Boosting the absorption of foam formed structures - preliminary studies

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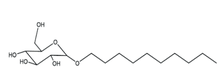
Summary

- The goal of the work is to develop the performance of foam formed cellulose based materials in absorption structures
- Low material density increases absorption but have negative effect on strength
- Basic paper making additives were tested to increase strength: clear improvement in water durability was achieved especially with TEMPO-CNF
- Investigations around more effective strength additives will be continued

Foam enables manufacturing of low basis weight & high bulk fibre structures

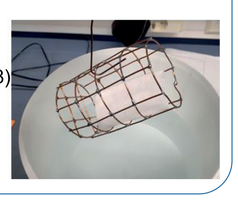
Surfactant
- Simulsol SL10 (Seppic)
- Nonionic alkyl polyglycoside
- MW 320g/mol



Procedure:
- 0.46% fiber suspension
- 1.4 g/L Simulsol SL10
- 3800 rpm mixing speed
- 70% air content

Laboratory foam mold
- Sheet forming

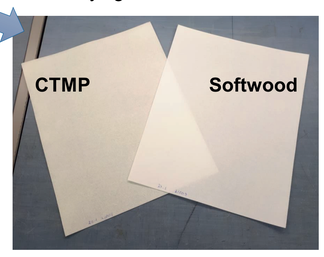
Sample analysis:
- Water absorption (modified Basket method, ISO 12625-8)
- Dry and wet tensile strength (ISO 12625-4 and -5 for Tissue)



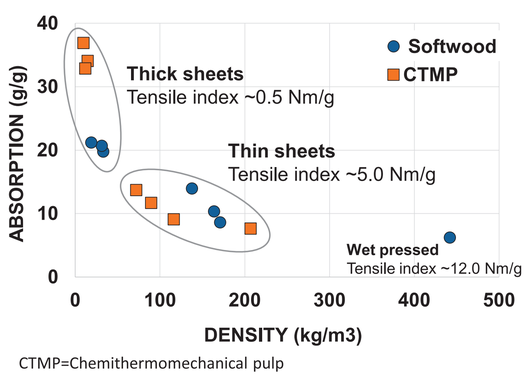
Thick sheets
- <50 kg/m^3, 60g/m^2
- No foam removal, no wet pressing
- Oven drying at 70°C

CTMP=Chemithermomechanical pulp

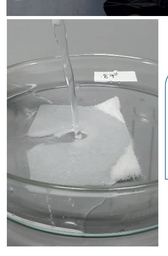
Thin sheets
- 150-200 kg/m^3, 60g/m^2
- Foam removal with vacuum
- No wet pressing
- Drum drying at 70°C



High bulk increases structure absorption but decreases strength



CTMP=Chemithermomechanical pulp

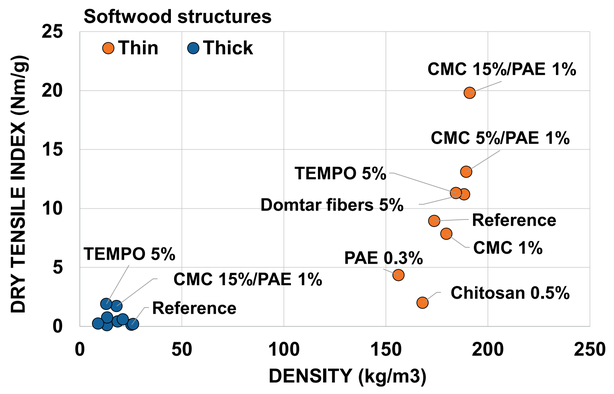


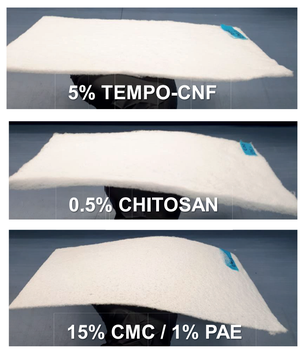
Thick sheets
- Very soft but weak structure
- No wet strength

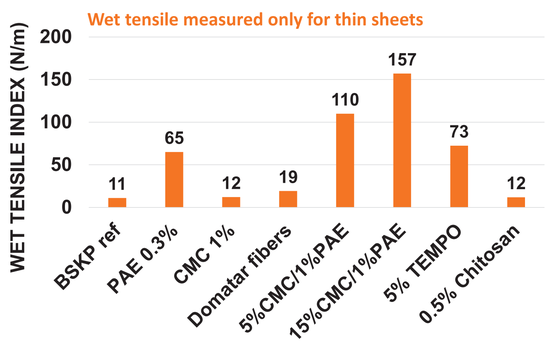
Paper additives to increase structure dry and wet strength

Additives added to fiber slurry before foaming:
- Polyamide-epichlorohydrin (PAE) – Commercial paper wet strength resin
- Carboxymethylated cellulose (CMC) – Commercial paper dry strength agent
- Domtar fibers – Commercial fibrillated fiber material
- TEMPO-oxidized CNF (TEMPO) – Oxidized nanocellulose, charge density ~1.2mmol/g
- Chitosan – Cationic polysaccharide produced from chitin

TEMPO-CNF and CMC+PAE increased strength with both density levels





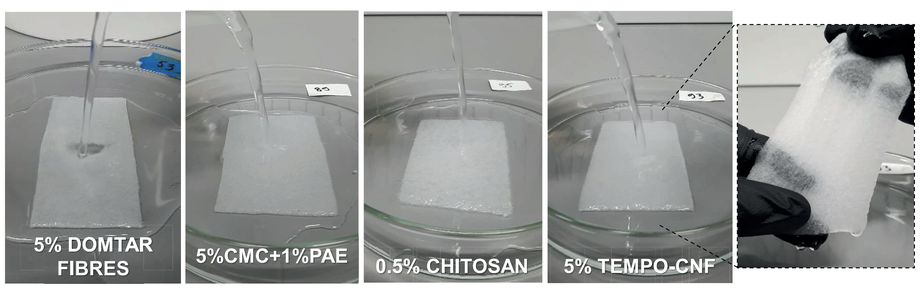


Thick sheets with additives
- Clearly stiffer than the reference
- Notable increase in strength only with TEMPO-CNF and 15%CMC
- TEMPO, Domtar and Chitosan still very soft haptics

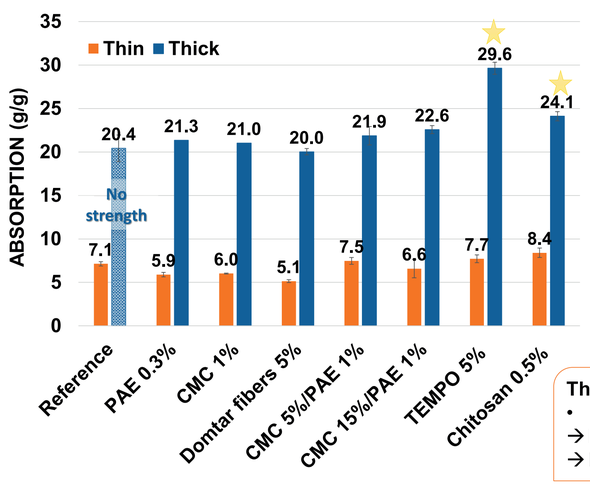
Thin sheets with additives
- Notable increase in strength with high dosage of CMC+PAE, TEMPO-CNF and Domtar fibers

→ High anionic charge and large surface area increase bond strength

Demonstration of water durability of thick sheets



TEMPO-CNF and Chitosan increased absorption with bulky structures



Thick sheets:
- Increased wet strength

→ No structure collapse during wetting

→ Increased absorption

TEMPO-CNF clearly increased absorption and wet strength

Chitosan increased absorption and wet strength

Domtar no wet strength – no increase in absorption

Thin sheets:
- Additives decrease sheet density

→ Increase in strength

→ Decrease in absorption

Conclusion

- **Thick sheets: structure wet strength important for absorption → no pore collapse during wetting**
- **Charged & high surface area additives good for strength and absorption**
- **Increasing strength of low density structures to the same level with high density sheets very challenging (less fiber-fiber bonds)**

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beyond the obvious