PROCESS CHEMISTRY CENTRE

ÅBO AKADEMI UNIVERSITY

The controlled extraction of hemicelluloses

J. V. Rissanen, H. Grénman, T. Salmi, D. Yu. Murzin.

Åbo Akademi University, PCC.
Turku, Finland

Extraction

H_2O, *T*

Filtration

10 kDa <

Long chained hemicelluloses

Further processing

Emulsifiers, Films etc.

< 10 kDa

Medium and short chained hemicelluloses

Hydrolysis

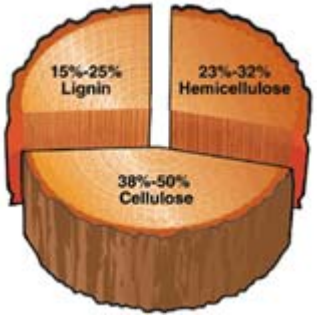
Platform chemicals

Oxidation
Hydrogenation
Fermentation
Esterification
Aqueous reforming

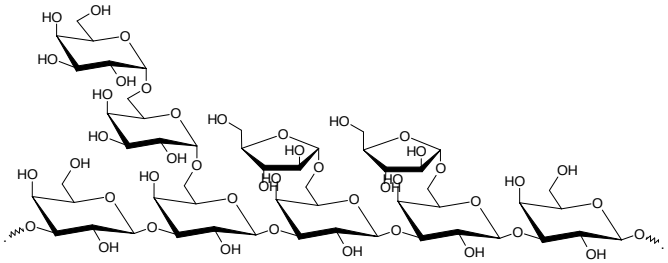
Sugar acids, Sugar alcohols, Lubricants, Fuels etc.

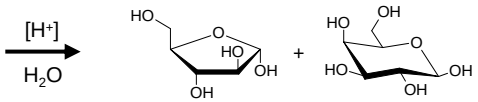
Background

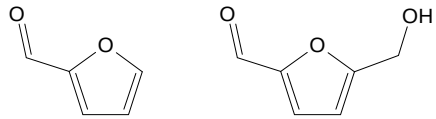
- Protonation of glycosidic bonds



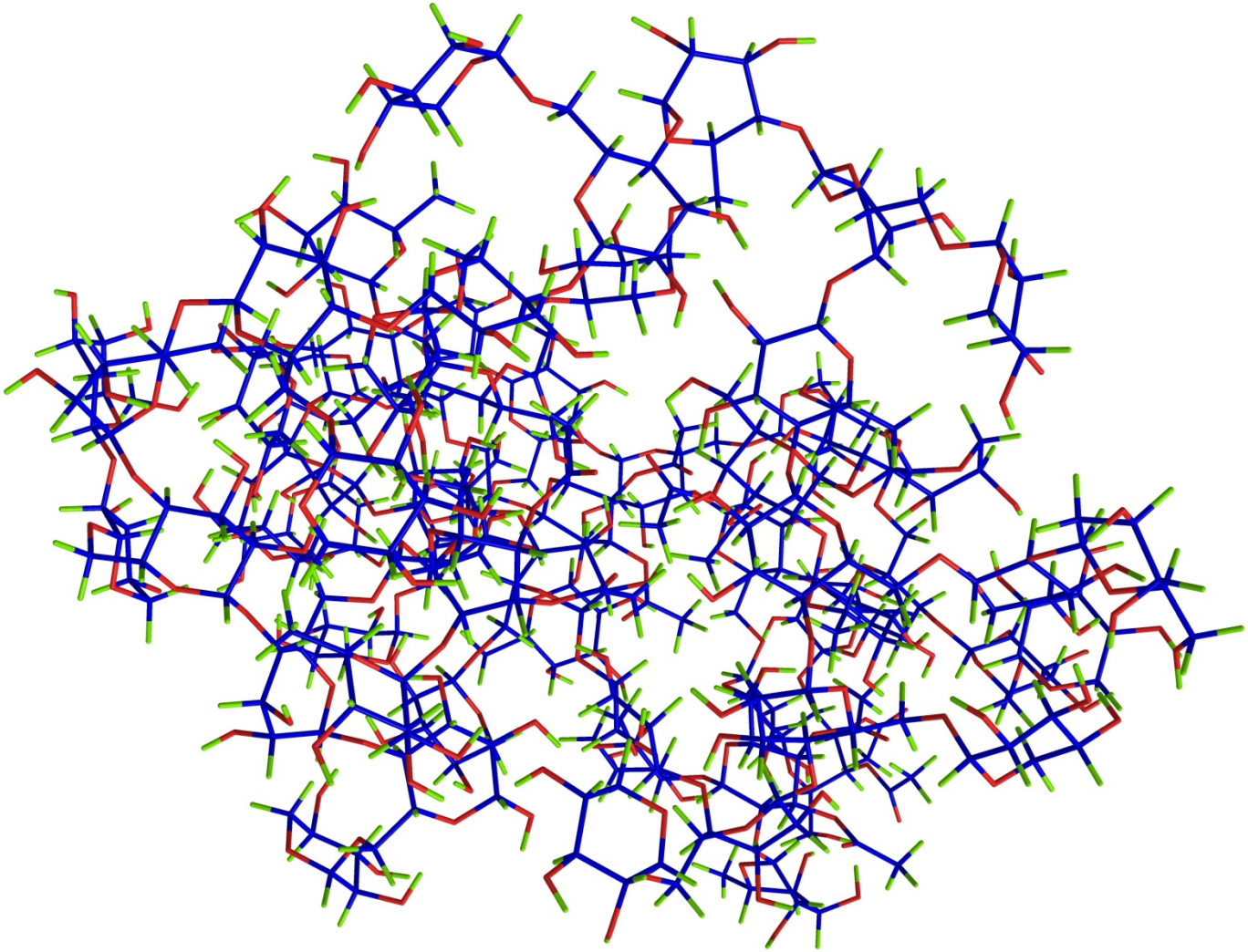
Wood







Hemicellulose molecule

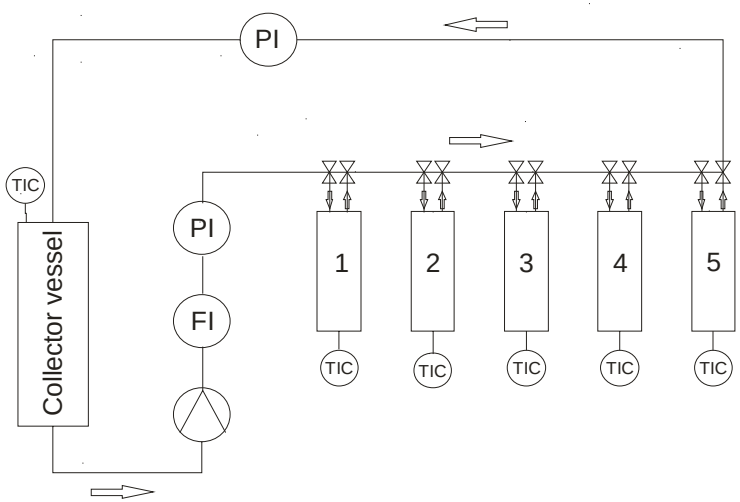


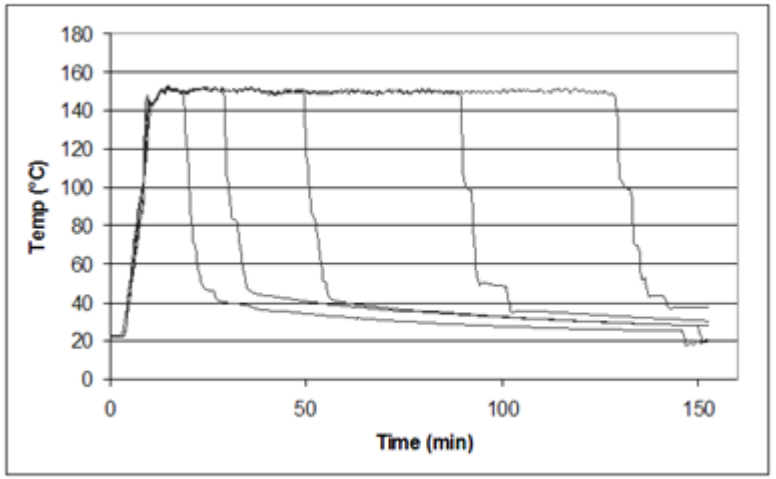
Starting material

Non-extracted chips, 1.25 – 2 mm

Non-extracted cubic blocks, 10 mm

Reactor system



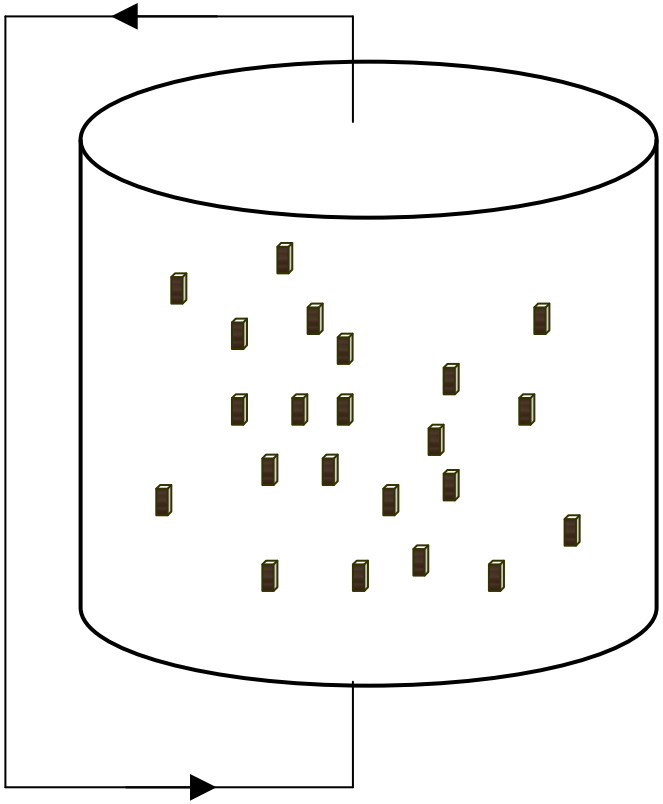


- Cascade reactor
- Flexible 5 point sampling of liquid and solid phases
- Accurate control and measurement of temperature, pressure and flow rate

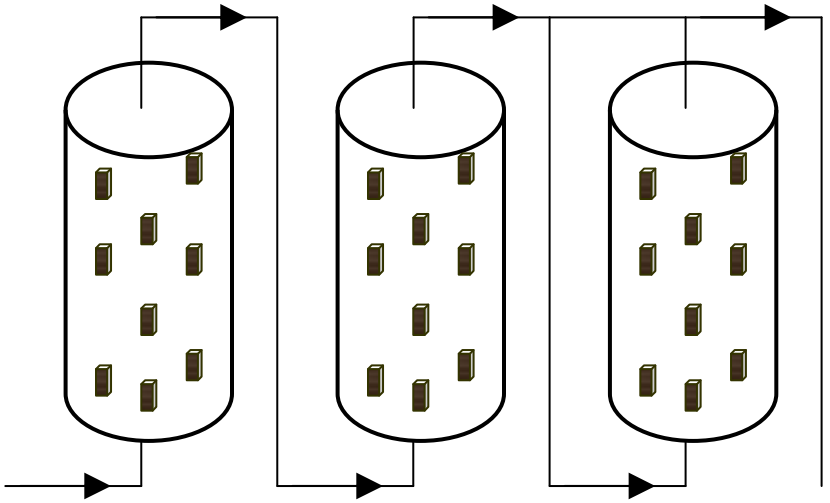
Reactor system

Batch reactor versus cascade reactor

Traditional batch digester



Cascade reactor



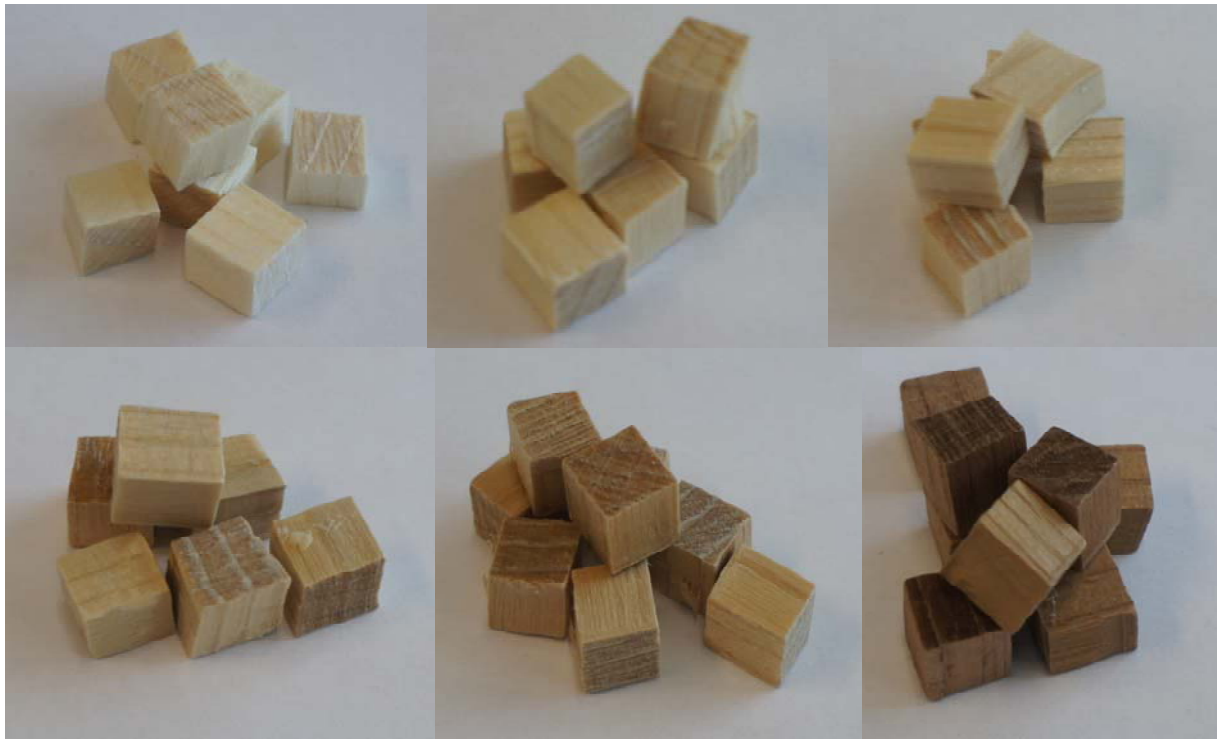
The chips do not differentiate between reactor type

Liquid samples, 170°C, 0-60 min

5 min | 10 min | 15 min | 20 min | 60 min

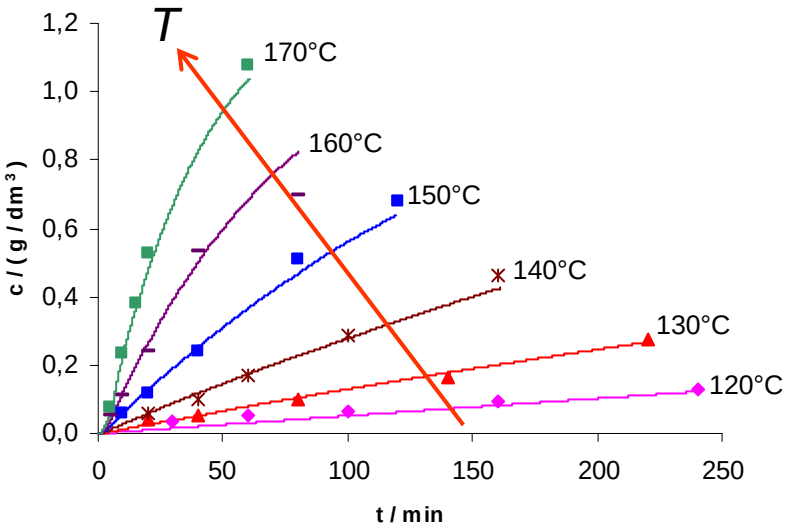
- Viscosity of the extraction liquor increasing
- Colour becomes brown

Solid samples, 170°C, 0-60 min

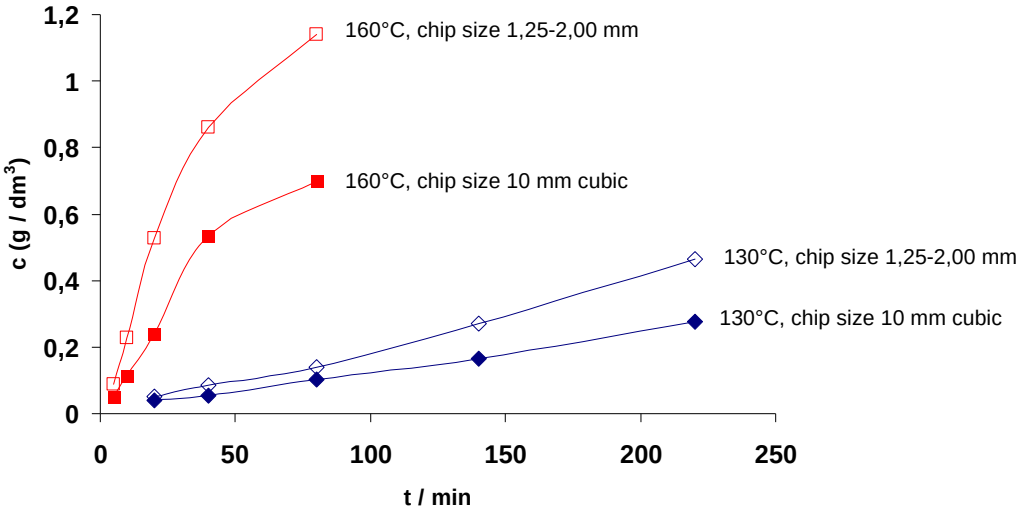


Experimental results

The influence of temperature and chip size on the overall extraction rate

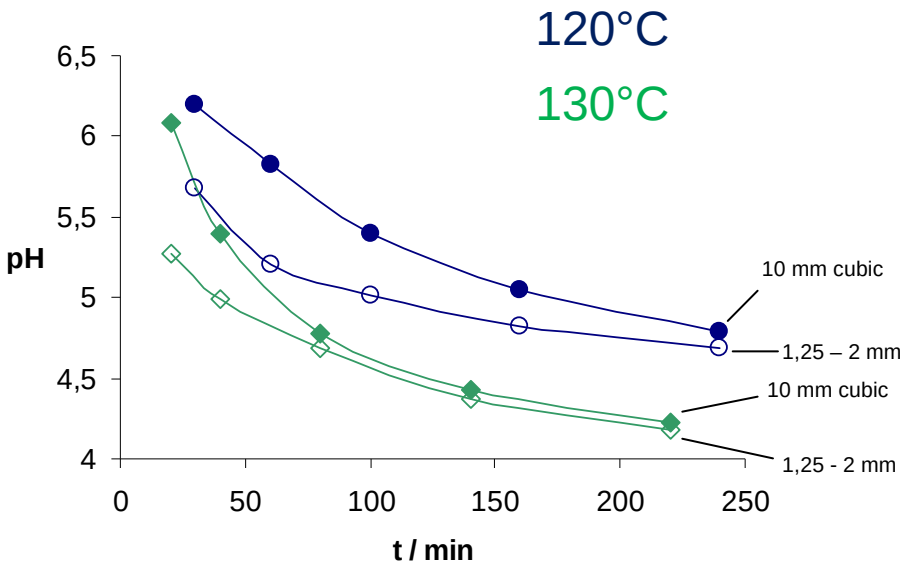


Concentration of hemicellulose as a function of time (10 mm cubic blocks).



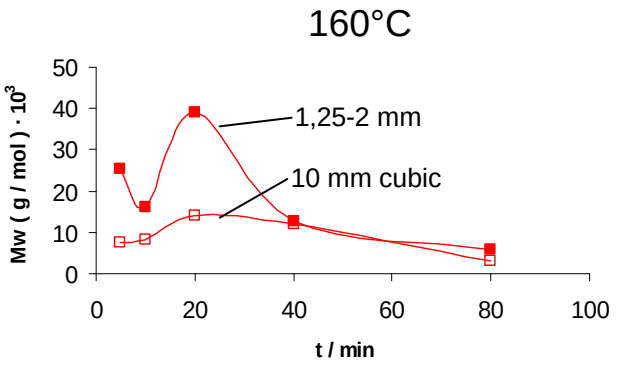
Liquid phase concentration as a function of time with different chip sizes.

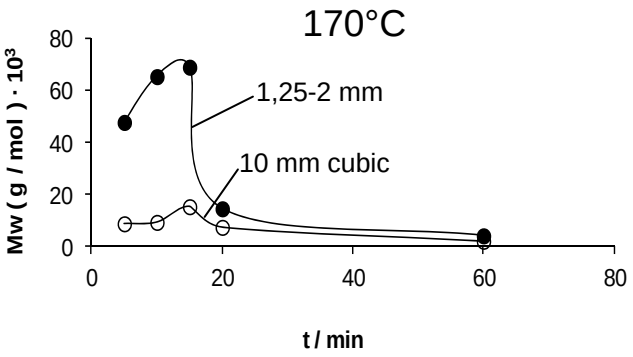
The behaviour of the pH during the reaction



The pH with 1,25 – 2 mm chips (open symbols) and 10 mm cubic blocks (solid symbols).

Molar mass





Conclusions

- Industrial applications need long chained hemicelluloses and monomers
- The extraction kinetics are crucial in order to taylor the product as well as the production
- The overall extraction is influenced by several interlinked phenomena

Conclusion –

The influence of the extraction parameters is complex and interlinked