# Pressability and strength of newsprint furnishes

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*The addition of chemical pulp to groundwood increases the strength of the wet web but does not significantly increase the solids content of pressed sheets.*

Newsprint has been traditionally produced from a mixture of mechanical and chemical pulp (*1*). In many mills, the proportion of the more expensive chemical pulp is determined by machine runnability, which depends on adequate web dewatering characteristics and wet-web strength. In these mills, the cost of production could be reduced if satisfactory machine efficiency could be achieved with less chemical pulp.

The wet-web strengthening effect of chemical pulps has been rationalized in several ways (*2–6*). For example, it has been suggested that the intrinsic strength of a blended furnish increases when the proportion of longer fiber is increased (*2*). Alternatively, it has been proposed that chemical pulps improve drainage, resulting in higher web solids content at the couch, and that the web is stronger because of its greater dryness (*3, 4*). Others have stated that chemical pulps improve the press dewatering characteristics of newsprint furnishes (*5, 6*).

Recently, our pilot machine experiments indicated that improved water removal by the former might have little effect on the web solids content after some press sections. Other results indicated that the press dewatering characteristics of chemical pulps are not superior to those of mechanical pulps (*7, 8*). In this study, we examined the effect of chemical pulp proportion on press dewatering and on the wet-web strength of several Canadian newsprint furnishes.

## Results and discussion

### The pressability index of pulp mixtures

The pressability index (PI) was developed to provide a quick and simple method of evaluating the press dewatering characteristics of pulps (*7*). PI was shown to correspond to the solids content of pressed, low-basis-weight webs on a pilot paper machine (*7*). A review of other methods used to evaluate pulp pressing parameters is provided by Pikulik (*7*).

The press dewatering studies were carried out on four pulp blends prepared from never-dried pulps obtained from three Canadian newsprint mills. The pulps are described in **Table I.**

PI values were determined for 100% mechanical pulp, for 100% chemical pulp, and for several pulp mixtures prepared in our laboratory. The PI of the four mechanical pulps ranged from 40.5 to 43.0, as seen in **Fig. 1.** The average standard deviation of each measurement was 0.3. Although the PI of the reinforcing chemical pulps was either equal to or slightly lower than that of the corresponding mechanical pulps, the PI of the stone groundwood (SGW) pulps increased slightly (by 0.5) when small proportions of chemical pulp were blended into them. Further addition of chemical pulp to SGW reduced the PI. The PI of thermomechanical pulp (TMP) was not significantly changed by the addition of semibleached kraft pulp (SBK).

### The strength of pulp mixtures

The effect of the proportion of chemical pulp on the wet-web strength of pulp mixtures depends on the solids content. **Figure 2A** shows that the increase in breaking length obtained when adding a given amount of high-yield sulfite (HYS) to SGW becomes greater as the web solids content is increased from 20% to 50%.

**Figure 2B** shows that addition of up to 30% SBK to TMP has no effect on wet-web strength as long as the solids content remains below 40%. **Figure 2C** shows that the beneficial effect of lightly refined (597 mL CSF) SBK on the wet-web strength of sheets made of SGW–SBK blends was greater at higher solids contents. This relationship was similar to that found for the SGW–HYS blends (Fig. 2A). However, **Figure 2D** shows that further refining of the SBK to a freeness of 255 mL CSF caused a synergistic effect, with mixtures containing 20–50% SBK being significantly stronger than either component. Synergistic effects on strength properties have previously been reported for SGW–sulfite (*2, 6, 9*) and SGW–SBK mixtures (*9–12*). The present finding implies that refining of the kraft pulp component of a newsprint furnish can significantly improve the strength of the wet web.

Several ways of evaluating the paper machine runnability of different pulps are discussed in the literature (*10, 11*). These techniques have been applied to the study of the effects of adding chemical pulp to mechanical pulp (*2, 6, 9–12*). The simplest approach compared the breaking length and stretch for pulp mixtures at several common

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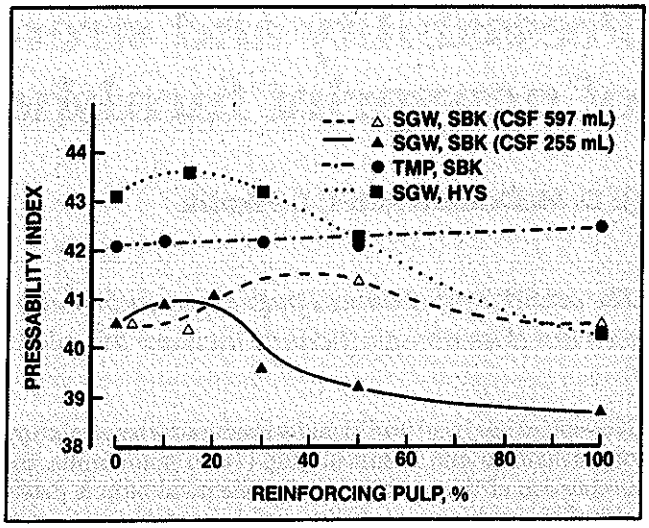
**I.** Identification of the pulps studied

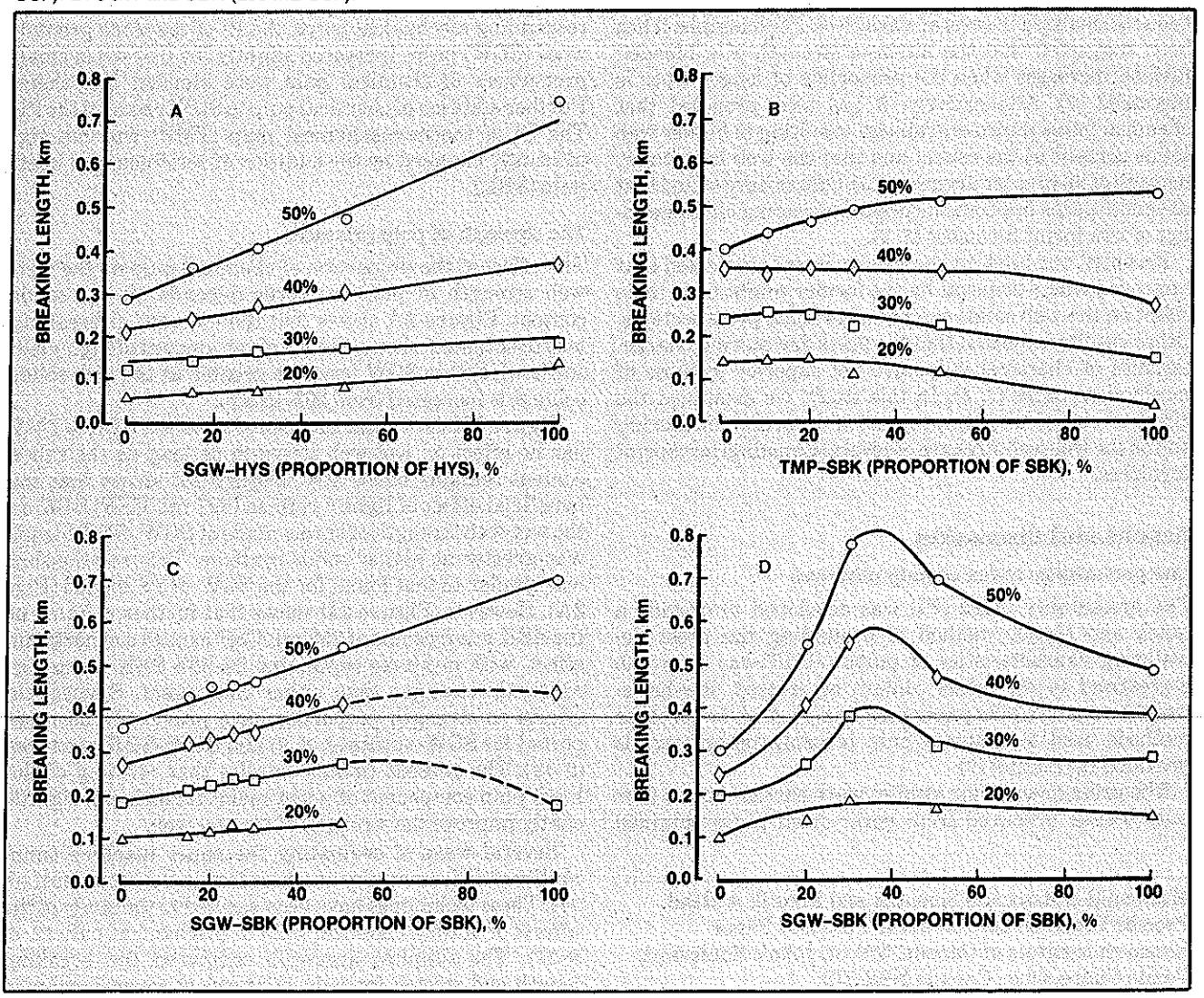
| Mill | Location | Mechanical pulp Type* | Mechanical pulp Freeness, mL CSF | Chemical pulp Type* | Chemical pulp Freeness, mL CSF |
|---|---|---|---|---|---|
| A | Eastern Canada | SGW | 77 | SBK | 597 |
| | Eastern Canada | SGW | 47 | SBK | 255 |
| B | Eastern Canada | SGW | 83 | HYS | 550 |
| C | Western Canada | TMP | 87 | SBK | 676 |

*SGW = stone groundwood. TMP = thermomechanical pulp. SBK = semibleached kraft. HYS = high-yield sulfite.

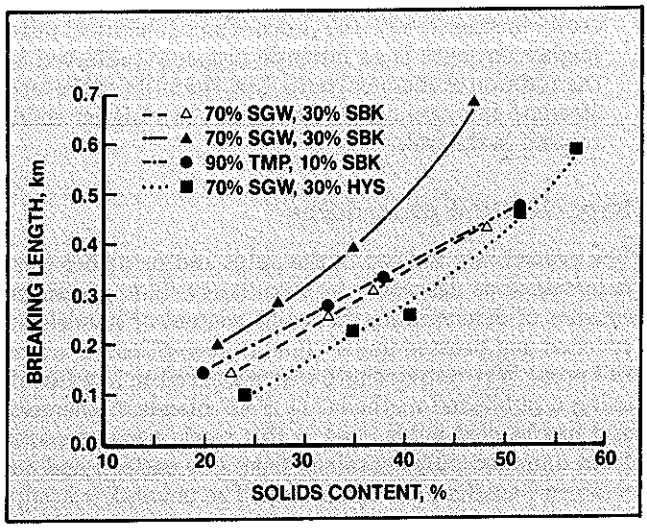
**1.** The pressability indexes of the chemical pulps (SBK and HYS) were either equal to or lower than those of the mechanical pulps (SGW and TMP). However, the PI of the SGW pulps could be increased by adding an optimal proportion of a reinforcing chemical pulp.



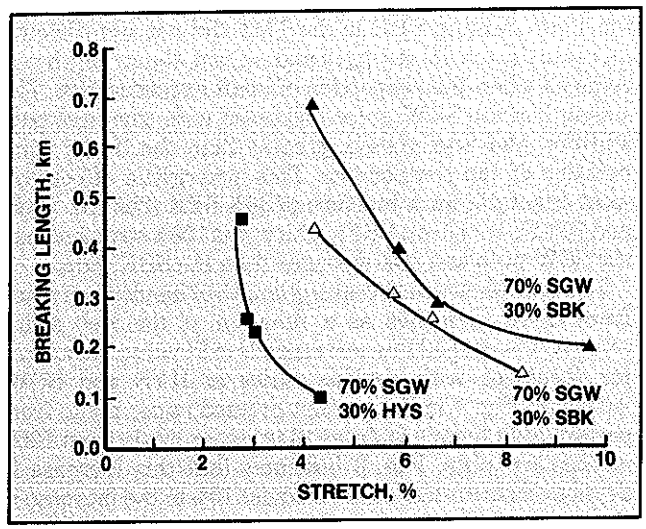

**2.** The effect of the proportion of chemical pulp on the wet-web strength of pulp blends at four web solids contents. The web solids content (20%, 30%, 40%, or 50%) is indicated for each curve. A: SGW and HYS. B: TMP and SBK (676 mL CSF). C: SGW and SBK (597 mL CSF). D: SGW and SBK (255 mL CSF).



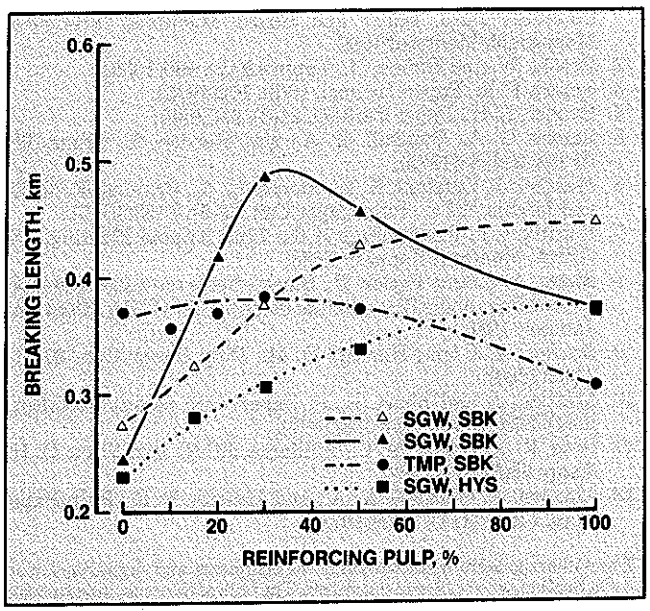
**3.** The relationship between tensile strength and web solids content for four newsprint furnishes.



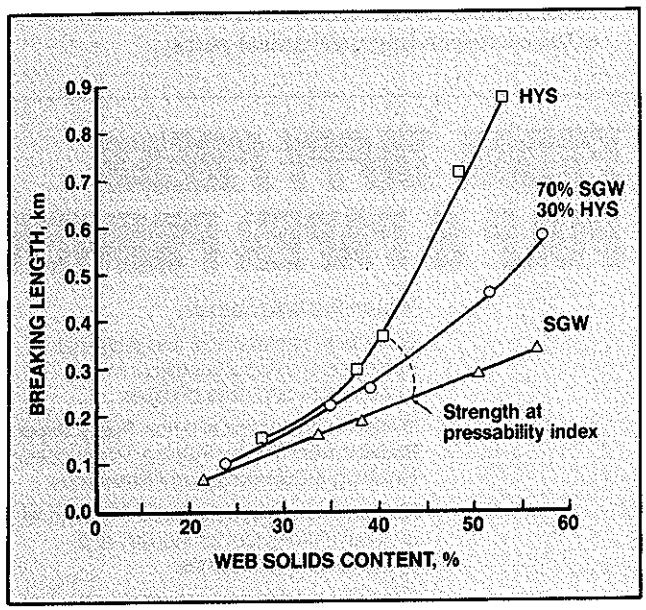

**4.** Failure envelopes for three furnishes. Failure envelopes were determined by combining the data for breaking length and stretch for sheets of various solids content. A furnish with greater breaking length and stretch is expected to have better machine runnability.




**5.** Tensile strength of handsheets as a function of pulp composition. The solids contents of the handsheets correspond to the PI values given in Fig. 1.




**6.** Handsheets containing 100% and 30% HYS were stronger than SGW handsheets. The dashed line represents the strength of intermediate mixtures at the pressability index and indicates that the strength was not improved by increased water removal.




web solids contents that were deemed to be representative of the moisture content after the couch and press nips of typical machines (*2, 6, 9, 10, 12*). This approach is demonstrated in **Fig. 3**, which shows the development of tensile strength as a function of solids content for the newsprint furnishes used in this work. The tensile strength and stretch measurements can be combined to give the total energy absorbed (*6, 10, 12*). However, these methods do not consider the differences in the press dewatering properties of various furnishes.

Another approach (*11*) consists of plotting the breaking length-stretch results for webs at a series of moisture levels to form a failure envelope. This approach takes into consideration both the tensile strength and stretch properties, and it provides a method of furnish evaluation that ingeniously avoids the question of dewatering. The furnish with a greater breaking length and a greater stretch is assumed to have a better runnability on a paper machine. Failure envelopes were determined for three furnishes used in this work and are presented in **Fig. 4.**

A comparison of the results depicted in Figs. 3 and 4 shows that both of these approaches ranked the runnability of the furnishes in the same order. However, application of the pressability index makes it possible also to take into consideration the water removal characteristics of pulp mixtures. The strength-stretch properties of pulps can be compared at solids contents representative of those developed in the last press nip of a commercial newsprint

machine.

**Figure 5** shows the breaking length of handsheets as a function of pulp composition. The solids contents of the handsheets correspond to the pulp PI values given in Fig. 1. The three SGW pulps were significantly weaker than the TMP. Adding SBK to the TMP did not significantly increase the tensile strength and, in fact, the strength was reduced when the proportion of kraft exceeded 50%. The strength of the SGW pulps increased with chemical pulp addition and was always greater than the linear combination of the components. This synergistic effect was most dramatic for a mixture of 30% SBK (255 mL CSF) and 70% SGW (47 mL CSF), which was 100% stronger than the SGW pulp and 30% stronger than the SBK pulp.

**Figure 6** shows the breaking length of handsheets made from three furnishes as a function of the web solids content. The dashed line corresponds to PI values measured for furnishes with various ratios of HYS and SGW. Although Fig. 1 indicates that pressed paper made from certain pulp blends is dryer than paper made from 100% mechanical pulp, Fig. 6 indicates that this increase in dryness contributed, at most, about 10% to the increase in the tensile strength.

## Conclusions

The results of our study support the following conclusions:

1. The pressability indexes of the chemical pulps studied in these experiments were similar to or lower than those of the corresponding mechanical pulps.
2. The addition of chemical fiber to groundwood caused at most only a small increase in the solids contents of pressed sheets.
3. Wet-web strength of SGW–chemical-pulp blends generally increased with the proportion of chemical pulp. Higher strength is an intrinsic property conferred by the addition of chemical pulp. Less than 10% of the total strength increase can be attributed to a higher solids content in the web.

## Experimental procedures

The pressability indexes of the pulps and furnishes were determined as described by Pikulik (*7*). This procedure consists of determining the solids content of handsheets couched and pressed under standard conditions in a two-roll press. Wet-web strength was measured on handsheets using a published method (*11*). Four blends of chemical and mechanical pulps used in this work were prepared from unmixed pulps obtained from two eastern and one western Canadian newsprint mill. The never-dried pulps were collected at a consistency close to 3% immediately before the mixed stock chest and were stored in a cold room prior to the measurements.

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