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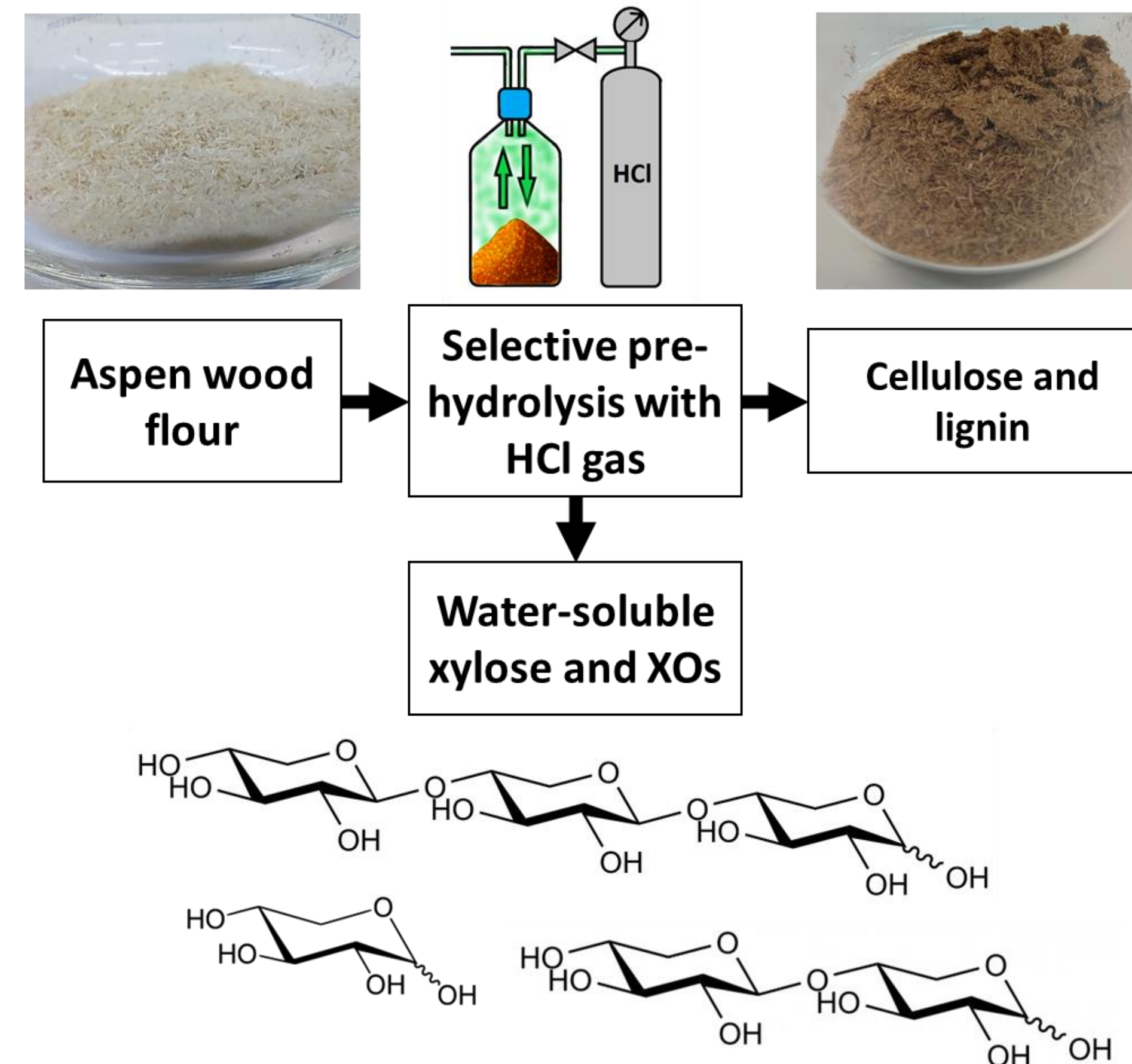
Aalto University
School of Chemical
Engineering

Pre-treatment of biomass with HCl gas for selective removal of hemicellulose

A. Topias Kilpinen & Eero Kontturi

Department of Bioproducts and Biosystems, Aalto University

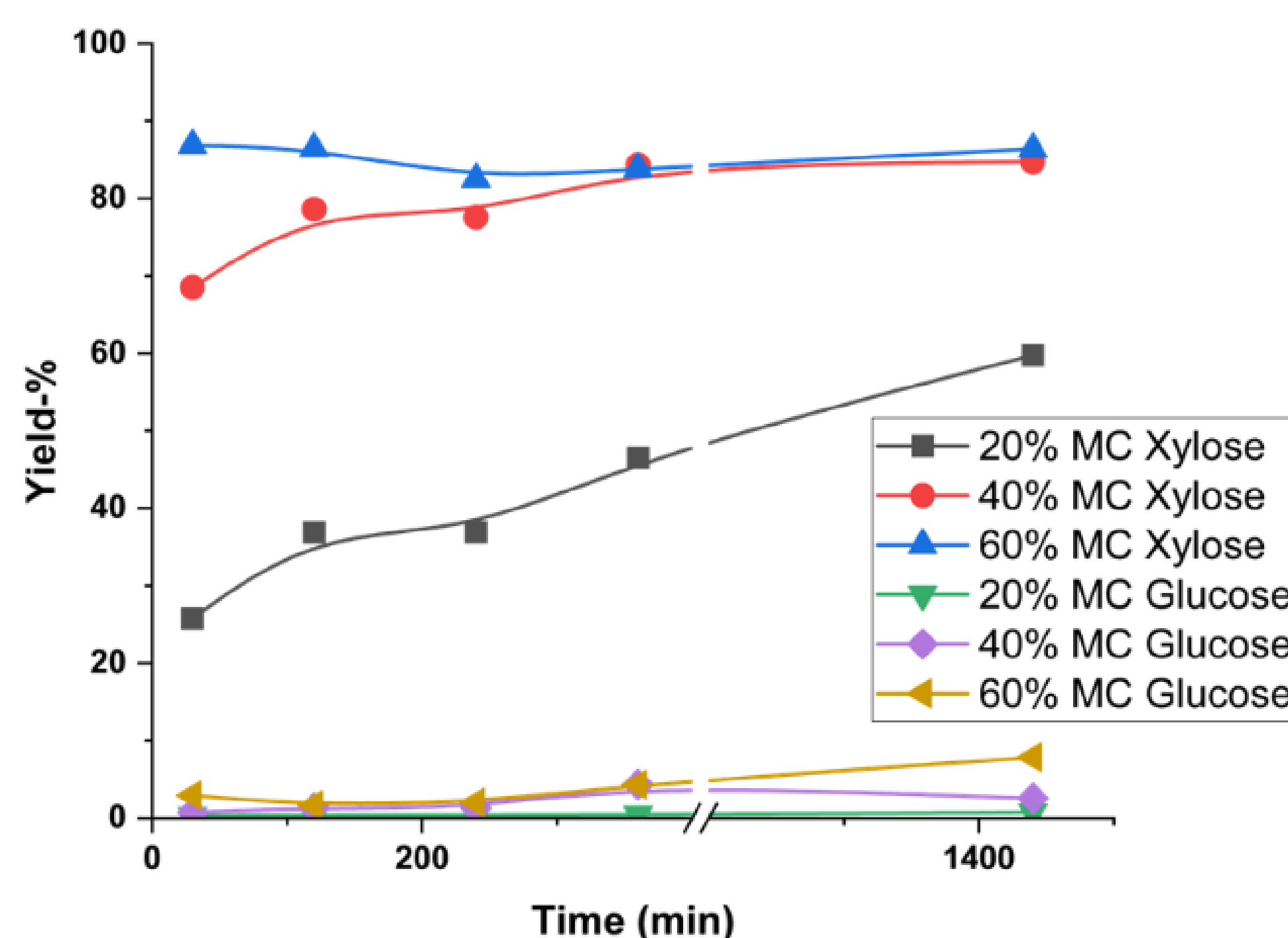
- In this study, anhydrous hydrogen chloride gas was employed to selectively hydrolyze hemicellulose from aspen wood flour utilizing a gas-solid system.
- Wood flour from aspen (*Populus Tremula*) was hydrolyzed with the gas hydrolysis reactor used by Pääkkönen *et al.* in 2018.
- In gas hydrolysis biomass is exposed to HCl gas under pressure. This will cause the formation of hydrochloric acid inside the trace amounts of water inside the biomass and catalyze *in situ* concentrated acid hydrolysis.



Process

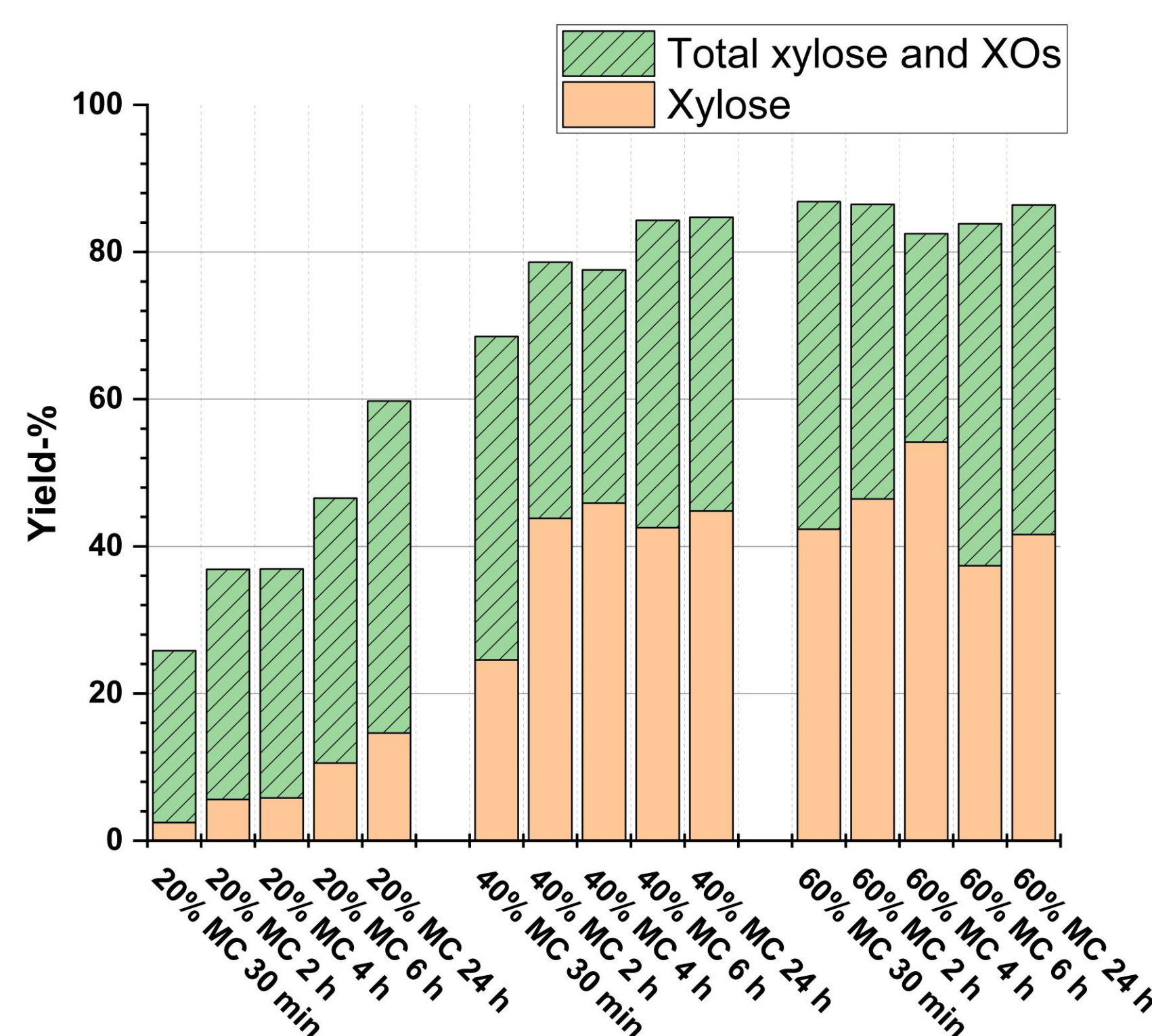
- Desired amount of gaseous HCl was added to the closed reactor bottle by weight basis and the system was pressurized to 1 bar with nitrogen gas.
- Selectivity towards hemicellulose was achieved by adjusting the acid concentration inside wood flour to 36%, so only hemicellulose and disordered cellulose would be degraded during hydrolysis.
- Temperature-control was employed to prevent xylose degradation during the concentrated acid hydrolysis.
- Process parameters included the moisture content of the aspen wood flour (20%, 40% and 60%) and reaction times from 30 min to 24 h.

Total carbohydrates



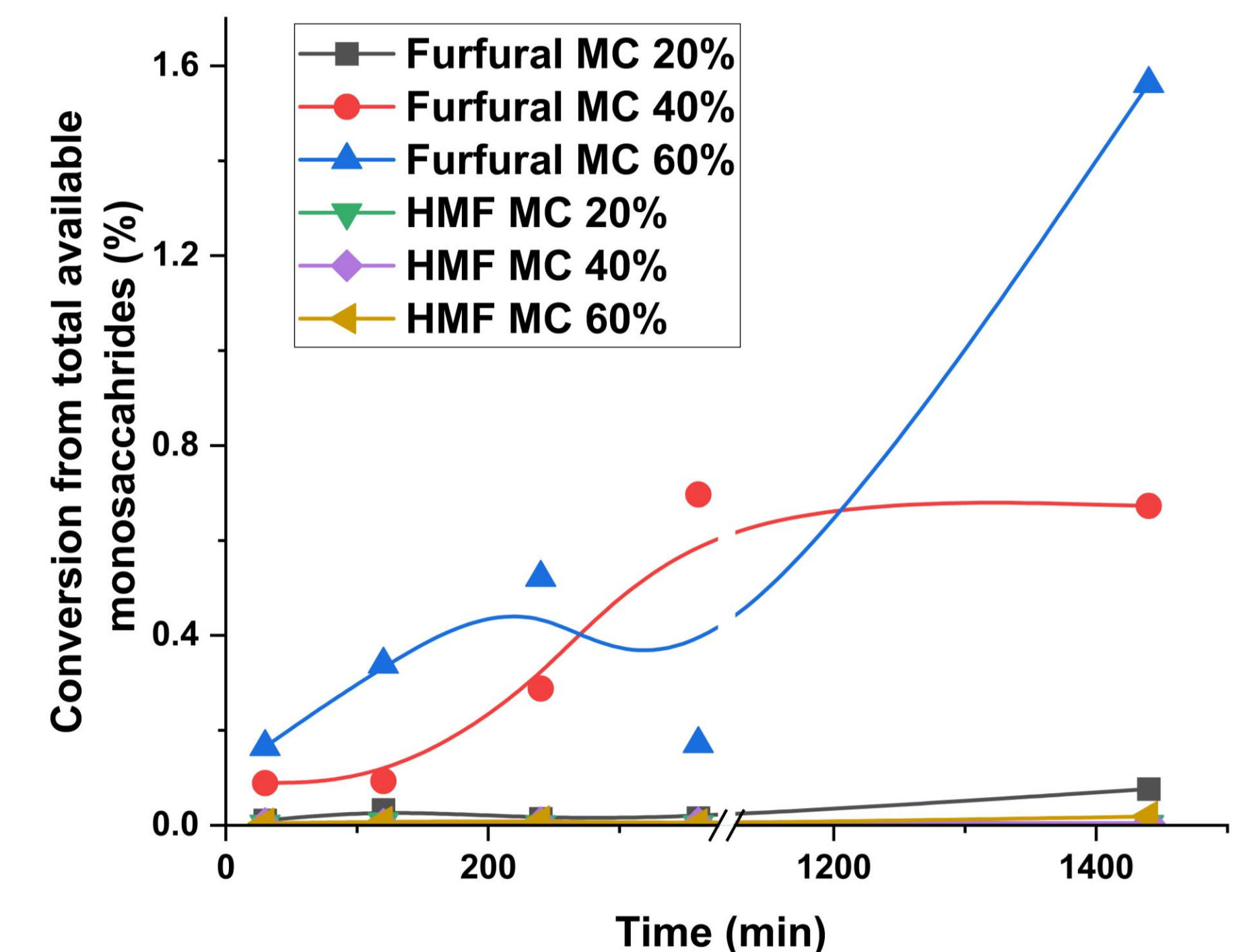
Total yields of water-soluble carbohydrates from pre-hydrolysis with hydrogen chloride gas. With all moisture contents mainly hemicellulose is degraded.

Xylose to XO ratio



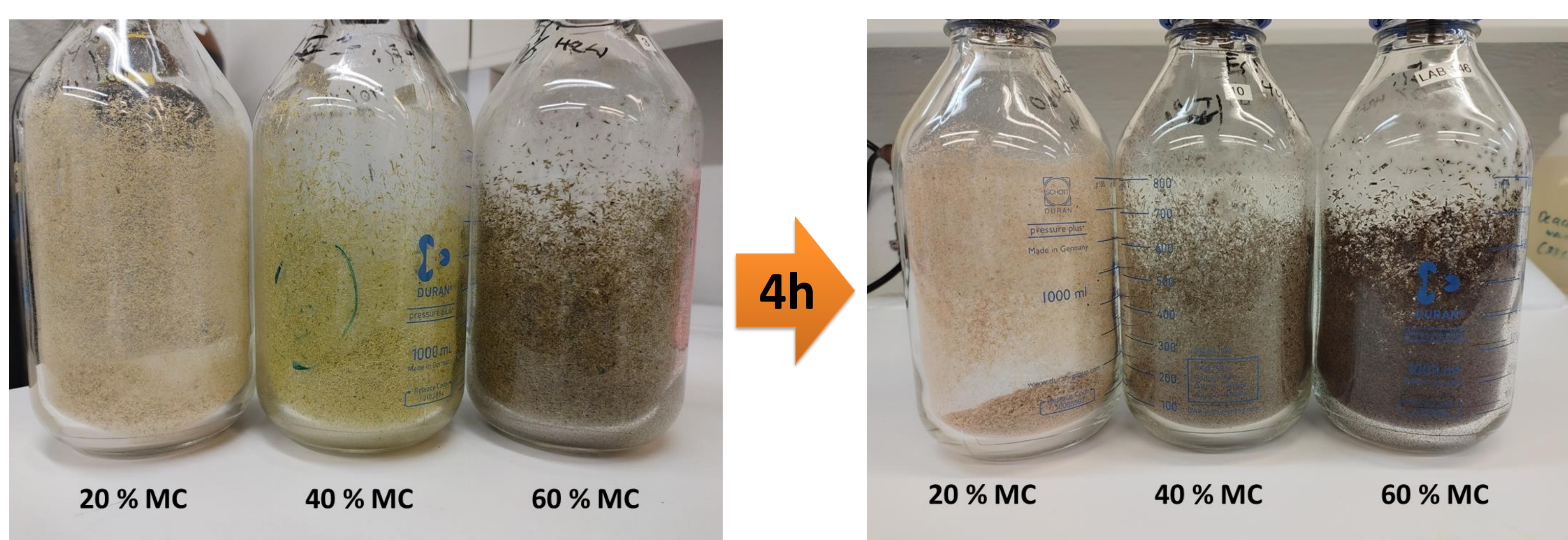
Yield of water-soluble xylose and xylose + xylooligosaccharides (XO) from gas hydrolysis. In moisture contents of 40-60% around half of the hydrolyzed xylans are in monomeric form. Rest are different sized XOs. In 20 % moisture content most of the xylans are in oligosaccharide form.

Furans



Degradation of monomeric sugars during gas hydrolysis. Degradation to HMF is negligible and conversion to furfural reaches 1.55% only at 60% moisture content and 24 h reaction time.

Color change during hydrolysis



Samples after gas application and after 4 h reaction time prior to heating in water bath. None of the samples have turned into sticky syrup after 4 h reaction time.

Conclusions

- Aspen wood flour was successfully hydrolyzed with HCl gas for selective and efficient removal of C5-sugars.
- The optimal conditions were found to be at 60% moisture content and 30 minutes reaction time. Under these parameters it was possible to retrieve 87% of the available xylan from aspen wood flour with only 1% glucan degradation.

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Contact information

MSc Antti Kilpinen
antti.kilpinen@aalto.fi
Department of Bioproducts and Biosystems, Aalto University