	1.030	1.163	1.296
Burst, kPam^2/kg								
Scott bond, Nm/g								
Tear, Nm^2/kg	4.6	5.2	5.8	6.3	6.7	7.1	7.3	7.5
In Plane Tear Resistance								
Stiffness, (L&W)								
Stiffness, (Taber)								
Elongation, %	1.9	2.2	2.6	2.8	3.1	3.3	3.4	3.5
Capillarity Klemm, mm/10min								
Zero Span Tensile, Nm/g								

REFINER OPERATING CONDITIONS

Refiner plates	
Knife width, mm	3
Grove width, mm	3
Bar angle, degrees	5
Speed, rpm	1200
Pulp Consistency, %	5
Inlet Pressure, kPa	70
No-Load Power, kW	
Specific Edge Load, Ws/m	0.5