<table>
<thead>
<tr>
<th>Title</th>
<th>Basics on newsprint manufacture and newsprint types.</th>
</tr>
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<tr>
<td>Author(s)</td>
<td></td>
</tr>
<tr>
<td>Date</td>
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<td>URL</td>
<td><a href="http://hdl.handle.net/10220/1293">http://hdl.handle.net/10220/1293</a></td>
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Basics On Newsprint Manufacture
&
Newsprint Types
Session 2:

Basics on newsprint manufacture
Overview of the modern technology used to make newsprint

Newsprint types
Standard newsprint
Improved newsprint
Directory paper
Bulky paper...
Basics of newsprint manufacture

- Paper and paper industry historical data
- Evolution of the width and speed of the paper machines
- Papermaking basics
- Different types of fibres
- Papermaking operations
- Different types of pulps
- Better technology: better newsprint
- Introduction to paper recycling and deinking
- Soft calendering: a new way to optimize paper properties
- Comparison of newsprint types: standard, improved,...
# Paper and Paper Industry Historical Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 BC</td>
<td>Paper in some Chinese graves.</td>
</tr>
<tr>
<td>105 AD</td>
<td>In China, Tsai Loun</td>
</tr>
<tr>
<td></td>
<td>First paper made with textile fibres.</td>
</tr>
<tr>
<td>610 AD</td>
<td>Technique introduced in Japan.</td>
</tr>
<tr>
<td>751</td>
<td>Technique in the Middle-East.</td>
</tr>
<tr>
<td>1450</td>
<td>Gutenberg's Bible.</td>
</tr>
<tr>
<td>1798</td>
<td>First paper machine by Nicolas Robert.</td>
</tr>
<tr>
<td>1800-1860</td>
<td>Mechanisation of the processes.</td>
</tr>
<tr>
<td>1840</td>
<td>First wood mechanical pulp (Keller).</td>
</tr>
<tr>
<td>1840-1880</td>
<td>Wood pulp is used</td>
</tr>
<tr>
<td></td>
<td>(both mechanical and chemical).</td>
</tr>
<tr>
<td>1860-1950</td>
<td>Speed and width increase of the paper machines.</td>
</tr>
<tr>
<td></td>
<td>1820: Speed 5 m/min, Width 85 cm</td>
</tr>
<tr>
<td></td>
<td>1930: Speed 500 m/min, Width 770 cm</td>
</tr>
<tr>
<td>1950-Today</td>
<td>Further increase of PM speed and widths.</td>
</tr>
<tr>
<td></td>
<td>New pulps and additives: TMP, DIP, new filler material, new additives and chemicals.</td>
</tr>
<tr>
<td></td>
<td>New sheet formation: twin wire formers.</td>
</tr>
<tr>
<td></td>
<td>Further automation.</td>
</tr>
<tr>
<td></td>
<td>Environmental concerns.</td>
</tr>
</tbody>
</table>
The First Paper Machine
by Nicolas Robert
in 1798
Maximum operating speed (m/min)

Operating speed is the average sustained speed during 24 hrs of continuous operation.

- Newsprint machine
- Magazine paper machine
- Fine paper machine

Year:
- 1900
- 1920
- 1940
- 1960
- 1980
- 2000
FIGURE 2: The widths of paper machines have steadily increased during the past century, but there have been periods of 20 to 30 years when no width increases occurred.
Papermaking Basics

1. Mix in water

2. Drain

3. Press

4. Dry
Schematic representation
of the structure of a cellulose molecule

Formation of hydrogen bonds
between two cellulose molecules
Figure 38. An annual growth ring is clearly illustrated in this transverse section of Pterocarpus. To the inner side, small, thick-walled vessels of the latewood can be seen. Beyond the ring boundary, the cells are larger and have thinner walls. The cells turn at about 45° at the radial pith after being cut off from the vascular cambium. A tear can be seen increasing the wood at right angles to the ring boundary. (p. 550)
Figure 20. Vessel member walls are not always covered in pits. In this view of a cluster of vessels in red beech, some walls show prolific vessel-to-vessel pitting while others are completely devoid of pits. (x 1350)
Figure 56. Transverse section through compression wood in Pinus radiata. Note the helical checks and finer variations in the cell walls. (× 1650).
Softwood fibers magnified about 50 times.

Hardwood fibers magnified about 50 times.
Overview of papermaking operations

- Logs
- Lumber mill
- Chipper
- Grinder
- Chip storage
- Scraps
- Pulpers to separate fibers
- Measure, blend, clean and screen
- Refiners
- Pulp washing, cleaning, screening and bleaching
- Digester
- Headbox
- Press section
- Dryers
- Calender
- Reel
- Web modification and/or converting

Raw materials
Wastepaper
Figure 4.2. Drum barker
Figure 4.4. Chipper and chipper detail

Chip detail

Log chute

Drive motor

Knives

Flywheel

Rotation

Chips

Knife

Log

Chips

Log chute

Flywheel

Chipper

Figure 4.4. Chipper and chipper detail

Chip detail

Log chute

Drive motor

Knives

Flywheel

Rotation

Chips

Knife

Log

Chips

Log chute

Flywheel

Chipper
BASICS OF NEWSPRINT MANUFACTURE

DIFFERENT TYPES OF PULP

- Mechanical pulps (1):
  - Stone Ground Wood pulp (SGW)
  - Rotary stone to grind the wood.
  Addition of water (cooling effect)
  Advantages: yield (≈98%), opacity, dim.
  stability, printability
  Disadvantage: poor mechanical prop.,
  yellowing, high energy consumption
  In decline since 1970.

  - Pressurised Ground Wood Pulp
    (PGW):
    - Same as for SGW but with high pres-
      sure (3-4 bars) and high temperature
      (120°C).
    Same advantages.
    Better mechanical properties
    Disadvantages: higher energy consump-
    tion, lower brightness
BASICS OF NEWSPRINT MANUFACTURE

DIFFERENT TYPES OF PULP

- Mechanical pulps (2):
  - Refiner Mechanical Pulp (RMP)
  - Wood chips go through a refiner (two discs rotating in inverse directions)
    Advantages: better mechanical properties and better bulk factor

- Thermo Mechanical Pulp (TMP):
  - Same as for RMP but with pressure
    Very popular today
    Adv.: good mechanical properties
    Disadv.: high energy consumption

- Chemi Thermo Mechanical Pulp (CTMP):
  - Same as TMP but with chemicals (Ex: sodium monosulfite)
Figure 4.11. High-yield mechanical pulp process

Figure 4.12. Disc refiner detail
Refiner used for Thermo-Mechanical Pulp (TMP) Production
BASICS OF NEWSPRINT MANUFACTURE
DIFFERENT TYPES OF PULP

- Chemical pulp:

Two processes:
- kraft or sulphate process
- sulphite process

The kraft process is the most used.

Process: Wood chips treated at high temperature and pressure with chemicals (liquor) to eliminate the lignin components of the wood.

Yield: about 50%

Advantages: nice strong fibres
Disadvantage: yield

Less and less used for newsprint (cost)
Chemical Pulp

Groundwood Mechanical Pulp
BASICS OF NEWSPRINT MANUFACTURE

DIFFERENT TYPES OF PULP

- Deinked pulp:

Raw material: recycled waste paper (old newspapers and magazines)

Advantage: cheap raw material, less energy required

Disadvantage: a lot of experience is needed to manufacture a good-quality newsprint out of deinked pulp.

Bid trend today to manufacture newsprint with recycled content (ecological image)
Waste paper treatment with the flotation or the wash deinking process

**Waste Paper**
- Water & Steam
- Filtrate
- Pulper
- Vat
- Cleaning & Deflaking
- Decker
- Pulp + Ink + Chemicals

**Chemicals**
- Removal of the ink particles from the fibres with chemicals and increased temperature
- Intermediate stock
- Removal of the solid contaminants: stickies, metal or wood pieces...
- Adjustment to the right consistency
- Filtrate recycling

**FLOTATION DEINKING**
- Filtrate
- Accept
- Secondary flotation
- Centrifuge
- Inks + Chemicals + Ash

**Primary flotation**
- Foam

**WASH DEINKING**
- Filtrate
- Accept
- Ash + fines

**Wash 1**
- Flotation
- Foam
- Centrifuge

**Wash 2**
- Sedimentation

**Wash 3**
- Pulp press
- Inks + chemicals

Yield: 90 - 95%

**Deinked pulp**
- Fine screening & screening
- Decker
- Bleaching
- Dispersion
- Vats
- Paper Machine
- Recycled paper

Yield: 80 - 85%

**Removal of small contaminants**

**Adjustment to the right consistency**

**Improvement of the pulp brightness**

**Reduction of the size of stickies**

**Homogenization of the size of ink particles adhering to the fibres**

**Stock before papermaking**

Diagram: 10

© Ilte, March 91
Diag. 11. Simplified mechanism of the flotation process

Diag. 12. Simplified mechanism of the wash deinking process
Use of deinked pulp in West Europe (1992)

- Newsprint: 46%
- Sanitary tissues: 18%
- Printing & writing papers: 20%
- Other grades: 16%
Estimated use of deinked pulp as a percentage of total furnish for the main grades

North America

Western Europe

Sanitary tissues

Newsprint

Printing & writing papers

Source: Jääkko Pöyry
Figure 5.5. Centrifugal cleaner

Heavy material is thrown to the outside wall, where it settles to the bottom and is removed.

Lightweight material is drawn toward the center, where it is removed from the top.

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Figure 6.1. Fourdrinier paper machine

- Headbox
- Stock inlet
- Dandy roll
- Wire
- Calender stack
- Rewinder
- Slitter knives
- Reel
- Dryers
- Size press
- Presses
- Couch roll
- Fourdrinier
Figure 6.11. Fourdrinier wet-end parts
Figure 6.25. Press section design
Fourdrinier (single-wire) paper machine

Hybride former

Double-wire paper machine (Gap former)
Basics of papermaking

SHEET FORMATION

- One of the basic characteristics

- Can be checked visually by transmitted light --> appearance of light and dark areas.

- On the wet part of the paper machine, fibres tend to cling together to form flocculations. The purpose of the headbox is to break these flocculations. Bad formation may be compensated by a good compressibility

- Wire marking: depends on the type of wire. Can have a visual effect on printed solids and halftones.
BETTER TECHNOLOGY: BETTER NEWSPRINT

Newsprint composition:
In 1950, newsprint = 70% SGW + 30% chemical pulp
Today's trend: very few chemical pulp, use of TMP and deinked pulp

Width and speed of the machines:
typical today: 8.5m and 1500 m/min
(needs less personnel than an old 3.6 m wide machine running at 500 m/min and produces 7 times more)

Twin-wire formers:
better drainage capacities (water elimination) --> greater speeds

Better press sections:
Better paper surface --> printability, compressibility, absorption
BETTER TECHNOLOGY: BETTER NEWSPRINT

Twin formers + better furnish:
No linting --> offset process possible for newspapers (up to 4+4)
Better dimensional stability
Better mechanical properties

New process control systems:
uniformity of the properties (MD and CD)

Problem: different grammages, reel diameters and reel widths
--> problems to optimize at the winding station

A lot of different possible raw materials and equipments to manufacture newsprint
--> a lot of different newsprints but general improvement of the quality
Soft-calendering

History of the process:
- In the 70s: first use for board and wood-free grades.
- In the mid-80s: alternative to hard-nip calendering in newsprint manufacture, because of the rapid progress being made in hot roll technology and soft roll covers.

Advantages:
- improved print quality
- improved strength
- higher moisture contents
- suitability for recycled fibres
- good control of two-sidedness

After hard-nip calendering:
  - paper thickness constant
  - paper density varies

After soft-nip calendering:
  - paper thickness varies
  - paper density constant

--> Constant paper density means better print quality because the ink will penetrate evenly into the paper (without mottling)
Soft-calendering

Hard or soft nip?

A hard-nip crushes fibres and breaks inter-fibre bonds

--> reduction of the strength of the paper.

In a soft-nip: "soft" treatment of the paper fibres and better fibre bonding because of the use of thermo rolls

--> the tensile index can be increased by up to 15%.

--> the amount of chemical pulp and virgin fibres can be reduced, which pays back.

Parameters:
The following parameters influence the quality of the final paper:

  - speed (generally fixed by the paper machine)
  - temperature (generally 130-140°C, great influence on roughness)
  - linear load (up to 350 kN/m for a TMP furnish)
  - moisture level of base paper
  - external moistening
  - dimensions of calendering rolls
  - type of soft roll covers
Fig. 1: Comparison of calendering effects.

Fig. 2: Nip pressure at 1000 kN/m, Ø 1000 mm.
Figure 7.14. Supercalender design
NipCoMat Soft Calender
Different types of newsprint

Standard Newsprint:
- Generally produced on twin-wire machines and is machine-finished.
- Adjusted to a suitable smoothness for all newspaper printing methods (offset, letterpress, flexo).
- Main components: TMP, Deinked pulp, groundwood pulp and small amounts of chemical pulp.
- Main grammages: 40, 45 and 48.8
- Basic use: Daily and weekly newspapers, periodicals, catalogues and magazines printed in coldset offset, letterpress or flexo.

PROPERTY VALUES

<table>
<thead>
<tr>
<th>NORNEWS, STANDARD NEWSPRINT</th>
<th>40 *</th>
<th>45</th>
<th>48.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage, g/m²</td>
<td>40</td>
<td>45</td>
<td>48.8</td>
</tr>
<tr>
<td>Brightness, % ISO</td>
<td>57</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Luminance, % (Y-value) **</td>
<td>63.5</td>
<td>64.5/63.5</td>
<td>64.5/63.5</td>
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<tr>
<td>Dominant wavelength, nm</td>
<td>576.5</td>
<td>576.5</td>
<td>576.5</td>
</tr>
<tr>
<td>Excitation purity, % ***</td>
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<td>7.5/5.5</td>
<td>7.5/5.5</td>
</tr>
<tr>
<td>Opacity, %</td>
<td>90.5</td>
<td>92.5</td>
<td>-</td>
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<tr>
<td>Roughness Bendtsen</td>
<td>80/120 (letterpress/offset)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 MPa, ml/min</td>
<td>80/120 (letterpress/offset)</td>
<td></td>
<td></td>
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<tr>
<td>Moisture content, %</td>
<td>9</td>
<td></td>
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# STORA FELDMÜHLE KVARNSVEDEN
## PM 11
### STORA NEWS 49g/m²

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<th>Characteristic</th>
<th>Value</th>
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<tr>
<td>Grammage, g/m²</td>
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<tr>
<td>Apparent Density, kg/m³</td>
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<td>Thickness, µm</td>
<td>75</td>
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<tr>
<td>Roughness Bendtsen, 0,1 MPa, ml/min ts/ws</td>
<td>89/99</td>
</tr>
<tr>
<td>Roughness Bendtsen, 0,5 MPa, ml/min ts/ws</td>
<td>32/34</td>
</tr>
<tr>
<td>Roughness PPS, 1 MPa, ml/min ts/ws</td>
<td>3,28/3,40</td>
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<tr>
<td>Air permeance, ml/min</td>
<td>196</td>
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<tr>
<td>Tensile strength, kN/m, MD/CD</td>
<td>2,70/0,87</td>
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<td>Stretch at break, %, MD/CD</td>
<td>1,05/3,14</td>
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<tr>
<td>Tearing strength, mN, MD/CD</td>
<td>174/263</td>
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<td>Brightness, ISO, %, ts/ws</td>
<td>58,0/58,3</td>
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<tr>
<td>Y-value, %</td>
<td>64,7</td>
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<tr>
<td>Opacity, %</td>
<td>93,9</td>
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<tr>
<td>Lightscatt.coeff. m²/kg</td>
<td>52,8</td>
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<tr>
<td>Lightabs.coeff. m²/kg</td>
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<td>Excitation purity, %</td>
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<td>Dom. wave-length, nm</td>
<td>576,2</td>
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<tr>
<td>Oil absorption, Cobb Unger g/m², ts/ws</td>
<td>15,3/18,7</td>
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<tr>
<td>Surface strength, ts/ws</td>
<td>1,0/1,2</td>
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<tr>
<td>X-value, letterpress, ts/ws</td>
<td>2,8/3,8</td>
</tr>
<tr>
<td>Printability properties, Prüfbau-test evaluated at:</td>
<td>1,5 g/m² ink on paper</td>
</tr>
<tr>
<td></td>
<td>*) 0,92/0,93 ***) 1,31/1,27</td>
</tr>
<tr>
<td>Print through x 1000, ts/ws</td>
<td>48/52</td>
</tr>
<tr>
<td>Strike through x 1000, ts/ws</td>
<td>23/27</td>
</tr>
<tr>
<td>Set-off x 100, ts/ws</td>
<td>32/29</td>
</tr>
<tr>
<td>Rub-off x 1000, ts/ws</td>
<td>27/28</td>
</tr>
</tbody>
</table>

*) Ink hold-out  
**) Ink requirement, g/m²

Kvarnsveden 1994-04-11
**NORSKE SKOG PAPER ANALYSIS**

**NORDENFJELLSKE TREFOREDLING**

**PAPER LABORATORY**

**Date**: 15/03/94  
**Sign**: M. LEINSVANG

<table>
<thead>
<tr>
<th>Mill</th>
<th>Quality</th>
<th>Grammage</th>
<th>Comment</th>
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<tbody>
<tr>
<td></td>
<td>NSI</td>
<td>48.8 g/m²</td>
<td>PRODUSERT FOR GUARDIAN, TILSATT FYLLSTOFF</td>
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<table>
<thead>
<tr>
<th>PM</th>
<th>Tambour No</th>
<th>Peel No</th>
<th>Grammage</th>
<th>Sheet thickness</th>
<th>Sheet density</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2269</td>
<td>48.9 g/m²</td>
<td>77.9 µm</td>
<td>628 kg/kbm</td>
</tr>
</tbody>
</table>

| Roughness Bendtsen | 0,1 MPa | Ts/Ws | ml/min | 91/89 |
| Roughness Bendtsen | 0,5 MPa | Ts/Ws | ml/min | 29/29 |
| Hardness           |         | Ts/Ws |        | 32/32 |
| Roughness P.P.S    |         | Ts/Ws | µm     | 3.2/3.3 |
| Porosity Bendtsen  |         | Ts/Ws | ml/min | 175/175 |
| Friction           |         |       |        | 0.35/0.36 |

| Tensile Strength  | MD/CD   | kN/m  | 2.47/0.61 |
| Tensile index     | MD      | Nm/g  | 50.5/0.33 |
| Tensile ratio CD/MD|        |       | 0.94/3.12 |
| Elongation         | MD/CD   | mN    | 180/273  |
| Tearing resistance | MD/CD   | mN/m²/g| 5.58/1.52 |
| Tear index         | CD      | mN/m²/g| 5.58/1.52 |
| Tear ratio CD/MD   |         |       | 60.2/6.45 |
| Moist content      |         | %     | 5.40/5.40 |
| Brightness ISO     |         | %     | 576.7/576.7 |
| Y-value            |         | %     | 54.7/54.7 |
| Excitation purity  |         | %     | 54.9/54.9 |
| Dominant wavelength|         | nm    | 5.86/5.86 |
| Opacity            |         | %     | 5.86/5.86 |
| Specific light scattering coeff.| m²/kg | 5.86/5.86 |
| Formation          |         | %     | 5.86/5.86 |

**Furnish**

<table>
<thead>
<tr>
<th>TMP</th>
<th>Chem. pulp</th>
<th>Broke</th>
<th>Dip</th>
<th>Starch</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>%</td>
<td>%</td>
<td>Yes/No</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
Different types of newsprint

Directory paper:
- Main use: telephone books and various catalogues
- High pagination: lower grammage
---> 40 g/m² and below.
- To go below 40 g, requires well-refined mechanical pulp and high-quality filler addition to maintain opacity.

Bulky Newsprint:
Mainly used for pocket books printed in offset or letterpress. Also for newspaper supplements and advertising inserts.

Bulk factor = $C(\mu m) / G(g/m²)$
with $C$: caliper and $G$: grammage

For standard newsprint: $\approx 1.5$
For bulky: $\approx 1.8-2.4$
Different types of newsprint

Improved Newsprint:

Basic properties:
- high brightness
- good opacity
- better printability (can be used in heatset offset)
- high bulk and stiffness
- good runnability and low linting

Differences with standard grades: better brightness and surface

Major use: daily newspapers with high quality colour printing, newspaper supplements, advertising inserts and direct mail, books and comics

PROPERTY VALUES

<table>
<thead>
<tr>
<th>NORBRIGHT and NORBRIGHT SUPER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage, g/m²</td>
</tr>
<tr>
<td>Brightness, % ISO</td>
</tr>
<tr>
<td>Luminance, % (Y-value)</td>
</tr>
<tr>
<td>Dominant wavelength, nm</td>
</tr>
<tr>
<td>Excitation purity, %</td>
</tr>
<tr>
<td>Opacity, %</td>
</tr>
<tr>
<td>Roughness Bendtsen 0.1 MPa, ml/min</td>
</tr>
<tr>
<td>Moisture content, %</td>
</tr>
</tbody>
</table>
The preferred diameters for newsprint reels are as follows:

- 1000 mm
- 1070 mm
- 1150 mm
- 1250 mm.

Recommendations for reel core and chuck specifications

4.1. Core properties for a reel up to 1.7 m in width

1. Inner diameter: 76.2 + 0.4 mm; −0.0 mm.
2. Outer diameter: maximum 107 mm (to enable fixed splicing).
3. Weight: ≤4 kg/m (to avoid heavy waste).
4. Moisture content: 6 ... 9 percent.
5. Crush strength (compression strength): >2000 N/100 mm (other strength properties also important, though less common in practice due to lack of standard measuring methods).
6. Elasticity modulus: >2700 N/mm². Not critical at normal web widths (1.6 m), but becomes critical at web widths of 2.5 m.
7. Linearity (warpage): ≤2 mm/m.
8. Out-of-roundness: maximum 0.5 mm.
9. Deformation on core: Acceptable on inner diameter to a certain extent without major fibre damage, not on outer diameter. The reel must be demountable and replaceable.
10. Before the reuse of a reel, core damage must be evaluated.
11. Information to be listed inside core: manufacturer, type of core, identification code.

4.2. Chuck properties

Expanding chucks

1. Nominal diameter: preferable 75 mm.
2. Expansion movement: high, preferably 82 ... 85 mm in diameter.
3. Contact surface: 5000 mm², central drive; 2000 mm², belt drive.

Conical chucks

1. Contact surface: Long type of chucks recommended.

4.3. Information needed for core selection

In order to enable an optimum choice of core the following data concerning the reel and the reelstand should be given to the core manufacturer. This is of utmost importance in more problematic cases, such as extremely short conical chucks, big reel diameters or widths.

1. Maximum web width (cm)
2. Maximum reel diameter (cm)
3. Maximum reel weight (kg)
4. Paper caliper (μm)
5. Chucking thrust force (kp/cm² or kPa)
6. Maximum press speed (m/s)
7. Maximum deceleration rate (m/s²)