

A photograph of a stack of papers. The top sheet is stained with a large, irregular yellowish-brown mark. The text 'Basic Pulp' and 'Properties' is overlaid on the image.

Basic Pulp

Properties

Pulp Consistency

$$\frac{\text{Oven-dry weight of pulp} \times 100}{\text{Weight of pulp} + \text{water}}$$

Oven dry at 105°C

Oven dry (od) or bone dry (bd) = 100% consistency

Air dry = 92% consistency

High consistency = 20-40%

Medium consistency = 8-12%

Low consistency = 1-4%

Pulp Consistency

Gravity thickeners – 6-8% consistency

Vacuum washers, thickeners – 10-15% consistency

Presses – 20-40% consistency

Bleach plants – 10-12% consistency

Screening – 2-4%

Refining – 2-4%

Centrifugal cleaners – 0.3-0.5%

Paper machine headboxes – 0.2-0.5%

Pulp Freeness

Measures drainability of a pulp suspension

Canadian Standard Freeness – CSF (N. America)

Schopper-Riegler – SR (Europe)

CSF – higher numbers mean faster draining

SR – higher numbers mean slower draining

CSF developed as a measure of groundwood quality

CSF decreases with refining

CSF sensitive to fines and water quality

Water 860-890 CSF

Unrefined SW – 760-700 CSF

Unrefined HW – 600-500 CSF

Pulp Freeness

Measuring CSF

3 od. g in 1 L total volume. 0.3% consistency

Use deionized water for consistent measurement

20°C

Measure volume of excess water from overflow

Correction factors if weight \neq 3 g and temp. \neq 20°C

Pulp Refining

Refining physically modifies fibers to fibrillate and make more flexible – better bonding.

Refining increases tensile and burst strength but can decrease tear strength.

Consists of a series bars which provide a brushing and compressive action on fibers.

Laboratory refining done with Valley Beater or PFI mill.

Lab refining is an ideal low-intensity, homogeneous treatment and does not represent mill refiners.

Beater or refining curve – Refine a series of samples (4-5) to different levels and measure CSF, make handsheets, and determine strength properties as a function of the degree of refining.

Pulp Refining

Valley Beater – 360 od g in 23 L volume = 1.57% consistency

Remove samples at specified times of refining.

PFI mill – 24 od g in 240 g total weight = 10% consistency

Refine according to number of revolutions of PFI mill.

Separate sample required for each degree of refining.

Pulp Handsheets

Used for testing of pulp quality.

TAPPI standard handsheets = 60 od g/m² (1.2 od g)

Make sheets in handsheet mold with 1.2 od g pulp.

Couch sheets off mold with blotter paper.

Cover one side with polished chrome plate.

Put in handsheet press and press twice at 50 psig.

Ist time 5 minutes, 2nd time 2 minutes.

Place pressed sheets on plates in drying rings in conditioned lab.

Sheets must be air dried in conditioned lab for strength testing.

Pulp Handsheets

Typical handsheet testing

Basis weight

Caliper (thickness)

Tear strength

Tensile strength

Burst strength

Folding endurance

Pulp Kappa No.

Volume (ml) of 0.1N potassium permanganate consumed by 1 od g pulp.

Estimate of lignin content.

Kappa no. $\times 0.15 \cong$ % lignin

SW Linerboard pulp = 80-110 kappa

SW Sack kraft pulp = 50-70 kappa

SW Bleachable grade pulp = 20-30 kappa

HW Linerboard grade = 18-25 kappa

HW Bleachable grade = 10-18 kappa

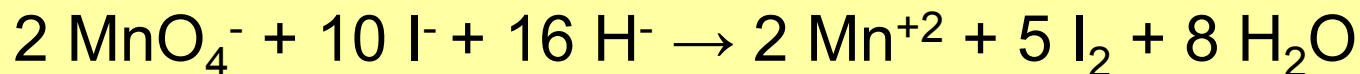
Pulp Kappa No.

Fixed amount of permanganate added to known weight of pulp at acid pH and reacted for 10 minutes.

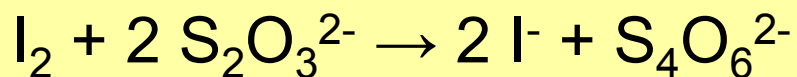
Permanganate oxidizes aromatic structures.

In HW pulps, permanganate also reacts with hexeneuronic acids which may contribute 15-30% of kappa no.

Potassium iodide, KI, added to react with remaining permanganate.



Liberated iodine is titrated with standard thiosulfate.



Older methods - permanganate or K#

Pulp Kappa No.

Air-dry pad of pulp. Determine consistency.

Weight of pulp that will consume 50% of permanganate.

100 ml 0.020 KMnO_4

100 ml 4 N H_2SO_4

800 ml H_2O

Mix 10 minutes

Temp. 25°C

20 ml 1 N KI

Titrate with 0.200 N $\text{Na}_2\text{S}_2\text{O}_3$

Starch indicator to see endpoint

Correction factors for 50% consumption and temperature

Blank with same procedure except pulp

Pulp Viscosity

Indirect measure of degree of polymerization of cellulose chains in fibers.

Indicates degree of chemical damage to fibers.

Dissolve pulp sample in fixed amount of cellulose solvent.

Measure viscosity by time of flow through capillary viscometer.

Longer polymer chains mean thicker solution and higher viscosity. Longer flow time.

Pulp Viscosity

TAPPI CED Viscosity

0.250 od g pulp dissolved in 25.00 ml H₂O and 25.00 ml
1.0 M cupriethylenediamine (CED)

CED easily oxidized by air so keep under N₂

Dissolved pulp solution put in capillary viscometer in
25.0°C water bath.

Time solution flow between marks on viscometer.

Viscosity (centipoise) = 1.052 x viscometer constant x
efflux time(seconds)