

# Fractionated treatment and separate refining of pulp to reduce energy consumption

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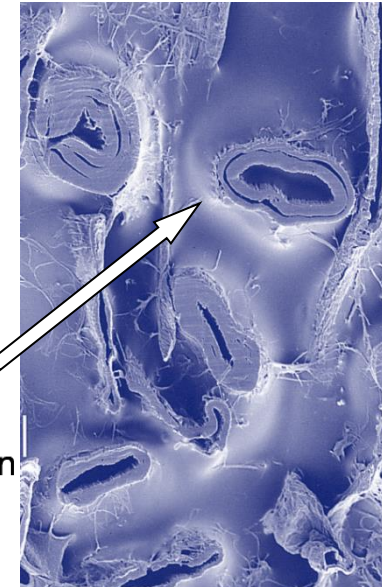
# Outline

- Introduction
- Fractionation and separate refining
- Results
- Conclusions

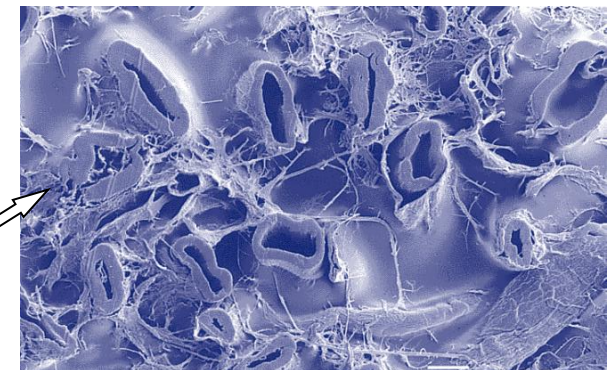
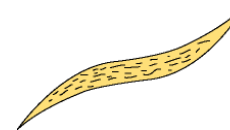
# Introduction

## Why refining?

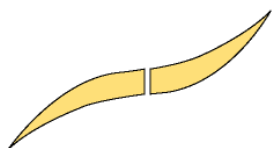
- Refining
  - Process engineering → milling process
  - Pulp and paper industry → forming process
  
- Through refining, fibres are...
  - internally fibrillated → higher flexibility
  - externally fibrillated → fines production, higher bonding area
  - long fibres are shortened
  - ideally, short fibres are not affected
  - better fibre-fibre bonding



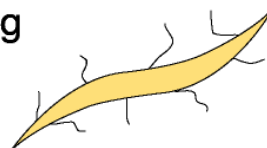
Internal fibrillation



External fibrillation



Shortening



# Introduction

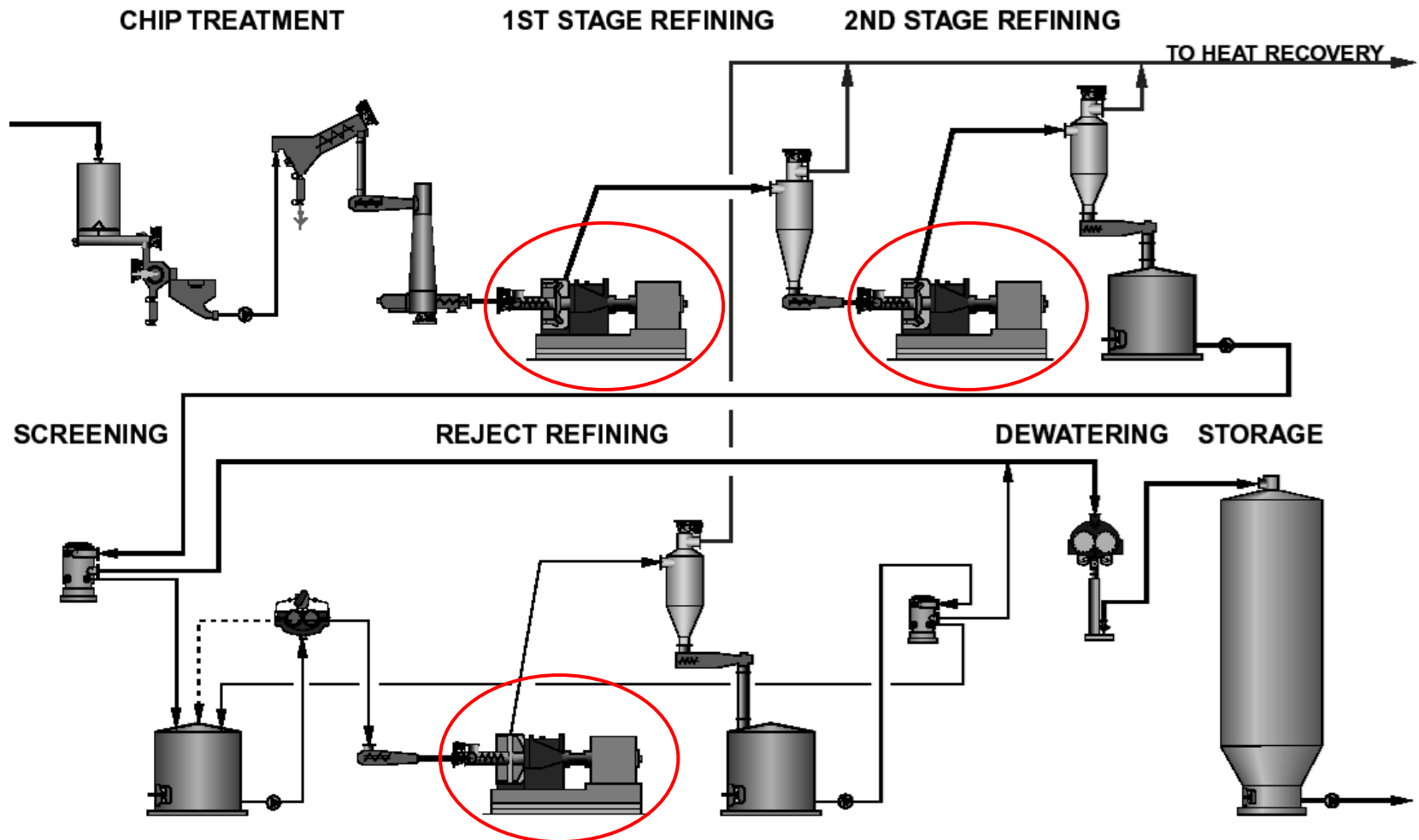
## Why refining?

- Refining needed in stock preparation, improving
  - fibre-fibre bonding ability
  - sheet formation
  - physical properties of the final product
- Unrefined pulp
  - lower sheet strength
  - rough surface
- Chemical and mechanical pulp need to be refined before they become suitable for papermaking

**Refining can represent up to 60% of the total power consumption**

# Introduction

## Thermomechanical Pulp (TMP) Plant



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# Fractionation and separate refining

- Fractionation is used to separate pulp into fine and coarse fraction
  - Fine fraction
    - can have higher tensile strength than the coarse fraction
    - their properties do not improve through refining
  - Coarse fraction
    - only the coarse fraction needs to be refined
    - refining only coarse fraction  $\Rightarrow$  energy consumption could be reduced
- Different types of fractionation devices available



# Fractionation and separate refining

## Types of refiners

- Lab scale
  - Jokro mill
  - PFI Mill
  - Valley Beater
- Industrial refiner (e.g)
  - Voith Sulzer Twinflo E



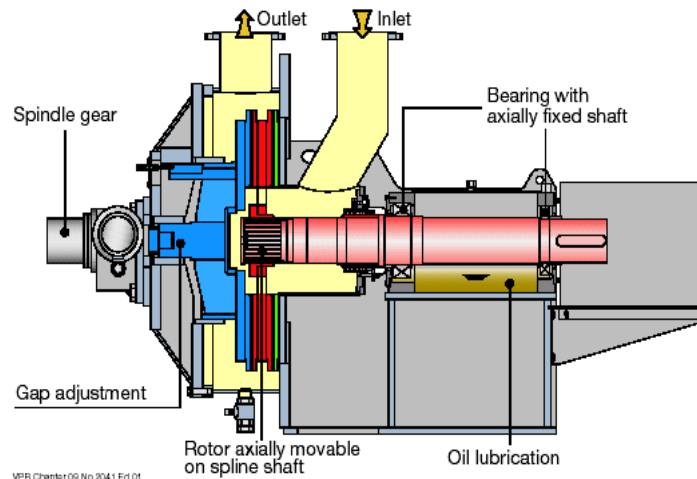
(PFI Mill, Frank-PTI)



(Jokro Mill, Frank-PTI)



(Valley Beater, Frank-PTI)



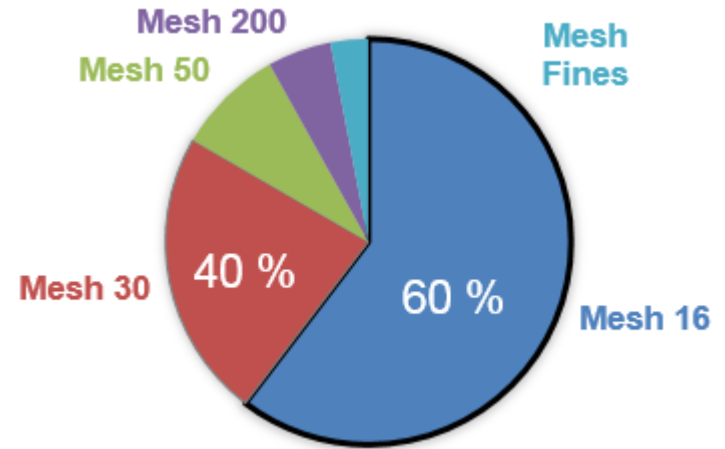
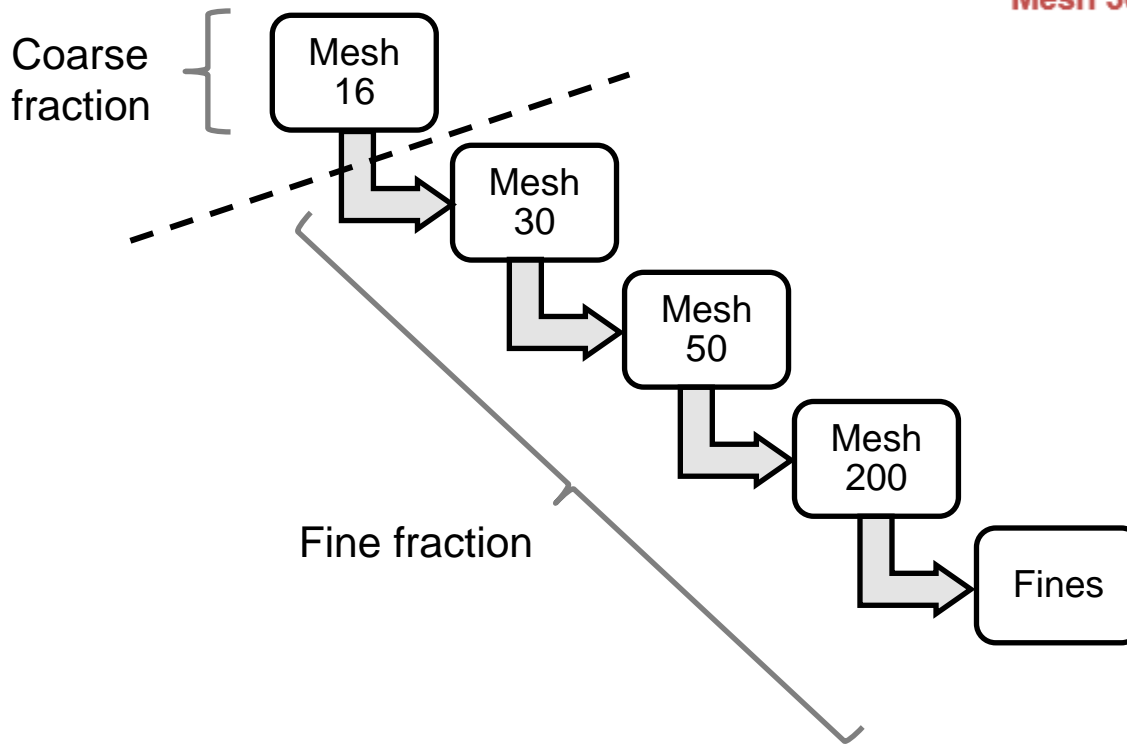
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# Fractionation and separate refining

## Fractionation on the lab scale

Preparation of the sample



Bauer McNett

# Fractionation and separate refining

## Refining on the lab scale

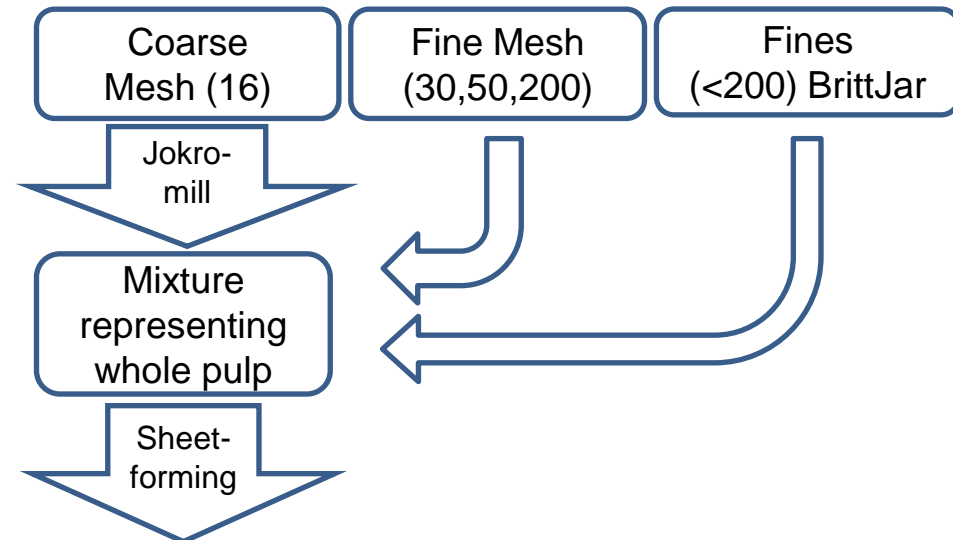
1. Refining of the entire sample (reference)
  2. Refining of the coarse fraction
  3. Refining of the fine fraction
- Refining performed using a Jokro Mill
    - 600 rpm in desintegrator
    - 20 minutes, 150 rpm
    - 240 rpm in desintegrator



# Fractionation and separate refining

## Sheet forming and mechanical testing

- Preparation of handsheets (Rapid-Köthen)

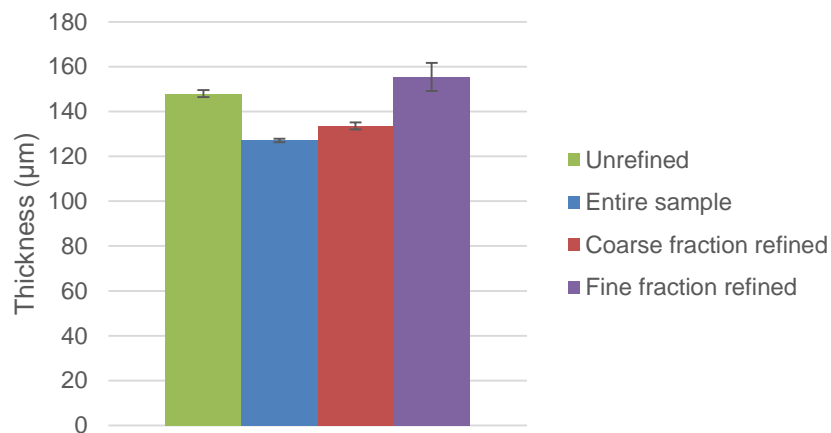


- Determination of properties such as thickness/density, tensile strength, beating degree ( $^{\circ}$ SR), air permeability

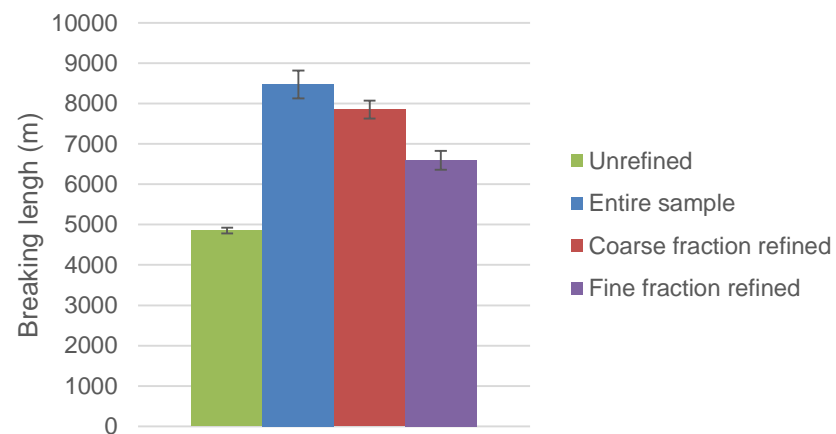
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- **Results**
- Conclusions

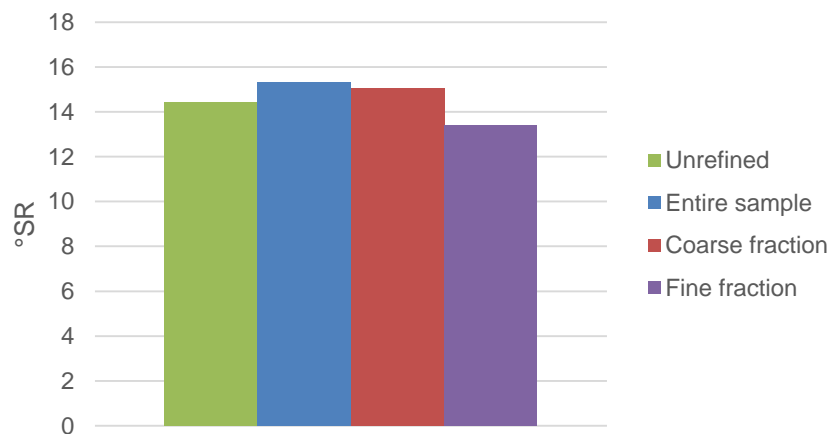
### Thickness



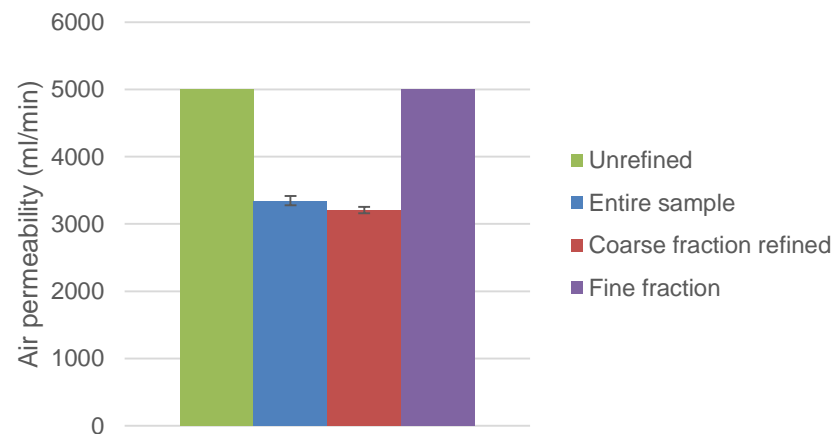
### Breaking length



### Schopper-Riegler



### Air permeability



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# Conclusions

- Refining improves the paper properties
- Promising results when the coarse fraction is refined compared to refining the whole sample
  - Similar effect on dewatering
  - Comparable results on thickness
  - Comparable results on air permeability
  - 40% less material refined → similar increase in breaking length → **energy savings**
- Future trials using different pulps and coarse/fine fraction ratios