Valorization of waste lignocellulosic biomass towards furanics and organic acids

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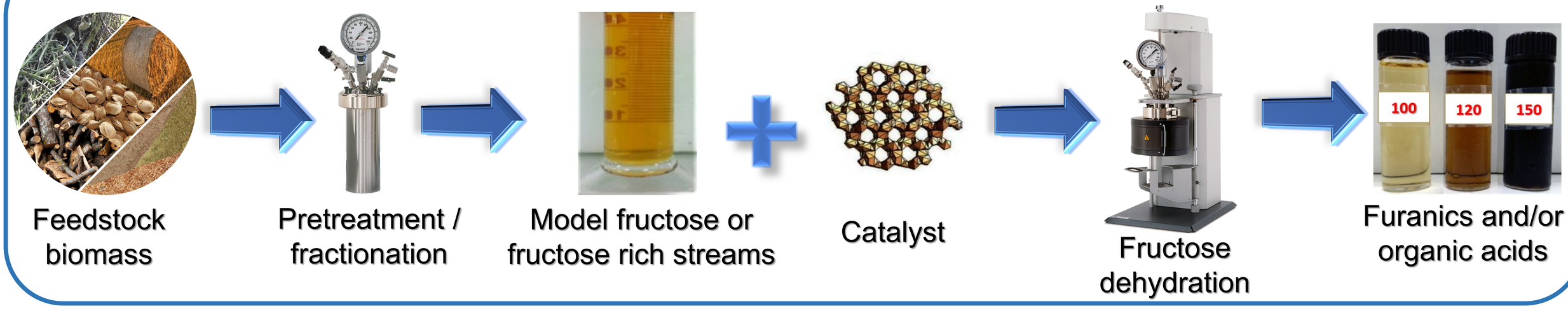
Introduction

- Lignocellulosic biomass composed of cellulose, hemicellulose and lignin can be an alternative source of chemicals and fuels towards the substitution of crude oil derived products.
- Hemicellulose is a branched polysaccharide composed of C5 and C6 sugars, ie. fructose, glucose, etc.
- Lignocellulosic agricultural and forestry residues (e.g. prunings, sawdust, straws) can be converted into a wide variety of platform chemicals.
- Glucose/fructose can be converted to HMF and/or related organic acids in a variety of homogeneous and heterogeneous acid catalytic systems.
- The aim of the present work is to optimize the process in order to treat real fructose rich streams in order to produce the desired furanics and/or organic acids.

Experimental



Feedstock biomass → Pretreatment / fractionation → Model fructose or fructose rich streams + Catalyst → Fructose dehydration → Furanics and/or organic acids

Selected results

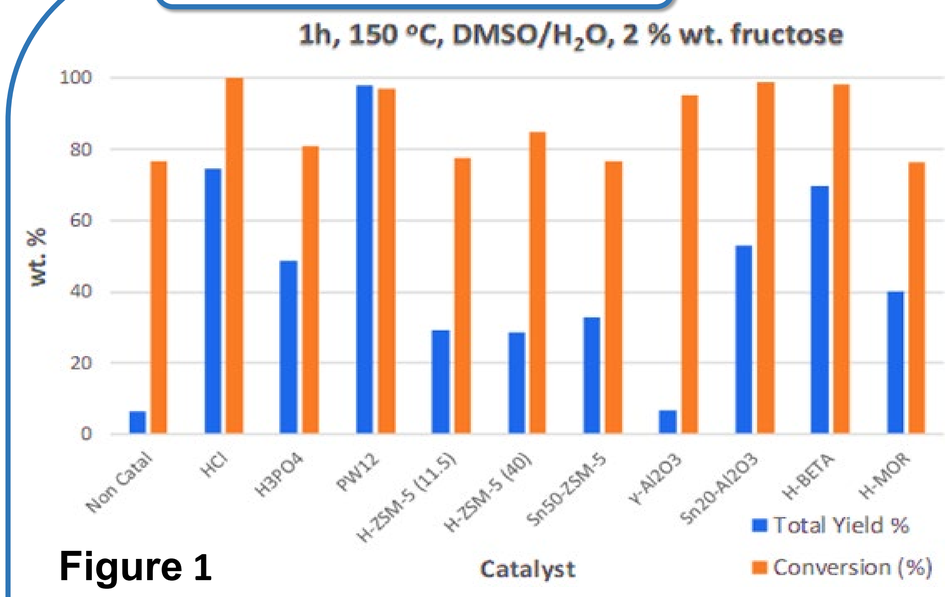
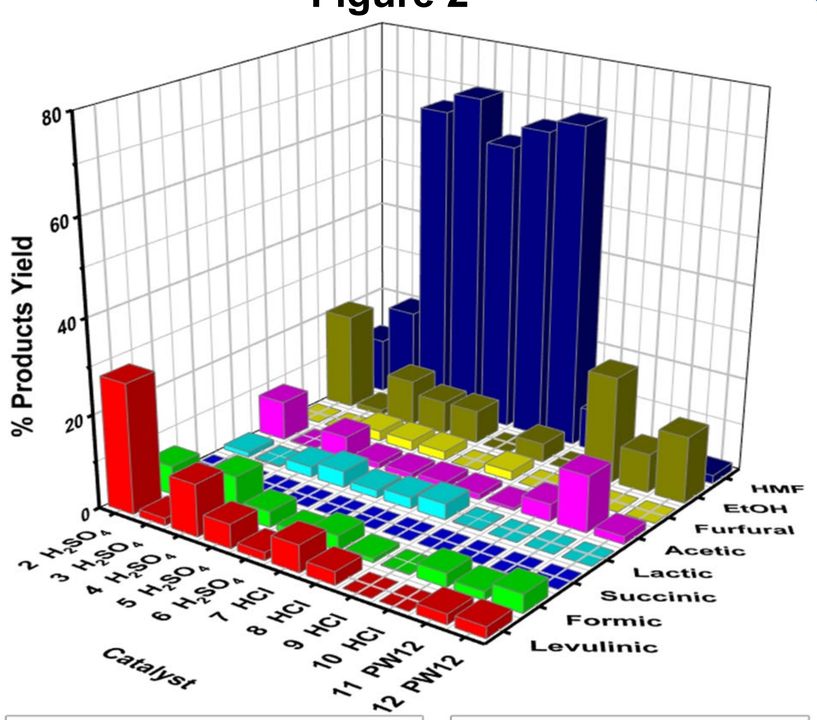


Figure 1

The dehydration of fructose at 150°C, 1h, in a DMSO/H_2O mixed solvent system, showed that except of the classical dilute HCl, the heteropoly acid Phosphotungstic acid (PW) is also very active and selective towards HMF with regard to homogeneous systems (Fig. 1).

Amongst solid acid catslysts zeolite H-Beta, bearing both Lewis and Brønsted acid sites is a very active (100%) with substantial selectivity to HMF (70%). Figure 2 shows the potential of the real fructose rich streams dehydration. The yields with the homogeneous catalysts in a range of pH, give excellent results with the HMF yield to be over 60%. The solid catalysts don't give good results (not presented) due to many factors affecting the dehydration.

Figure 2



1 H_2SO_4 - H_2O - pH = 0.9
2 H_2SO_4- H_2O - pH = 1.5
3 H_2SO_4 - DMSO/H_2O - pH = 1.7
4 H_2SO_4 - DMSO/H_2O - pH = 1.9
5 H_2SO_4 - DMSO/H_2O - pH = 2.9
6 H_2SO_4 - 65/35 DMSO/H_2O - pH = 1.5

7 HCl - H_2O - pH = 2.1
8 HCl - H_2O - pH = 1.5
9* HCl - H_2O - pH = 5.0
10 PW12 - DMSO/H_2O - pH = 1.5
11 PW12 - DMSO/H_2O - pH = 2.8

Acknowledgements

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