Rosenheim
Technical University
of Applied Sciences

From tree to peat substitute – Analysis and optimization of the production of wood fibres

Off the peat path, Online workshop, 25 April 2023

Research project
Research facilities

Rosenheim
Technical University
of Applied Sciences

Weihenstephan-Triesdorf
University of Applied Sciences
Institute for Horticulture

Rosenheim Technical
University of Applied Sciences
Laboratory for wood-based panels

Research focuses

- Evaluation of new peat substitutes
- Development of methods for quality assessment of growing media
- Elaboration of sustainable fertilization strategies
- Training and support for growers in conversion to peat-free cultivation

Research focuses

- Process optimization and development
- Improvement of raw material and energy efficiency
- Enlargement of the raw material basis
- Fibre production and analysis

Research project
Problems and goals

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Wood fibres as a regionally available, renewable peat substitute with the main issue of nitrogen immobilisation

→ Lack of information regarding the influence of the processing parameters on the N immobilisation

Analysis and optimization of the production chain of wood fibres

→ Achieving a low or rather calculable N immobilisation

→ Enlargement of the raw material base by using unconsidered wood species and assortments

Research project
Methodology

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Subproject A

Raw material acquisition and processing

Subproject B

Production of wood fibres by refiner and retruder technology

Subproject C

Horticultural examination of the wood fibres

Wood fibre production
Process chain

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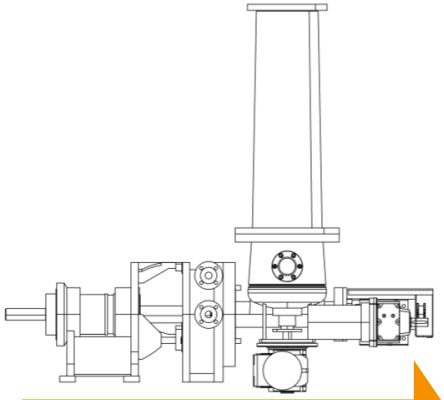
raw material

chipping

wood chips



defibration

wood fibres

Wood fibre production
Raw material

Primary use of softwood (e.g. spruce and pine) without bark

Climate change and forest restructuring call for an enlargement of the raw material base

- Softwoods as spruce and pine are highly prone to the consequences of climate change
- An increasing proportion of hardwood and a decreasing availability of softwood can be expected

Alternative wood species and assortments become increasingly important (e.g. beech, wood from short rotation plantations and bark beetle infected spruce)

Wood fibre production
Chipping

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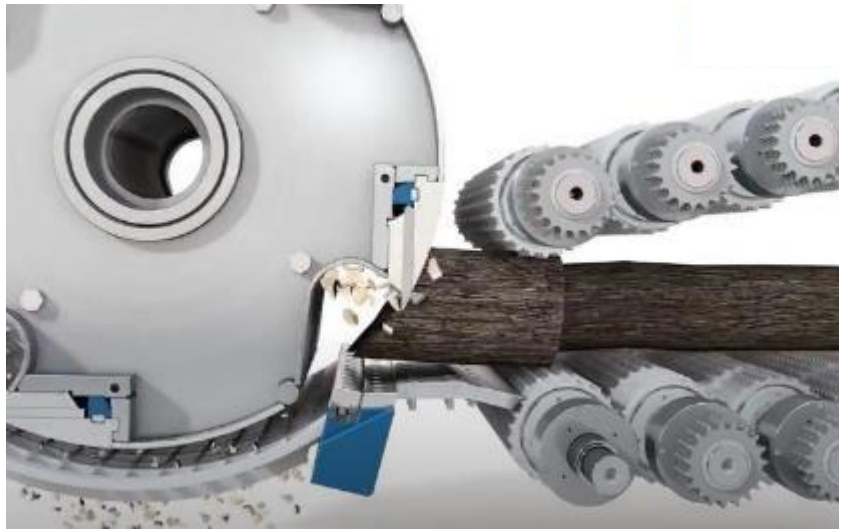
Drum chipper



Ausschnitt aus https://www.youtube.com/watch?v=3DiLzRd-Wkg&t=11s der Bruks Klöckner GmbH

- Versatile usability (logs, sawmill by-products)
- Chips of inconsistent size
- Higher fines content

Disk chipper

Ausschnitt aus https://www.youtube.com/watch?v=9vDIe_KMnWc&t=10s der Bruks Klöckner GmbH

- High quality chips of predominantly uniform size
- Only usable for logs

Wood fibre production
Chipping process parameters

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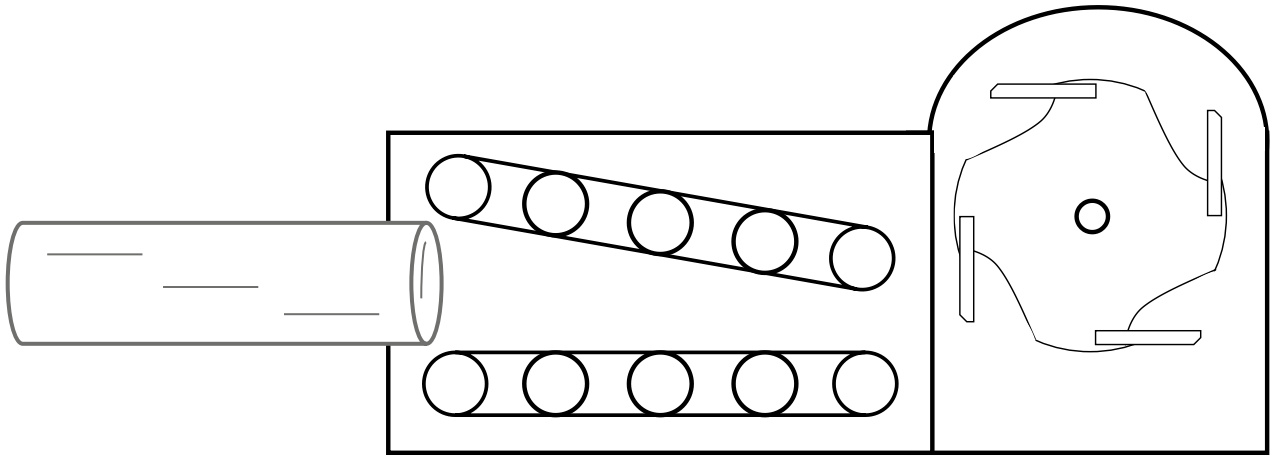
Influencing factors

- tree species
- moisture content
- wood quality



drum chipper

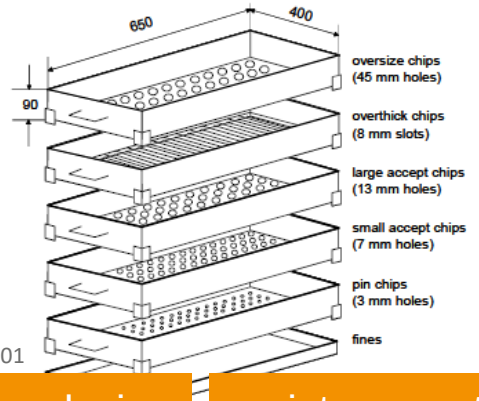
- infeed speed
- knife sharpness
- screen mesh size

Influenced variables

- particle size distribution
- specific energy consumption

Wood fibre production
Wood chips analysis

wood chips



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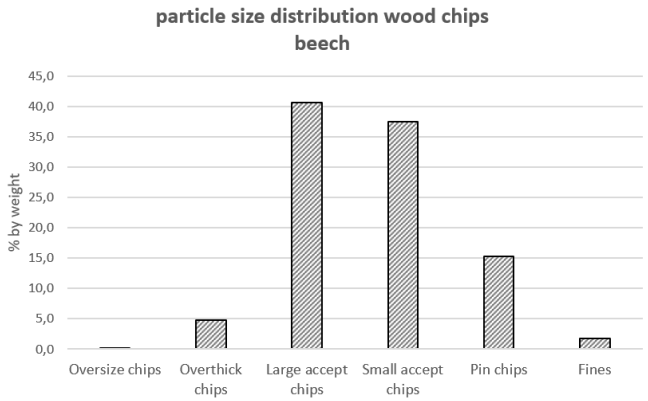
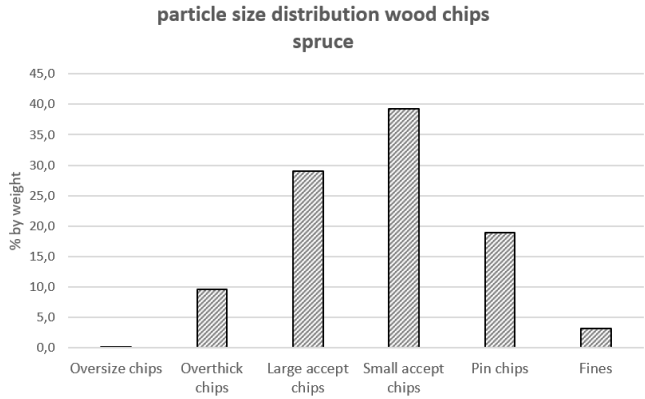
sieve analysis

moisture content



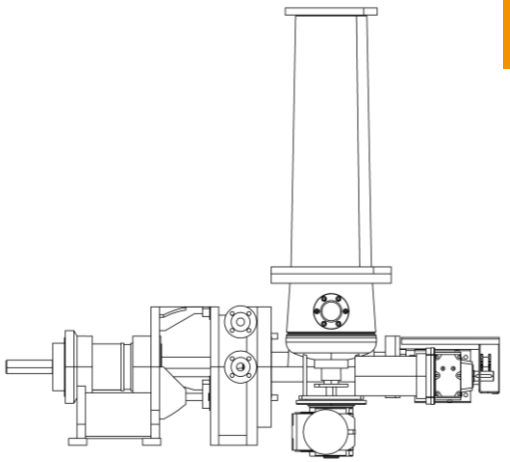


particle size distribution

Wood fibre production
Defibration

Defibration technologies

for growing media



Laboratory TMP refiner

Refiner

- Thermo-mechanical pulping process (TMP)
- Refiner mechanical pulping process (RMP)

Ex- / Retruder

Patent EP 0 620 779 B1

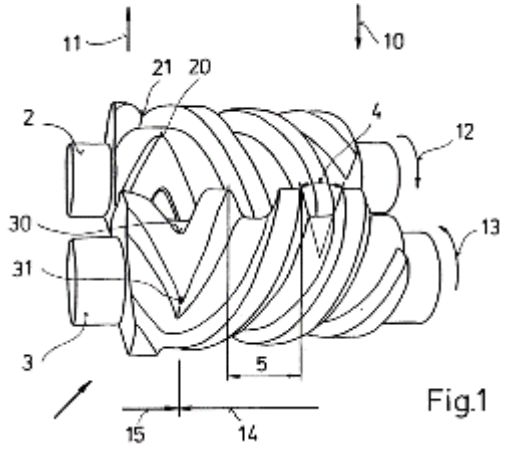


Fig.1

Wood fibre production
RMP refining

Refiner mechanical pulping process (RMP)

- Defibration of wood chips between grinding disks under atmospheric pressure
- Preheating of the wood chips by steam up to 100 °C possible

Wood fibre production
TMP refining

Thermo-mechanical pulping process (TMP)

- Defibration of thermally pretreated wood chips between grinding disks in a pressurized system
- Short preheating in steam at temperatures / pressures between 120-190 °C / ~ 2-12 bar
- Thermal pretreatment softens the wood structure and therefore enables a better separation of the fibres out of the fibre matrix
  - ➢ Reduced electric but increased thermal energy demand
  - ➢ Improved fibre quality

Wood fibre production
Refiner process parameters

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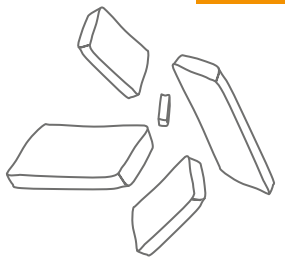
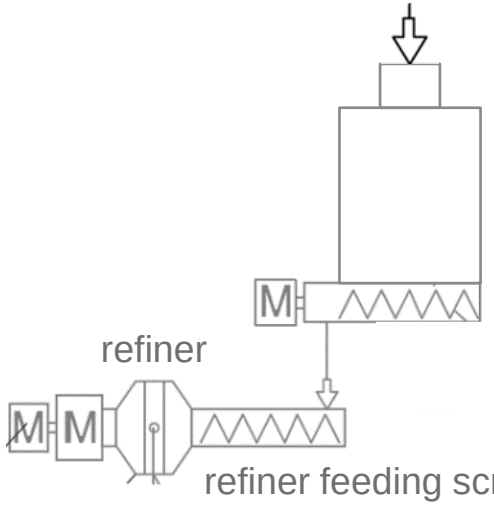
wood chips → RMP refiner





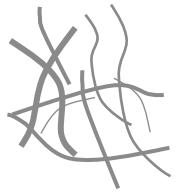
Influencing factors

- Raw material quality
- Tree species
- Moisture content
- Particle size distribution

Variable process parameters

- Presteaming
- Infeed speed
- Grinding plate pattern
- Grinding disc distance

wood fibres



Influenced variables

- Specific energy consumption (thermal and electric)
- Fibre morphology

Wood fibre production
Refiner process parameters

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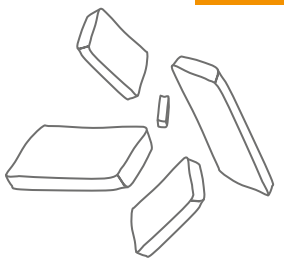
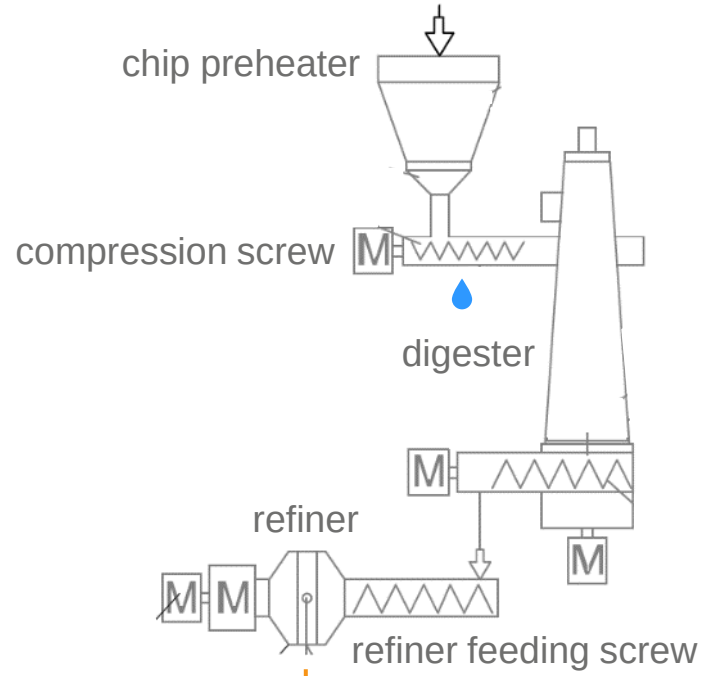
wood chips → TMP refiner





Influencing factors

- Raw material quality
- Tree species
- Moisture content
- Particle size distribution

Variable process parameters

- Steaming temperature
- Steaming time
- Infeed speed
- Grinding plate pattern
- Grinding disc distance

wood fibres

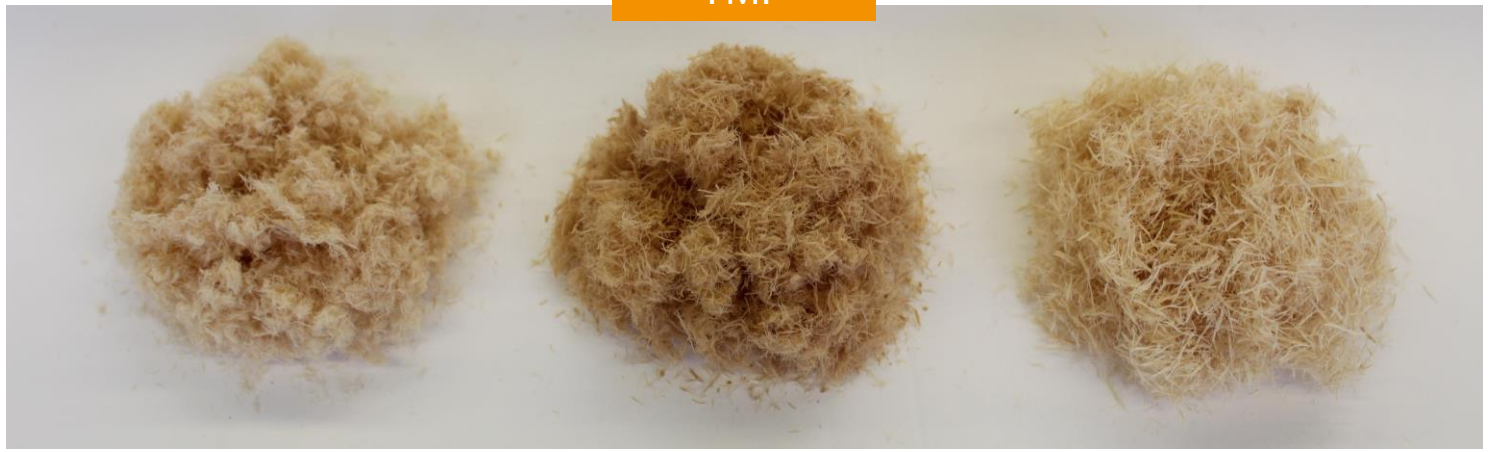
Influenced variables

- Specific energy consumption (thermal and electric)
- Fibre morphology
- Chemical properties (e.g. pH)

Wood fibre production
Refiner fibre quality

RMP

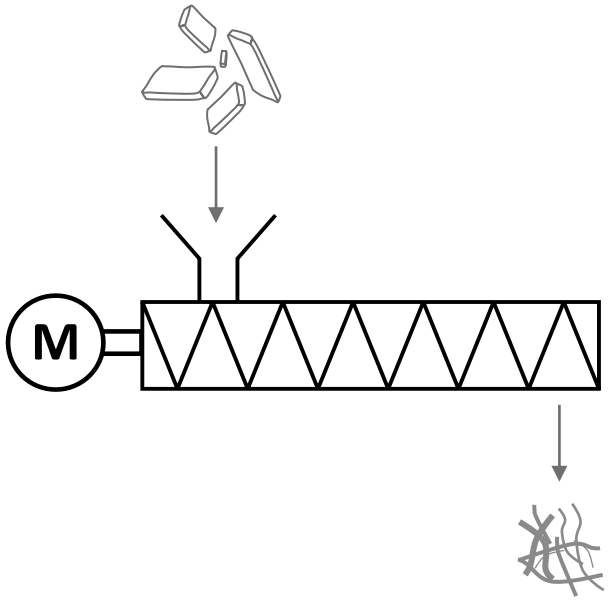
TMP



Refiner fibre quality

- Very wide range of fibre qualities producible
- Colour changes indicate the intensity of the thermal pretreatment

Wood fibre production
Extruder / Retruder



- Defibration of wood chips between two counterrotating screws due to shear stress
- Dimension of the discharge opening as variable process parameter with limited effect on energy demand and fibre morphology

Wood fibre production
Extruder / Retruder fibre quality

discharge opening

Fibre quality

- Coarse fibre quality with a high amount of shives
- Comparably small range of variation regarding fibre morphology possible

Wood fibre production
Fibre characterization

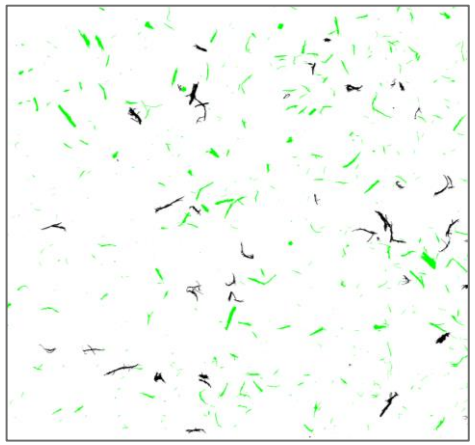


Image analysis

- Optical shape measurement
- Various automatic optical analysis systems on the market (wood-based panel industry)
- Not all analysis systems are suitable for large fibre sizes

Air-jet sieving

- Determination of particle size distribution by mass
- Comparatively simple, but more inaccurate than image analysis
- High importance of sieving parameters like sieving time and air pressure

Wood fibre production
Conclusion

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Refiner technology

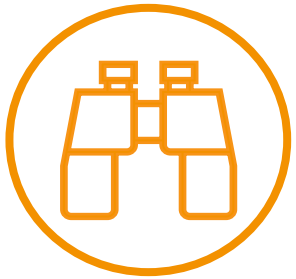
- Adjustment of variable process parameters allows to widely influence fibre morphology and specific energy consumption
- In comparison RMP refining is effluent free and more simple than TMP refining regarding its technical components and process control
- The TMP process shows a higher thermal but lower electric energy demand than the RMP process
- RMP process operates at temperatures ≤ 100 °C and therefore the fibres fulfil the requirements for being classified as CMC2 according to the new EU regulation for fertilising products (EU 2019/1009)

Ex- / Retruder technology

- Simple process technology but limited influence on fibre quality
- Postprocessing (e.g. sieving) may be needed to achieve desired fibre quality
- Efficiency of wet sieving / screening of fibrous material is actually very limited

➡ First investigations indicate that the specific energy demand of refiner and ex- / retruder processes vary within a comparable range

Research project
Outlook



Horticultural examination of a large variety of RMP and TMP fibre geometries as well as retruder fibres by the University of Weihenstephan-Triesdorf in order to

- gain information about the correlation between process technology and parameters, fibre morphology and horticultural properties (esp. N-immobilization)
- execute a data based optimization of the fibre production process in consideration of different tree species
- investigate the suitability of thermally modified wood for growing media

Questions?
Contact us!

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← horticultural questions

→ technical and process-related questions