Kraft Pulp Strength vs. Kappa Number and Pulp Viscosity

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The tear-tensile strength of softwood kraft pulps is essentially constant in the kappa number range 20-35. At higher kappas, the amount of residual lignin still in the pulp impairs the bonding of fibres in the sheet, lowering the paper’s overall strength. At kappas below ~20, too much chemical damage to cellulose during excessive pulping results in inferior strength.

These are matched sets (grey lines) of pilot-plant and mill-made kraft pulps from one bleachable-grade mill; the pilot-plant pulps were made from the chips being fed to the mill’s digester at each of the kappa targets represented in the graph. Conventional kraft pulping conditions were used; cooking time was varied to reach different kappa numbers.

Mill-made unbleached softwood kraft pulps are usually ~20-25% weaker than their corresponding pilot-plant reference pulps from the same chips, regardless of kappa number. This mill has particularly good tear-tensile strength delivery to brownstock (~85%).
Here, pulp viscosity is substituted for kappa number for the same pulps shown on Page 2. Because kappa and viscosity are linearly related over most of this range (see Page 4), tear-tensile strength against viscosity is comparable to tear-tensile strength against kappa.
Across the kappa range 25-50, the kappa-viscosity relationship was linear, with a slope slightly greater than one.

When excessive cooking to kappas below 20-25 is done, the selectivity for delignification is progressively impaired (i.e., the ratio of viscosity over kappa number decreases) -- pulp viscosity declines as cellulose is damaged chemically.
This graph simply adds more pairs of corresponding pilot-plant and mill-made pulps to the picture on Page 2 – the two curves are unchanged.
For more information, please contact:

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