

Newsprint from blends of kenaf CTMP and deinked recycled newsprint

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ABSTRACT: *Trials on a pilot-plant paper machine were carried out to determine the suitability of using kenaf chemithermomechanical pulp (CTMP) as a reinforcement pulp in newsprint furnishes containing deinked recycled newsprint. Data indicate that an acceptable newsprint can be produced using a blend of 25% kenaf CTMP and 75% deinked recycled newsprint. These results suggest that kenaf CTMP fiber can be used as a reinforcement pulp instead of expensive semibleached softwood kraft fiber.*

KEYWORDS: *Chemithermomechanical pulps, deinking, kenaf, mechanical properties, mixtures, newsprint, optical properties, reclaimed fibers, recycling.*

Kenaf, *Hibiscus cannabinus*, belongs to the family Malvaceae and is a fast-growing annual plant that grows to heights of 3.7–5.5 m with a diameter of 25–51 mm, depending on planting density. In the past, kenaf was used primarily as a source of coarse textile fibers for the manufacture of twine, carpet backing, burlap, and other related products. In the early 1960s, researchers began to study kenaf as a source of pulp fiber for paper in the United States (1). Since that time, there have been numerous other studies (2–11).

A recent study sponsored by the U.S. Department of Agriculture and Cooperative State Research Service (USDA-CSRS) showed that newsprint could successfully be made from blends

of 95% or 82% kenaf chemithermomechanical pulp (CTMP) and 5% or 18% kraft (12). The work presented here is an extension of that study and was carried out to determine whether kenaf CTMP could be used as a reinforcement pulp for newsprint produced from deinked recycled newsprint.

Newsprint is a large contributor to the growing problem of solid-waste disposal in the United States. Consequently, recycling of newsprint has become a major public concern. Newsprint is presently recycled into some paper products, but its use in the production of newsprint may require the use of a semibleached kraft softwood pulp as a reinforcement pulp. The reinforcement pulp would be needed to increase wet-web strength and final

sheet strength properties, thus improving runnability on the paper machine and on the printing press. The availability of kenaf CTMP as a substitute for expensive semibleached softwood kraft pulp could reduce manufacturing costs in unintegrated mills. However, no one has yet established the level of kenaf CTMP required to achieve the strength and optical properties required for newsprint.

The USDA Forest Service, Forest Products Laboratory (FPL), and the USDA-CSRS undertook a cooperative agreement to study the use of kenaf in recycled newsprint. The objectives were to

- Measure the strength and optical properties of newsprint produced from blends of kenaf CTMP and deinked recycled newsprint and compare these with results obtained for commercial newsprint made from virgin fiber and recycled fiber
- Determine whether kenaf CTMP could be used as a reinforcement pulp to produce an acceptable newsprint of blended kenaf and deinked recycled newsprint
- Recommend the optimum blend for kenaf CTMP and recycled newsprint.

Experimental

Deinked recycled newsprint pulp was obtained from a commercial ONP (old newspaper) deinking operation. Kenaf CTMP was produced at a commercial thermomechanical pulp-producing facility and shipped to the FPL. Raw kenaf was hammer-milled using a 25.4-mm screen and washed prior to refin-

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ing. A plug-screw feeder fed the kenaf to the first refining stage, where 2.6% sodium hydroxide and 3.0% hydrogen peroxide were added. Refining was done in a pressurized double-disc refiner at a steaming pressure of 2.1×10^6 dynes/cm² (2.1×10^5 Pa) with a 1.5-min retention in the horizontal steaming tube. The primary pulp then underwent a second stage of refining in an atmospheric double-disc refiner to a final freeness of 115 mL CSF.

Two commercial newsprints were obtained for testing at the FPL: a Canadian newsprint (75% spruce groundwood/25% semibleached kraft) and a recycled newsprint. Test values for these commercial newsprints served as a benchmark for the test values obtained from the kenaf/recycled newsprint blends produced on our pilot paper machine.

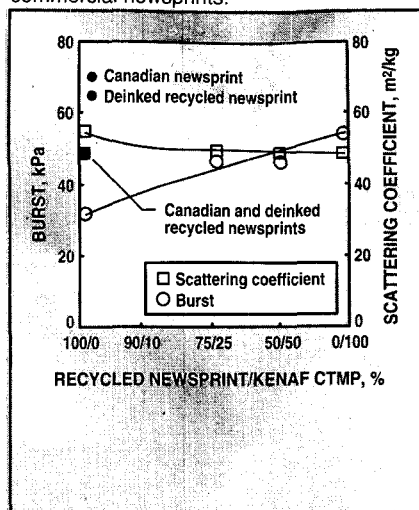
Both machine-made newsprint and handsheets (48.8 g/m²) were made from the following weighted blends:

- 100% deinked recycled pulp (control)
- 90% deinked recycled pulp/10% kenaf CTMP
- 75% deinked recycled pulp/25% kenaf CTMP
- 50% deinked recycled pulp/50% kenaf CTMP
- 100% kenaf CTMP.

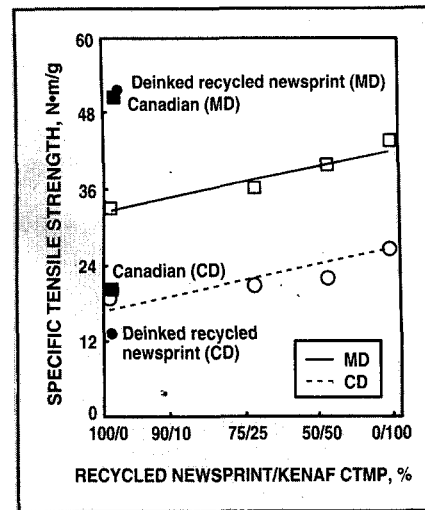
Machine-made newsprint was made on the FPL's pilot fourdrinier paper machine (457 mm wide, 301 mm trim). Continuous 1600-m rolls of newsprint were made of the control newsprint and the newsprint produced from 100% kenaf CTMP. For the three blends, enough newsprint was made for testing purposes. Prior to machine runs of each blend, handsheets were made from furnish obtained from the stock tank.

The machine-made newsprint and handsheets were tested for strength and optical properties and for color reversion.

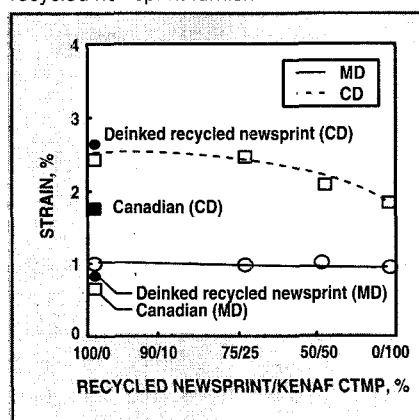
1. Burst strength and scattering coefficient as functions of kenaf content in recycled newsprint furnish. The filled data points in Figs. 1–5 are reference values obtained for two commercial newsprints.



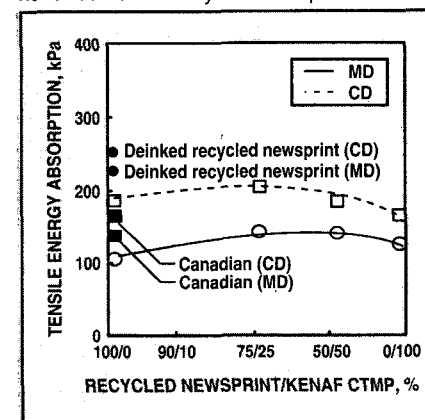
2. Specific tensile strength as a function of kenaf content in recycled newsprint furnish. (MD is machine direction; CD is cross-machine direction.)



3. Strain as a function of kenaf content in recycled newsprint furnish



4. Tensile energy absorption as a function of kenaf content in recycled newsprint furnish



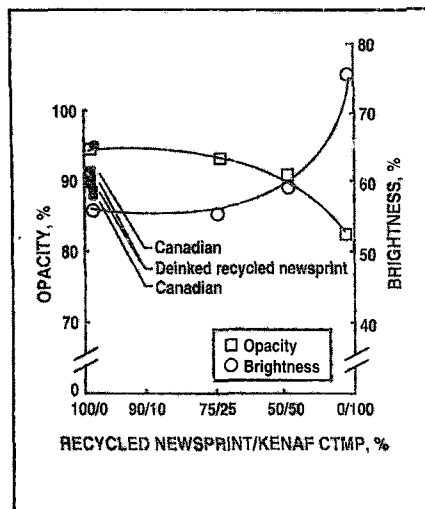
Results and discussion

The effects of adding kenaf CTMP to a deinked recycled newsprint furnish were evaluated both by paper-machine trials and handsheets. In this report, only data from the paper-machine runs are discussed. For reference, handsheet data for newsprint blends are listed in Table I.

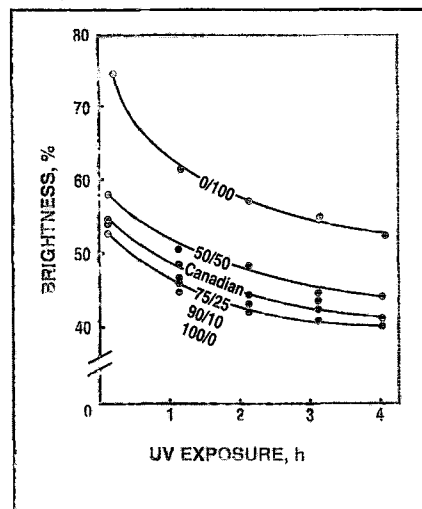
Figure 1 shows that the burst strength of the recycled newsprint blends increased with increasing addition of kenaf CTMP, although burst remained considerably below that of the Canadian newsprint and the commercial recycled newsprint at all levels

of addition. However, the density of the commercial newsprints was considerably higher, which could account for the discrepancy in values. The high wet-press pressures used in commercial newsprint production would be likely to increase the density of the newsprint and thus impart higher burst strength. Density of the 100% kenaf CTMP newsprint was less than that of the 100% recycled newsprint. The lower density of kenaf CTMP could improve the printability of the newsprint and help prevent crepe wrinkles and telescoping of the ends of rolls on the winder (13). Figure 1 also shows a slight improvement in scattering coefficient with

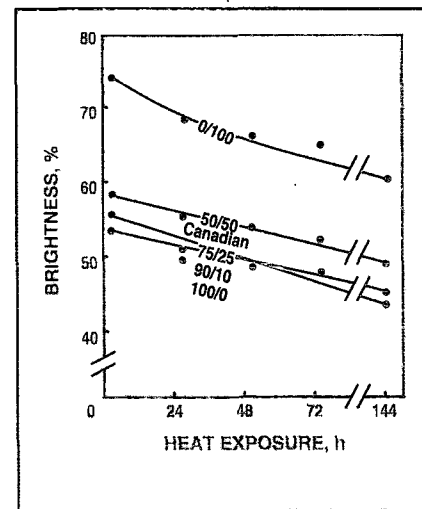
5. Brightness and opacity as functions of kenaf content in recycled newsprint furnish



6. Brightness as a function of UV exposure for recycled newsprint containing various levels of kenaf CTMP [recycled newsprint (%) / kenaf CTMP (%)] and for commercial Canadian newsprint.



7. Brightness as a function of heat exposure for recycled newsprint containing various levels of kenaf CTMP [recycled newsprint (%) / kenaf CTMP (%)] and for commercial Canadian newsprint.



increasing kenaf content, an indication of good bonding.

Figure 2 shows that specific tensile strength increased with increasing kenaf content. Specific tensile strength—an excellent measure of sheet strength because it is based on sheet mass—is an important factor in press runnability. Tensile strength is dependent on bond strength, and it is apparent from the data that kenaf CTMP fiber is a good “bonder.” The MD strength values were lower for newsprint produced on the pilot paper machine than for the commercial newsprints. This result may be related to the likely lower wet-press pressure on the pilot machine. However, the low strength values in the MD also could be the result of differences in machine draw. The CD tensile values were close to those of the commercial newsprints, indicating that differences in machine draw may be partially responsible for the difference in strength in the MD.

The strain properties of the 100% recycled newsprint made on the pilot paper machine were similar to those of the commercial newsprints, as seen in Fig. 3. The MD strain values were virtually constant at all levels of kenaf addition, probably the result of constantly adjusting the draw on the pilot paper machine. (It was necessary to

adjust the draw depending upon the amount of kenaf CTMP in the furnish. No attempt was made to hold the draw constant between trials.) Draws in the dryer section were reduced with increasing kenaf content in the furnish. CD strain decreased as the amount of kenaf increased.

Figure 4 shows the results for tensile energy absorption (TEA), which somewhat paralleled the results for strain (Fig. 3). The reduction in TEA with increasing content of kenaf CTMP may not be significant for newsprint, but it does indicate the limited ability of kenaf CTMP to absorb energy. This may or may not affect the ability of kenaf-reinforced newsprint to withstand repetitive straining and stressing during handling.

The addition of kenaf CTMP had a significant effect on the optical properties at a blend ratio of 50:50, as seen in Fig. 5. The 100% kenaf CTMP had a brightness of almost 77%. However, the results showed that the influence of this bright fiber was not apparent until the furnish contained 50% kenaf CTMP. The inflection point is somewhere between 25% and 50%.

Newsprint opacity was negatively affected by the addition of kenaf CTMP fiber. Figure 5 shows a continual decrease in opacity with the addition of

kenaf CTMP, a trend that becomes especially noticeable at and beyond the 50:50 blend. Generally, a decrease in the scattering coefficient causes a decrease in opacity. As shown in Fig. 1, as the amount of kenaf CTMP fiber in the furnish was increased, scattering coefficient decreased. Again, this is a reflection of the good bonding properties of kenaf CTMP fiber.

Note that high pulp brightness could account for some of the decrease in opacity at the higher addition levels of kenaf CTMP fiber. Research has shown that opacity decreases with increasing brightness of kenaf CTMP (14).

Figure 6 shows that ultraviolet (UV) light had a detrimental effect on sheet brightness. With exposure to UV light, the 100% kenaf CTMP newsprint (0/100) decreased more than 25% in brightness. However, its final brightness after 4-h exposure was equal to the control [100% commercial deinked newsprint (100/0)] and essentially as bright as the commercial Canadian newsprint. As the percentage of kenaf CTMP in the newsprint decreased, the amount of reversion closely paralleled that of the Canadian newsprint. The results in Fig. 6 show that kenaf CTMP had no effect on brightness until it was blended at a 50:50 ratio, in agreement with the results in Fig. 5.

I. Data for handsheets made from blends of kenaf CTMP and deinked recycled newsprint

Furnish blend	Grammage, g/m ²	Sheet density, kg/m ³	Burst index, kPa	Tear index, mN	Scattering coefficient, m ² /kg	Specific tensile strength, N-m/g	Strain, %	TEA* index, kPa	Opacity %	Brightness, %		
										Initial	After 4-h UV exposure	After 144-h heat exposure
100% deinked recycled newsprint	50.5	439	75.8	304	50.4	31.9	1.96	263	87.9	57.3	42.0	43.2
90% deinked recycled newsprint 10% kenaf CTMP	52.5	456	83.5	340	50.9	34.6	1.96	292	87.2	58.7	43.7	43.9
75% deinked recycled newsprint 25% kenaf CTMP	52.0	433	81.1	297	48.4	35.4	1.81	279	88.0	59.1	43.8	45.7
50% deinked recycled newsprint 50% kenaf CTMP	48.0	410	88.3	259	49.5	33.0	1.82	247	83.8	64.3	47.4	46.6
100% kenaf CTMP	49.0	383	90.4	267	47.3	37.0	1.39	173	82.3	76.4	53.9	58.6

*Tensile energy absorption

Figure 7 shows similar results for the effects of heat exposure on brightness. The primary difference is that short-term heat exposure is not as detrimental to sheet brightness as is UV light. However, the final effect of long-term heat exposure essentially equals that of UV light exposure.

Conclusion

An acceptable deinked and recycled newsprint can be obtained using approximately 25% kenaf CTMP in place of semibleached softwood kraft reinforcement pulp. A weighted blend of 25% kenaf CTMP/75% commercial deinked recycled pulp provided greater burst and tensile strength than the control furnish of 100% recycled newsprint. Other properties were not adversely affected, with the exception of opacity, which decreased with increasing kenaf content, especially beyond the 25% level.

Despite the high brightness of kenaf CTMP fiber, blends of kenaf and deinked recycled newsprint did not show a noticeable increase in bright-

ness for blends containing less than 50% kenaf CTMP. Color reversion was measured under UV light and at elevated temperature. The newsprint made from 100% kenaf CTMP started at a high brightness level and, after reverting, remained as bright as the unexposed newsprint made from recycled fiber. The effect of short-term heat exposure on sheet brightness was less detrimental than short-term exposure to UV light. □

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