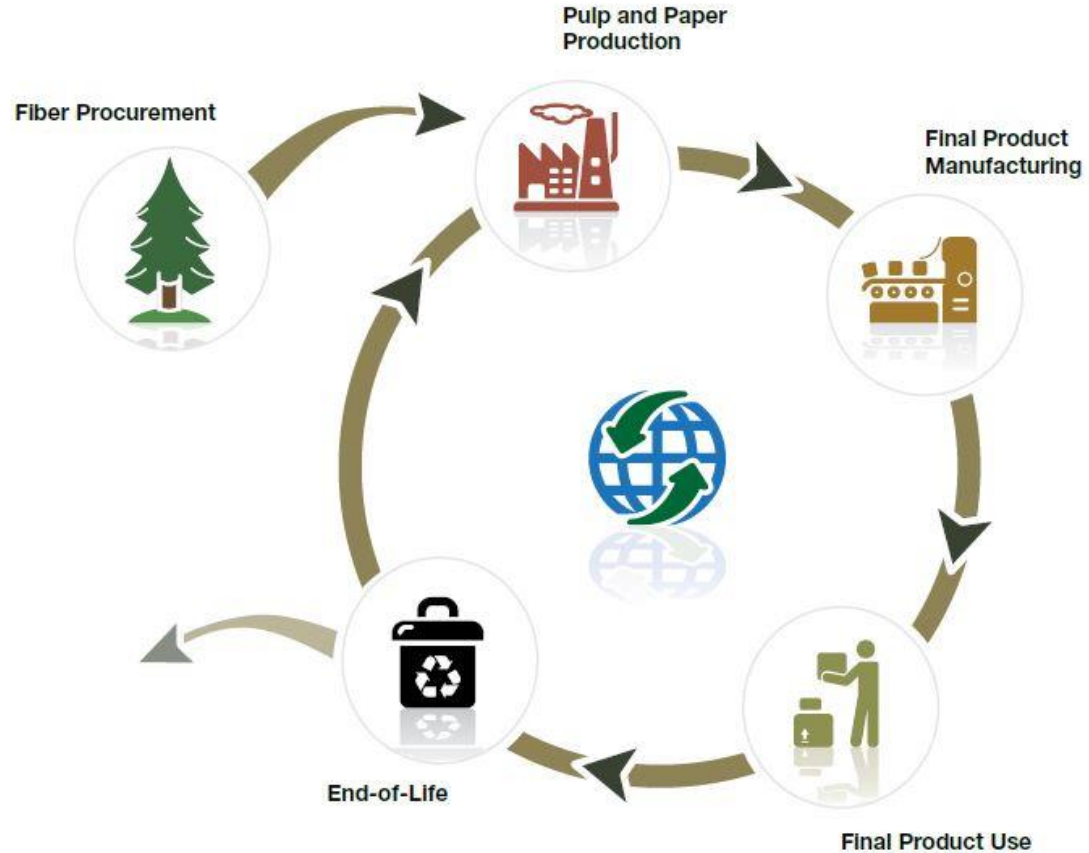


FIBER BASICS 201

A DEEPER DIVE INTO THE REALM OF
CELLULOSE



- Fiber Overview
 - Fiber Sources
 - Pulping Process
- Stock Preparation
- Morphology
- Summary



■ What are fibers?

Definition of 'fiber'



fiber



(faɪbər  )

Word forms: **fibers**

REGIONAL NOTE:
in BRIT, use **fibre**

1. **countable noun**

A **fiber** is a thin thread of a natural or artificial substance, especially one that is used to make cloth or rope.

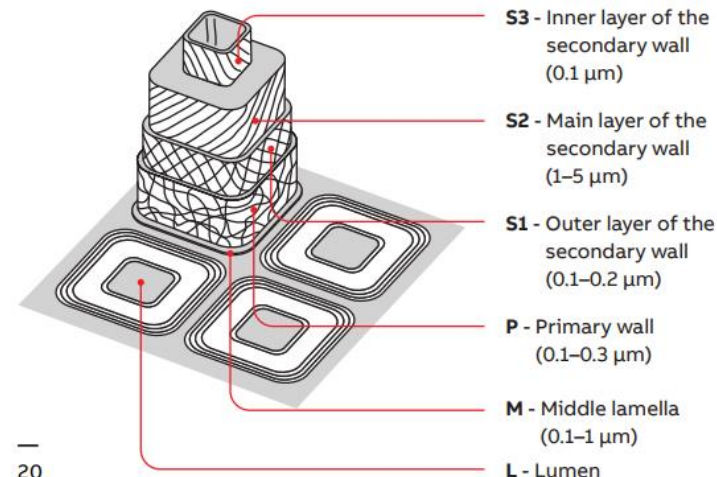
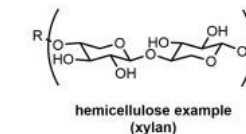
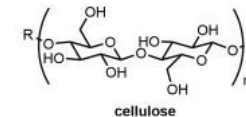
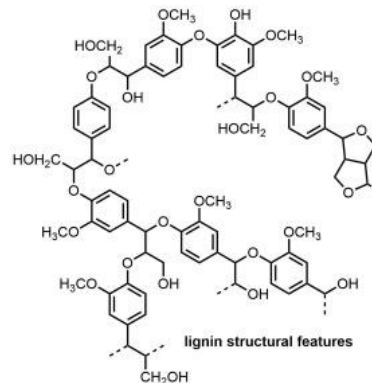
If you look at the paper under a microscope you will see the fibers.



Fiber Overview

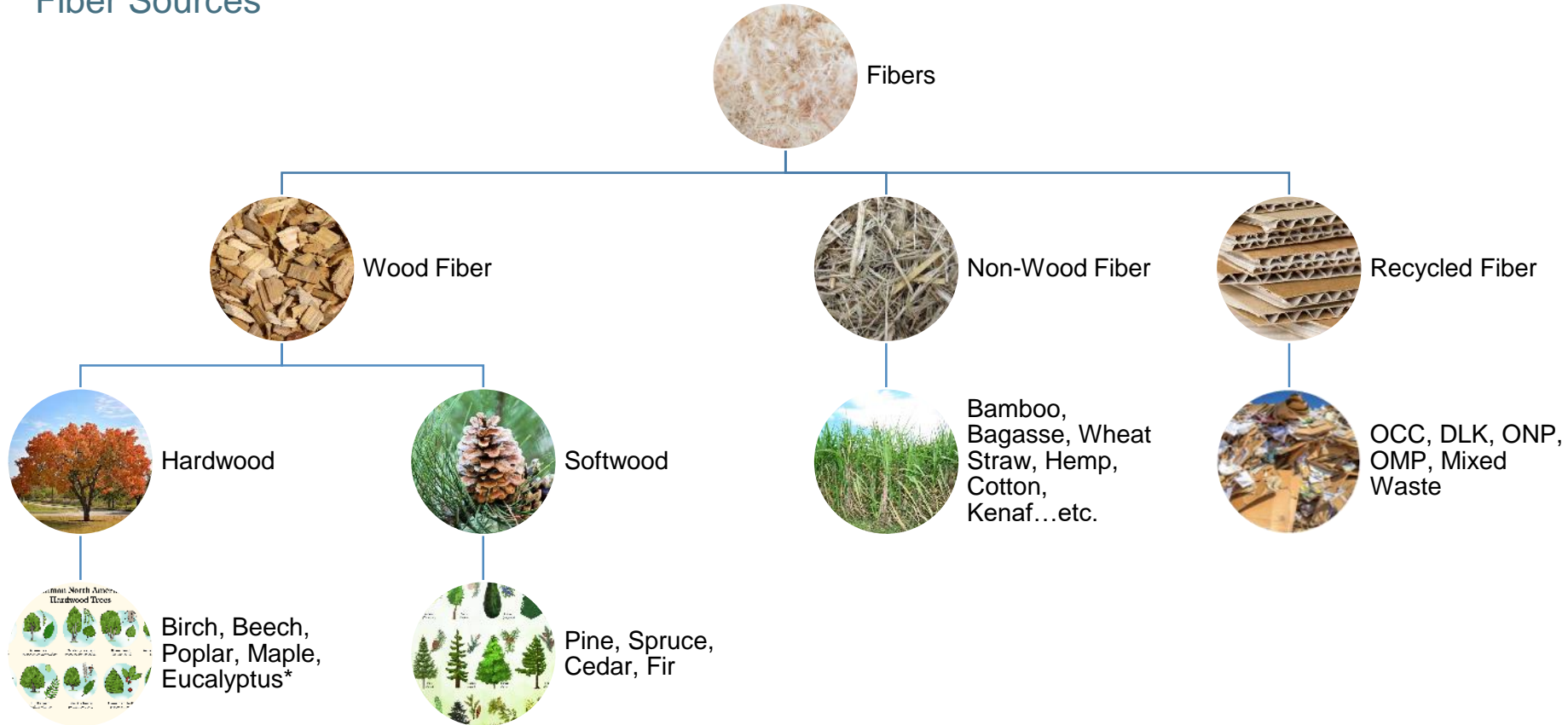
Building Blocks – All fiber sources contain

- Cellulose
 - 6 String carbon molecule
 - Most important for forming molded fiber
- Hemi-Cellulose
 - 5 or 6 String carbon molecule
 - Second most important for forming molded fiber
- Lignin
 - 31 String carbon molecule
 - Obstructs cellulose and hemi-cellulose from making bonds
- Extractives
 - Terpenes/Terpenoids
 - Fats and Waxes
 - Phenolic Compounds
 - Alkaloids
 - Can be profitable bi-products from the pulping process



—
20

Fiber Sources



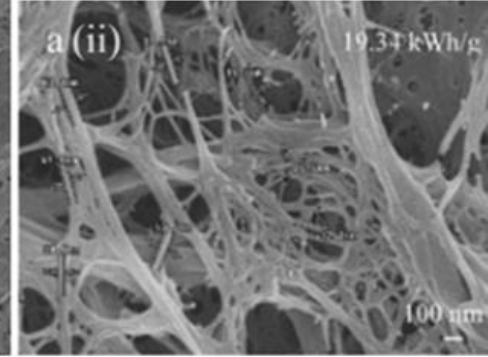
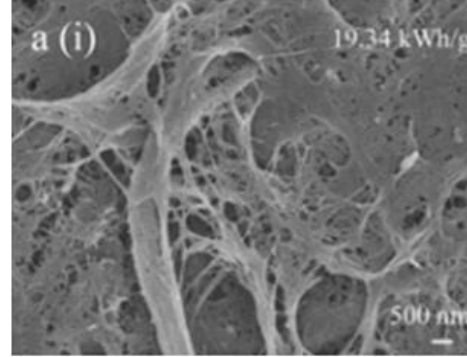
Fiber Overview

Fiber Sources

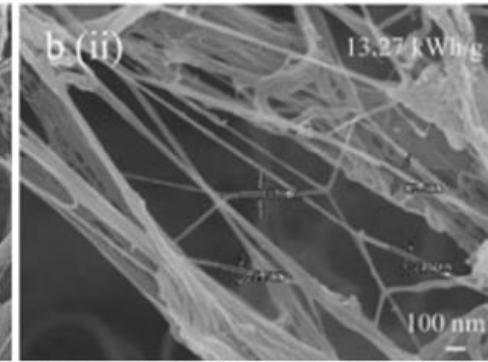
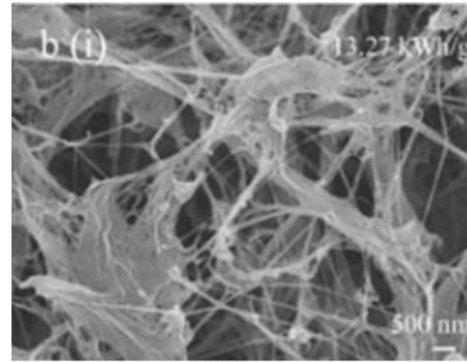
■ Different fiber sources have different characteristics

- Growth Patterns
- Fiber Length
- Fiber Width
- Fiber Shape
- Flexibility
- Water Retention
- Percentage of cellulose/lignin/hemicellulose/extractives
- Geography
 - NA vs EU

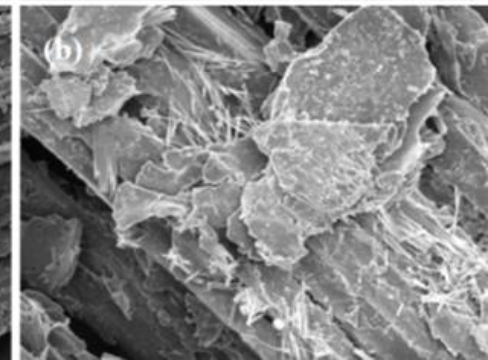
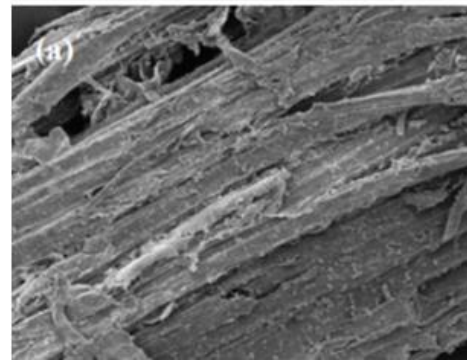
➤ Hardwood Fibers



➤ Softwood Fibers

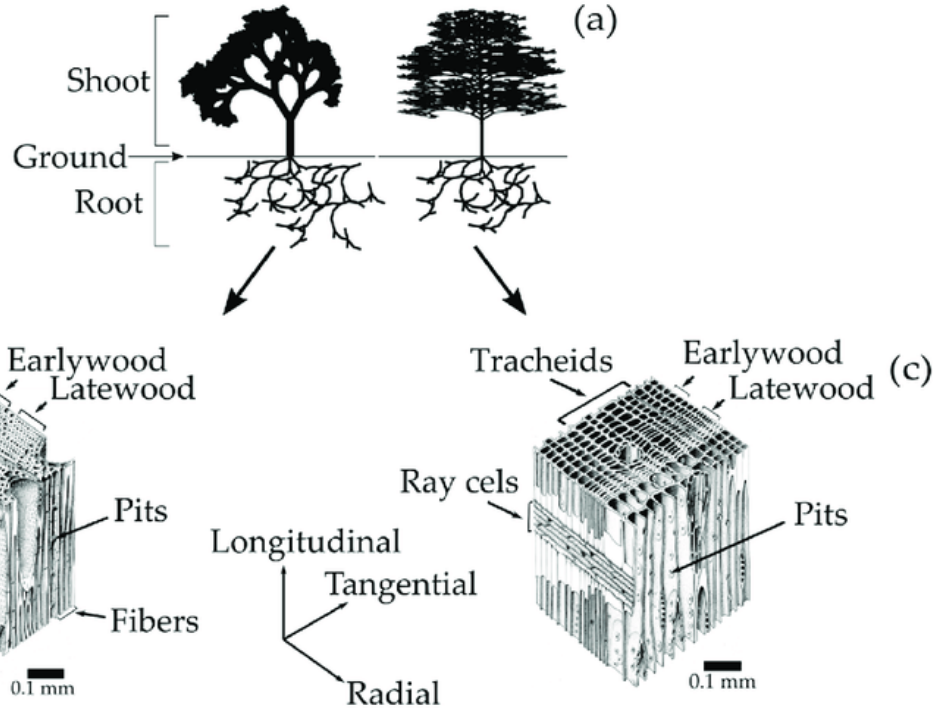


➤ Nonwood Fibers



Fiber Overview

Fiber Sources – Wood Fibers



Wood Fiber Types

Hardwood



Softwood



M. Hubbe



Fiber Sources – Nonwood Fibers

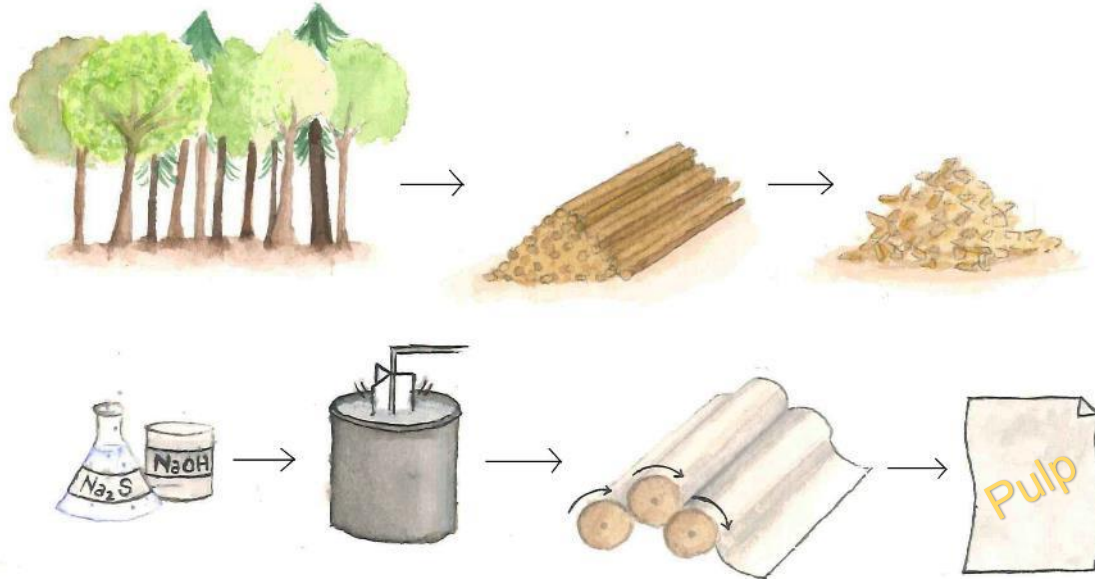
Table 3: Properties of non-wood fibers

| Species | Fiber length (mm) | Fiber diameter (μm) |
|---------|-------------------|----------------------------------|
| Bamboo | 2.8 | 15 |
| Straw | 1.5 | 13 |
| Bagasse | 1.7 | 20 |
| Hemp | 20 | 20 |
| Cotton | 20 | 20 |
| Reed | 1.2 | 12 |
| Wheat | 1.5 | 13 |
| Rice | 1.5 | 8.5 |

Fiber Guide by Håkan Karlsson Copyright © 2006 AB Lorentzen & Wettre, Box 4, SE-164 93, KISTA, Sweden

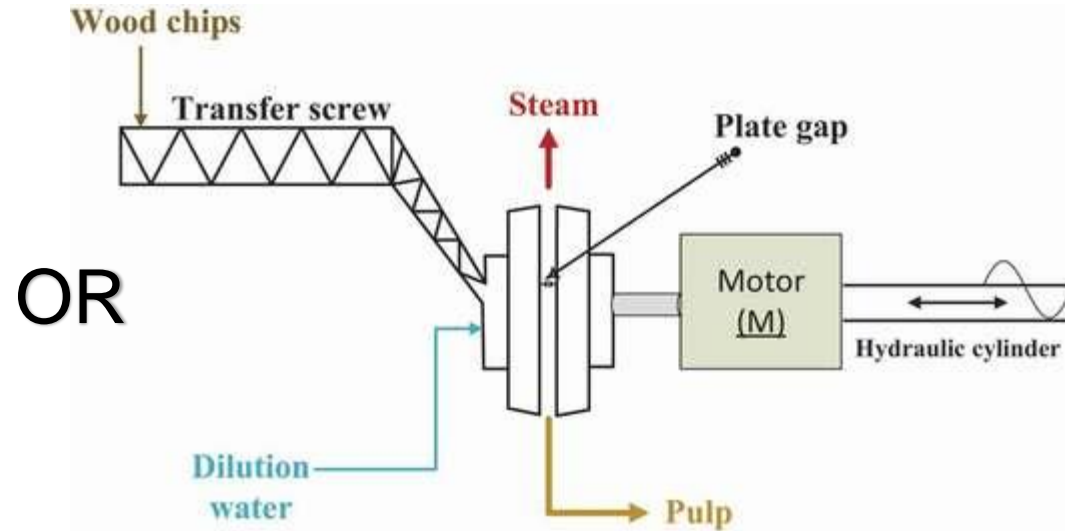
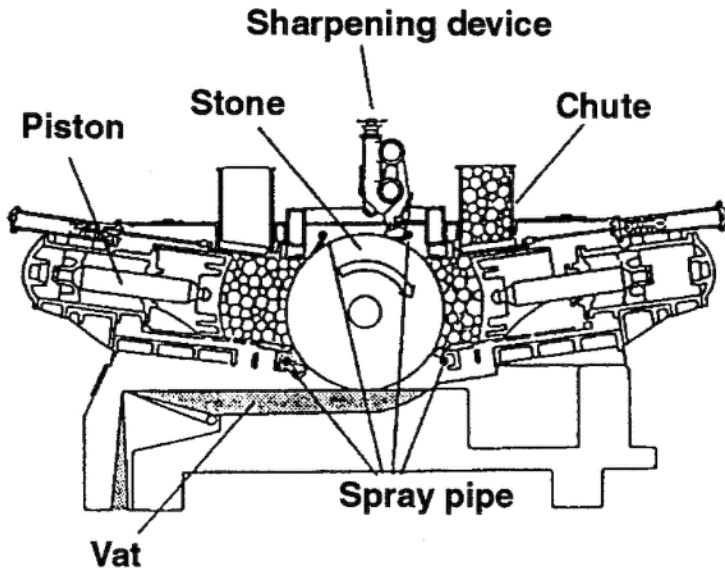
Fiber Overview

Fiber Sources – Pulping Process



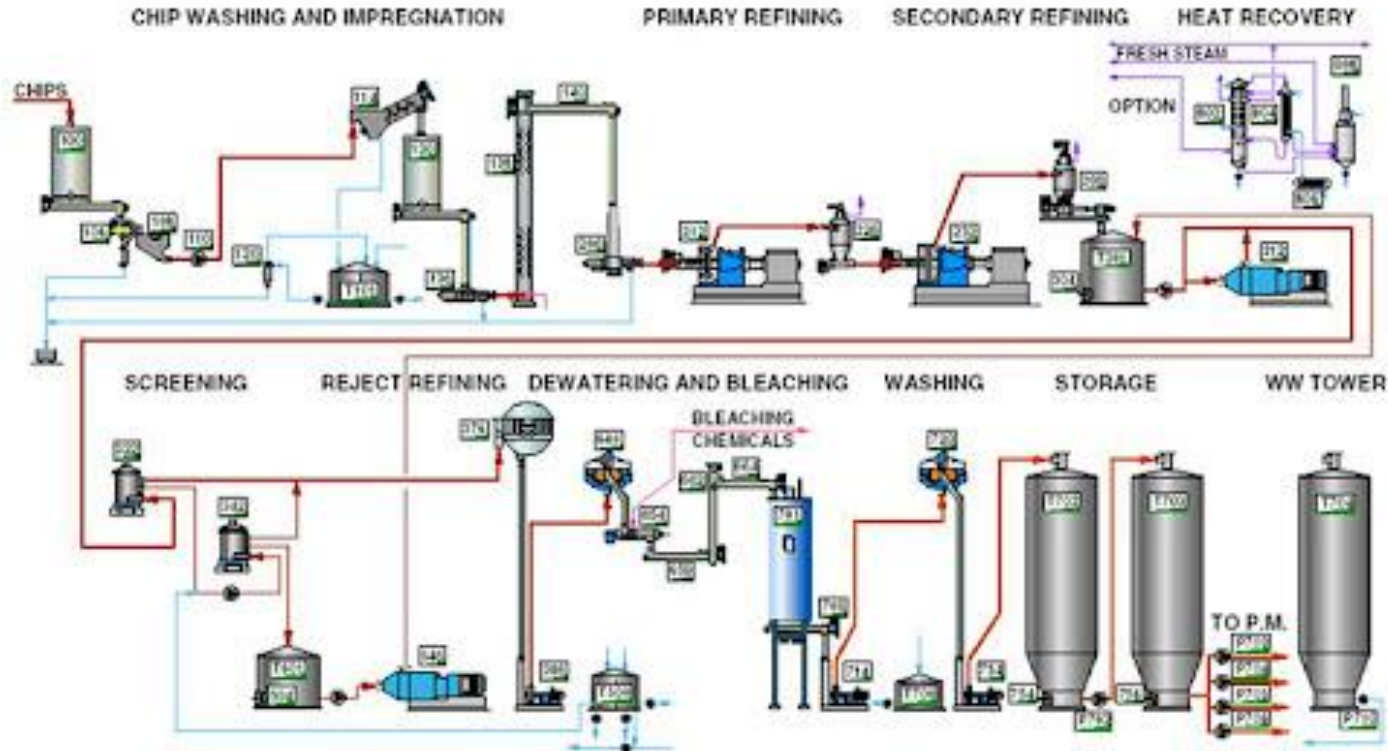
Fiber Overview

Fiber Sources – Pulping Technique - Mechanical

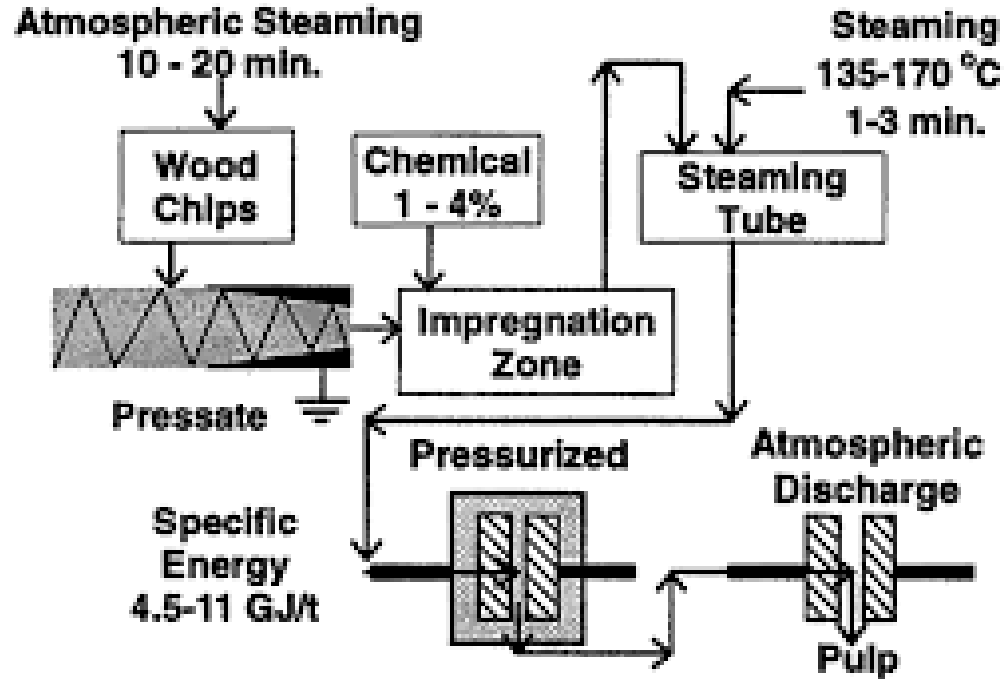


Fiber Overview

Fiber Sources – Pulping Technique – Chemical



Fiber Sources – Pulping Technique – ChemiThermo Mechanical (CTMP)



Fiber Sources – Pulping Technique

| Pulping process | Fibre separation mechanism | Yield | Pulp properties | Typical products |
|-----------------------------|--|---|--|--|
| Mechanical | Mechanical energy | High (85-95%) lignin preserved | Short, weak, unstable, high opacity fibres, good print quality | Newsprint, magazines, books, container board |
| Chemical | Chemical and thermal | Lower (45-50% for bleachable/bleached pulp. 70% for brown paper) | Long, strong, stable fibres | Kraft: bags, wrapping, linerboard, newsprint, graphic, writing paper, Sulfite: fine paper, tissue, glassing, newsprint |
| Semi chemical | Combination of chemical and mechanical | Intermediate (55-85%) | "Intermediate" pulp properties | Corrugated board, food packaging, newsprints, magazines |
| Recycled (RCF fibre) | Mainly mechanical with some heat and chemicals | Depends on waste paper source. Up to 95% for waste packaging, and 60% for waste hygienic products | Mixture of fibre grades, properties depend on waste paper source | Newsprint, magazines, packaging, tissue and writing paper. |

Kowalska, Malgorzata & Donatello, Shane & Wolf, Oliver. (2019). EU Ecolabel criteria for Graphic Paper, Tissue Paper and Tissue Products. Final Technical Report. 10.2760/71692

Stock Preparation

Next Steps – Preparing the Fibers



Stock Preparation



<https://voith.com/corp-en/papermaking/blueline-occ-process.html>

Pulping

- Pulp and Water
 - Batch vs continuous
 - Consistency (percent solids)
 - Dwell Time
 - Fiber to fiber interaction
 - Swelling
 - Temperature
 - pH

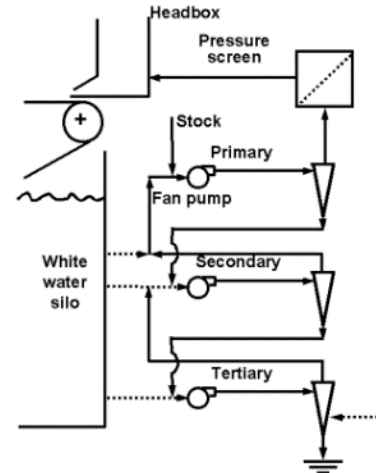
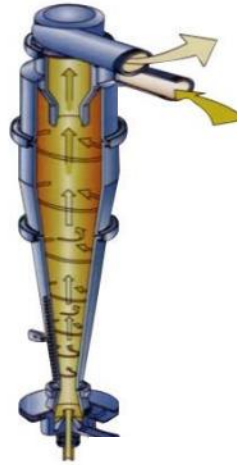


<https://www.pulpandpaper-technology.com/products/cellwood-machinery/vertical-pulpers>

Stock Preparation

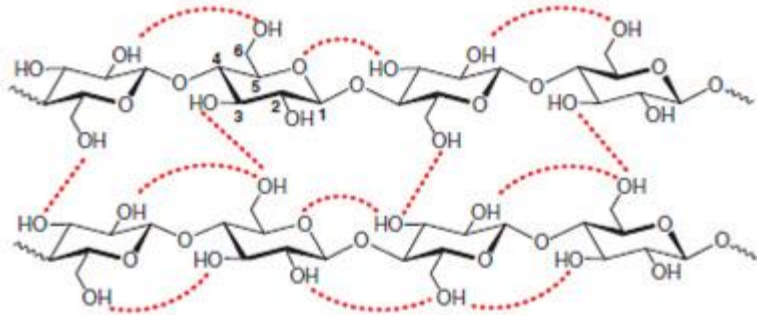
Screening and Cleaning

- Contamination Removal
- Most common in a cascading system
 - Maximized fiber recovery
- Removal Based on Size
 - Pressure Screen
 - Coarse screens
 - Fine screens
- Removal Based on Density
 - Cleaner Cones
 - High density
 - Low density



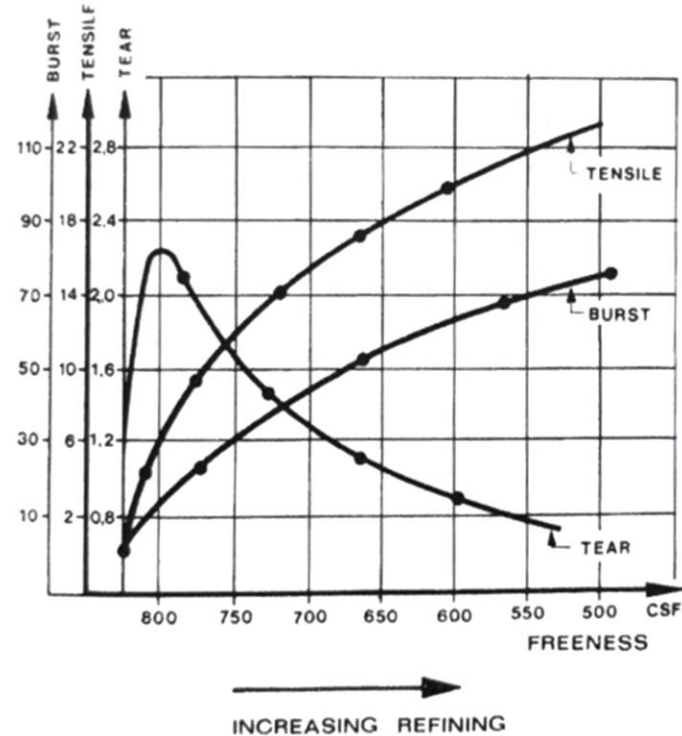
Refining

- Adds surface area to the fibers (fibrils)
 - Increases bonding sites
 - Can shorten fibers
- Increases fiber flexibility
- Changes strength properties
- Increases smoothness
- Slows drainage and drying time

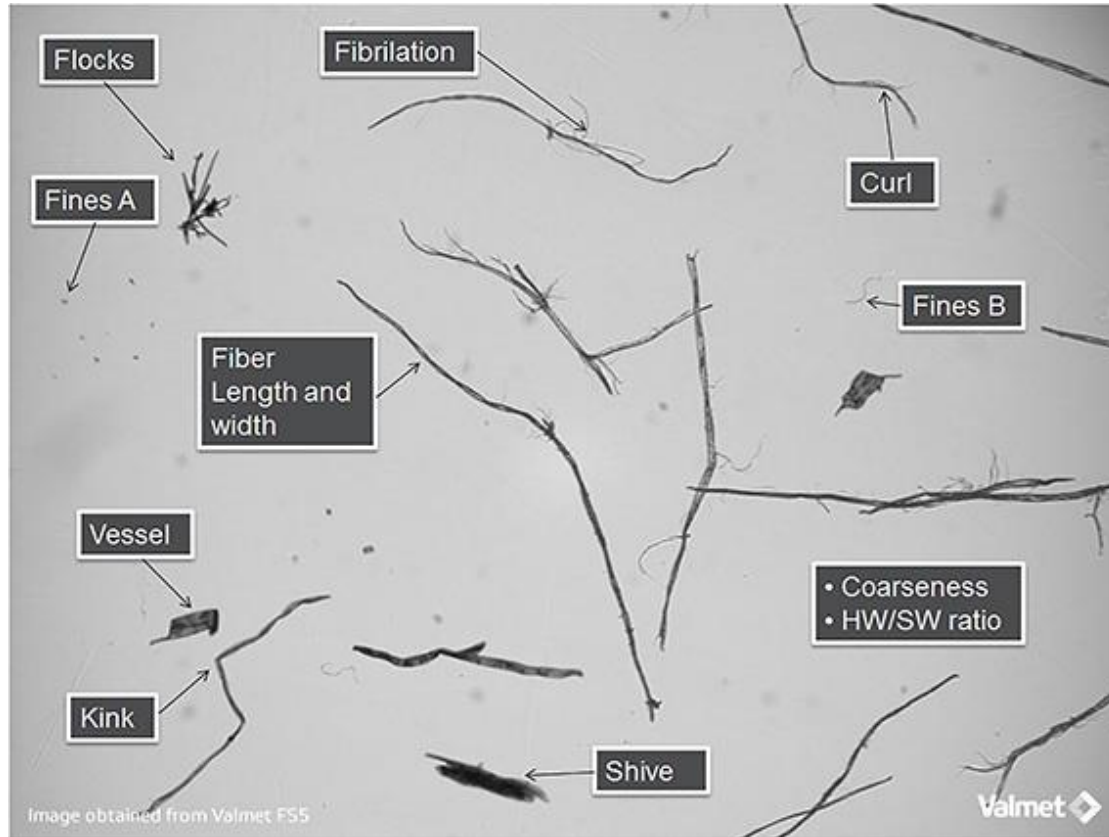


Refining Continued

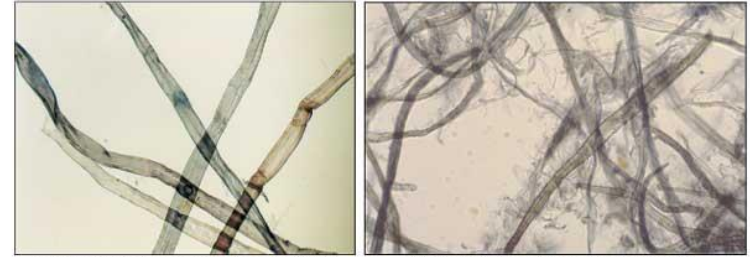
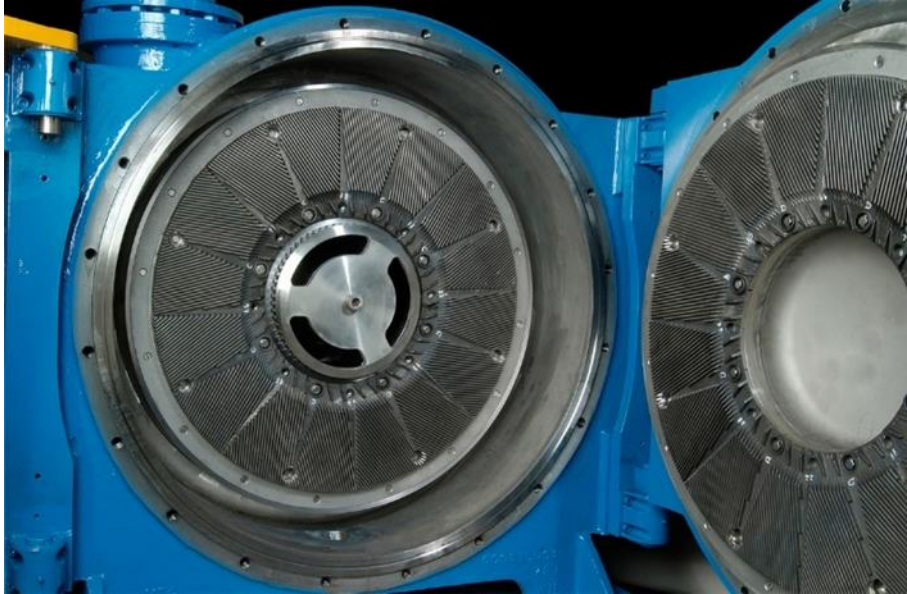
- Refining Techniques
 - Plate Gap
 - Plate Design
 - Refiner Style
 - Disc
 - Double Disc
 - Conical
 - Jordan
 - Valley Beater
 - Pulp Consistency
 - Fiber Source



Properties



Modifying Morphology



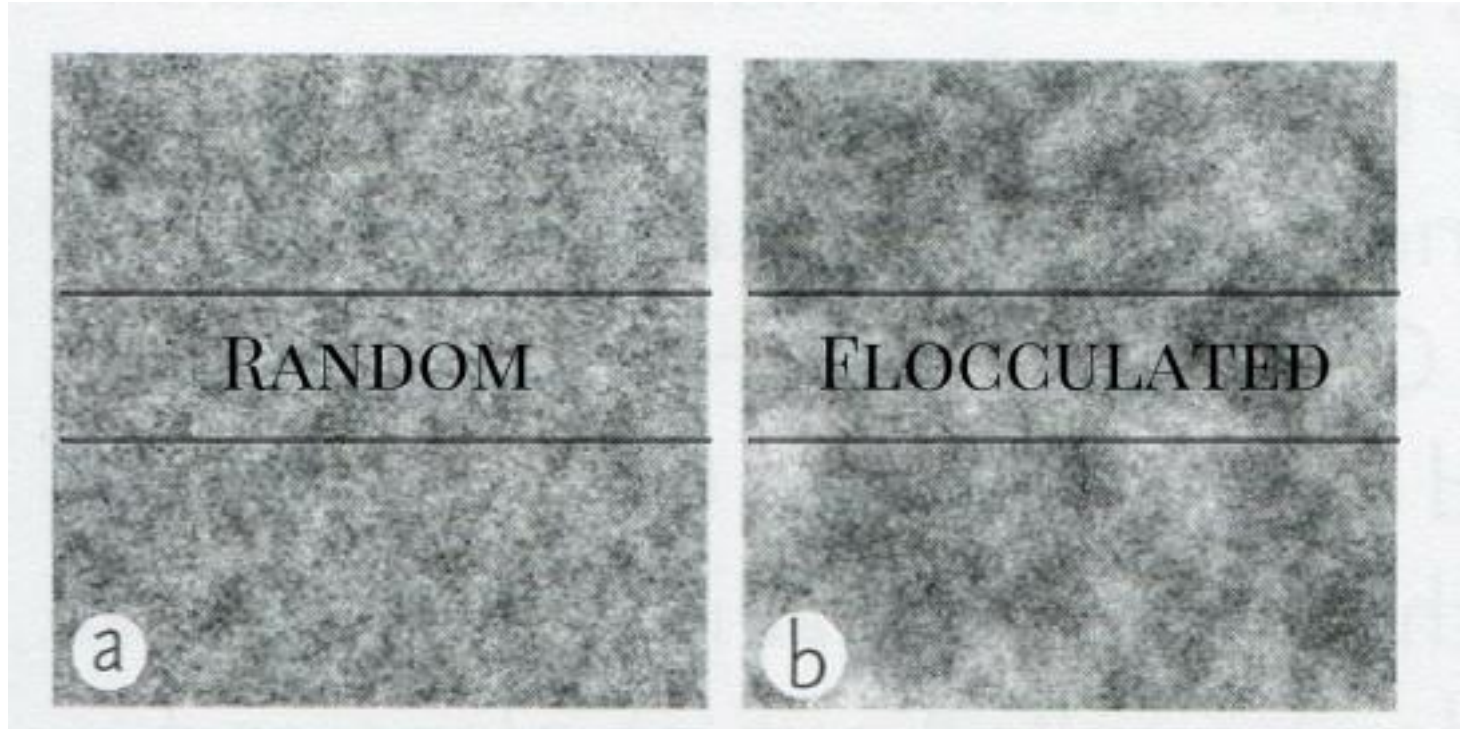
Chemical pulp fibers before refining

Chemical pulp fibers after refining

Objectives of refining:

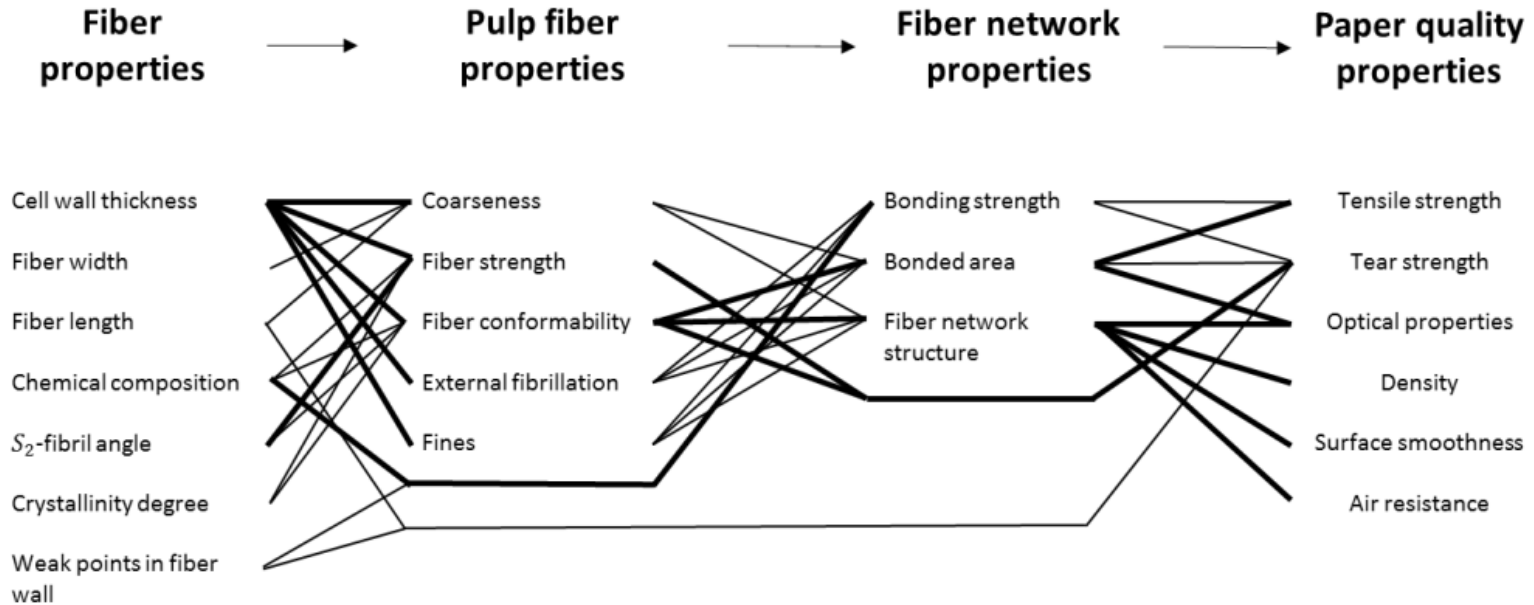
- to treat fibers to obtain desired properties for paper or board
- physical treatment of fibers so that they form a strong and smooth paper sheet with good printing properties

Refining is based on mechanical treatment of fibers with metallic bars with the presence of water.



Summary

Many Solutions/Problems



Questions?



Thank you!



DRIVING YOUR PERFORMANCE