FIBSUN

Novel fibre value chains & ecosystem services from sustainable feedstocks

Newsletter #15 | May 2025

Optimization of Common Reed for Thermal Insulation

Objective: Enhance common reed's suitability as an eco-friendly insulation material by improving its resistance to moisture and biological degradation.

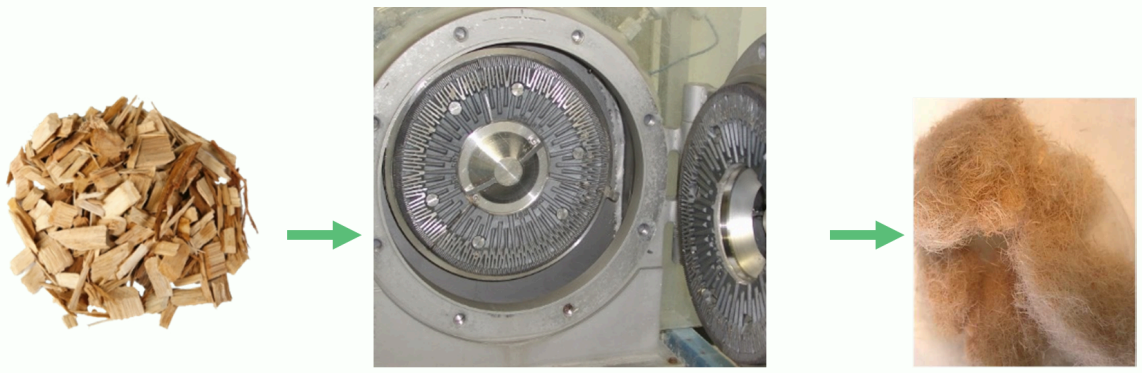
- **Hot Water Extraction (HWE)**:
  - Applied to reduce hydrophilic components, thereby increasing mold and fungi resistance.
  - Higher temperatures (up to 160°C) effectively removed hemicelluloses, yielding a cellulose-lignin-rich material suitable for insulation applications.

- **Mechanical Processing**:
    - Thermo-mechanical pulping (TMP) converted HWE-treated reed into particles comparable to conventional wood fibers used in insulation.
- **Large-Scale Processing**:
    - Scaled up HWE process treated 30 kg of reed, confirming the feasibility of industrial application.
    - Post-treatment included drying and particle size characterization to ensure material quality.
- **Applications**:
    - HWE-treated reed fibers can be utilized in producing insulation boards or particleboards.
    - Potential to partially replace synthetic resins in composites, contributing to more sustainable building materials.

Thermo Mechanical Pulping (TMP) of Common Reed

- **Process Overview**:
    - TMP involves two main steps: steam pre-treatment and mechanical refining.
    - Steam pre-treatment softens lignin in the biomass, facilitating fibre separation without significant chemical degradation.
    - Mechanical refining uses high-pressure forces between rotating discs to separate fibres while preserving much of the wood's structure.
- **Equipment Used**:
    - Andritz lab-scale 12-inch disc refiner at FCBA.

    - Operational parameters: 45 kW motor power, 3000 rpm rotation speed, 80 kg/h capacity, steam pressure of 3–4 bar, and refining temperature of 100–150°C.
- **Material Processed**:
    - Two batches of common reed supplied by LUKE: one with flowers and stems, and one with stems only.
    - Pre-heating conditions: 135°C temperature, 5-minute residence time, and 3.5 bar pressure.
- **Refining Conditions**:
    - Disc reference: Defibring disc D2B507.
    - Motor speed: 2900 rpm; feeding screw speed: 6 rpm.
    - No water added during refining.
    - Plate gaps varied: 50–250 µm for reed without flowers; 100–300 µm for reed with flowers, in 50 µm increments.
- **Fibre Quality**:
    - Finer fibres produced at smaller plate gaps; coarser fibres at larger gaps.
    - Fibre morphology similar to reference wood fibres achieved with plate gaps between 50–200 µm.
- **Comparison with SOPREMA**:
    - SOPREMA's system maintains constant defibration energy (105 ± 10 kWh/t) by adjusting plate gaps.
    - FCBA's system operates with constant plate gaps, measuring defibration energy throughout the process.



Extrusion of Reed Fibres

- **Equipment Used:**
    - Planetary Roller Extruder (PRE) L-WE 30 by Entex at LUKE's facilities.

    - Features a central spindle with six planetary spindles rotating counterclockwise.
    - Barrel divided into six zones with adjustable screw configurations and temperatures.
- **Material Preparation:**
    - Reed material ground to 1 mm particle size using a Cutting Mill Pulverisette.
- **Extrusion Parameters:**
    - Untreated Reed (CR):
        - Side feeder screw speed: 150 rpm; main screw speed: 150 rpm.
        - Solid feeding speed: 140 rpm; solid feeding rate: 25.6 g/min.
        - Water feeding: 35 g/min; solid content of feed: 31.1%; total feed rate: 60.6 g/min.
    - Hot-Water Extracted Reed (HWE-CR):
        - Side feeder screw speed: 200 rpm; main screw speed: 150 rpm.
        - Solid feeding speed: 110 rpm; solid feeding rate: 17.7 g/min.
        - Water feeding: 35 g/min; solid content of feed: 24.1%; total feed rate: 52.7 g/min.

Analysis of extruded reed fibres was carried out using the Valmet FS5 Fibre Image Analyser, in accordance with ISO 16065-2. The process involved diluting a small amount of material in water, followed by high-resolution optical analysis to determine fibre properties.

Key results:

- **Average fibre length (Lc(l) ISO):**
  - CR (common reed): 0.260 mm
  - HWE-CR (hot water-treated reed): 0.272 mm
- **Average fibre width:**
  - CR: 4.05 µm
  - HWE-CR: 4.09 µm
- **Number of fibres analysed:**
  - CR: 9,647,596
  - HWE-CR: 9,277,239

These results indicate that hot water treatment resulted in slightly longer and wider fibres. The high number of fibres analysed supports the reliability of the results.

Partner of the month

SOPREMA is a French company founded in 1908 that specializes in waterproofing, insulation, and roofing solutions. It operates in over 90 countries, with more than 11,200 employees and 123 production sites worldwide. The company places a strong emphasis on innovation and sustainability, investing heavily in R&D for eco-friendly construction materials. Its product range includes bitumen membranes, insulation systems, and green roofing solutions. SOPREMA is led by Pierre-Étienne Bindschedler, the founder's great-grandson, and continues to grow globally with a commitment to responsible building.

www.soprema.com

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