Nonwood Fiber Content Papers - Part 2:
Unbleached Papers Physical Properties

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This data was developed from tests on commercially produced paper and paperboards which were available at the time. Some of this data likely is a little outdated due to advancements in paper machine design such as improvements in Fourdrinier drainage and the development of twin wire paper machines and no-draw press sections, all of which allow for a high nonwood fiber fraction in the furnish. Nevertheless, this actual mill data still offers a valuable insight into the potential use of nonwood fibers in papermaking.

Unfortunately, since this paper was presented, no one has undertaken a similar ambitious project to determine the characteristics of currently available nonwood fiber content papers. With the renewed interest in nonwood fibers for papermaking in North America and Europe, perhaps the time has come for a research organization to undertake such a project.

The following table provides physical properties of unbleached papers produced from nonwood pulps. Even using pre-1975 technology, a few points to consider include:

- breaking length and tear factor of papers produced using the selected nonwood fiber pulps are low compared to paper produced with 100% woodpulp, which is expected based on the properties of the nonwood pulps used
- sack papers produced with 34-35% bagasse pulp in the furnish register a lower breaking length compared to sack paper produced with 100% woodpulp. However, by increasing the basis weight of this paper by 10-15%, comparable values can be obtained. And, using a "Clupak" extensible unit significantly improves the overall strength properties of sack paper.
- Kraft paper produced from bamboo pulp has lower strength values compared to kraft paper produced with 100% conventional long fiber, unbleached kraft woodpulp. Various bamboo MF and MG kraft papers are produced in India and China mostly for wrapping and grocery bag purposes, and, for this requirement, the strength properties are reasonably acceptable. However, it should be noted that Misra's paper did not indicate the species of bamboo which were used in the papers tested. Given the wide range of bamboo species which could be used (see Bamboo - A Fiber Resource with Great Potential), it is conceivable...
that properly selected species of **bamboo** would provide different, higher strength results for **bamboo** papers. It is worthwhile to note that three U.S.-based paper companies introduced lines of uncoated freesheet printing and writing papers during the 1990's using **bamboo** market pulps purchased from Asian locations, that some of the **bamboo** papers were produced using a 100% **bamboo** pulp furnish, and that these papers had strength properties similar to woodpulp papers.

- strength properties of MG kraft paper produced with 50% **wheat straw** pulp and with 70% **bagasse** pulp are favourably comparable to those produced with 100% kraft woodpulp
- strength properties of 100% **rice straw** kraft paper are low and this paper may have been acceptable for local markets only. It is unlikely that a 100% **rice straw** furnish would be used and more likely that some softwood kraft would be added to improve strength properties.
## Physical properties of unbleached papers produced with nonwood pulps

<table>
<thead>
<tr>
<th>Paper Grade</th>
<th>Furnish</th>
<th>Basis Weight (g/m²)</th>
<th>Ash (%)</th>
<th>Thickness (microns)</th>
<th>Breaking Length (m)</th>
<th>Burst Factor</th>
<th>Tear Factor</th>
<th>No. of Folds</th>
<th>Porosity (sec/100cc)</th>
<th>Cobb (g/m²)</th>
</tr>
</thead>
</table>
### Bagasse Content Papers
- **Sack paper** 34% bagasse: 74.0, 0.9, 145, 4880, 36.9, 113.0, 18, 31
- **Sack paper** 35% bagasse: 78.7, 1.0, 160, 4590, 25.4, 112.0, 22, 40
- **Sack paper** 40% bagasse: 90.6, 1.3, 135, 4300, 23.3, 112.5
- **Linerboard** 36% bagasse: 130.6, 1.0, 225, 5080, 33.8, 110.0, 34
- **Linerboard** 36% bagasse: 240.1, 0.9, 380, 5460, 39.4, 165.0, 47
- **MG Wrapping** 70% bagasse: 79.5, 1.0, 101, 5980, 27.4, 80.6

### Bamboo Content Papers
- **MG Kraft** 50/70% bamboo: 63.5, 3.8, 105, 3540, 17.4, 76.2, 23, 12, 25
- **MG Kraft** 50/70% bamboo: 78.3, 2.3, 140, 3780, 20.1, 80.6, 28, 7, 27
- **MG Kraft** 50/70% bamboo: 99.0, 3.1, 155, 3520, 18.0, 97.8, 32, 10, 47
- **MG Kraft** 50/70% bamboo: 107.1, 2.9, 190, 3600, 18.1, 84.5, 34, 8, 59
- **MG Kraft** 50/70% bamboo: 115.1, 3.0, 195, 3080, 14.6, 76.8, 66, 11, 68
- **MG Kraft** 50/70% bamboo: 152.3, 3.2, 230, 3250, 17.2, 76.0, 76, 12, 31
- **MG Kraft** 50/70% bamboo: 168.7, 3.7, 265, 3170, 16.8, 68.8, 58, 22, 32
- **MG Kraft** 50/70% bamboo: 96.4, 2.6, 160, 4095, 24.5, 74.2, 13, 9, 52

### Straw Content Papers
- **Kraft paper** 100% rice straw: 40, 5.6, 80, 3080, 12.5, 40.0, 3, 46, 17
- **Kraft paper** 100% rice straw: 48, 5.6, 80, 2850, 12.5, 35.4, 4, 70, 21
- **Kraft paper** 100% rice straw: 54, 5.6, 95, 2960, 12.0, 38.9, 4, 86, 25
- **Kraft bag** 50% wheat straw: 60, 5.0, 95, 5610, 29.8, 60.7, 103, 56, 25

### Woodpulp Papers for Comparison
- **Linerboard** 100% woodpulp: 127, 0.6, 215, 5890, 32.2, 179.0, 54
- **Linerboard** 100% woodpulp: 338, 0.6, 600, 4940, 68.5, 169.0, 39
- **Sack paper** 100% woodpulp: 70, 0.7, 130, 6150, 47.1, 158.6, 20, 25