VIEW ONLINE AT WILEY ONLINE LIBRARY
WILEYONLINELIBRARY.COM
DOI: 10.1002/BBB.1379

Biofpr
Biofuels Bioproducts & Biorefining

Fast hydrolysis process for biomass

According to USPTO Public PAIR, US Patent Number 8268126 has been issued to Zhen Fang (Kunming, CN) and Chun Fang (WA, US) for technology that provides a simple and low-cost method for rapidly dissolving and hydrolyzing lignocellulosic biomass.

The patent entitled 'Method, equipment and applications for fast complete dissolution and hydrolysis of lignocellulosic biomass' was issued on September 18, 2012 for research carried out by Professor Zhen Fang, Leader and Founder of Biomass Group at Chinese Academy of Sciences.

In previous work, Sasaki *et al.* established that microcrystalline cellulose could be completely dissolved in water at temperatures above 320 °C and became a 'cellulose solution', which made it possible to build up a continuous flow reactor for the rapid hydrolysis of cellulose. Continuous reaction of microcrystalline cellulose (20 wt%) in water at supercritical conditions (> 374 °C and 22.1 MPa) gave water-soluble products (with 100% conversion) containing 80% hydrolysates (glucose and oligomers) over short reaction times (ca. 0.05 s). However, the separation of pure cellulose from actual biomass (e.g., wood) is complicated and costly and is not a process that is easily commercialized. Thus, it is necessary to find a method for complete dissolution of actual lignocellulosic biomass and to facilitate further refining to value-added products.

Fang *et al.* found that by adding 0.8 wt% Na_2CO_3, wood without any pretreatment can be completely dissolved upon fast-heating (7~16 °C/s) to form a 'wood solution' at 329–367 °C over short reaction times (0.7–2 s). The 'wood solution' can be rapidly (aprroximately 15 seconds) hydrolyzed to sugars/sugar oligomers under homogeneous conditions.

Based on the above work, a 'fast hydrolysis' process was invented for actual lignocellulosic biomass:

(a) Placing lignocellulosic biomass (wood or grass particles) in 1.9~10 wt% alkaline solution, and keeping biomass/liquid ratio at (0.003~1.05)/1, as sample 1;

(b) Heating pure water to a temperature between 329~367 °C, as sample 2;

Mixing sample 1 with sample 2 from steps (a) and (b) in a reactor, keeping biomass concentration at 0.1~35.1%, adjusting pH of the mixture >11.4 and water density of 322~787 kg/m^3, rapidly heating the mixture to 329~367 °C (pressure of 14~106 MPa) at a heating rate of 7~16 °C/s, and the lignocellulosic biomass will completely dissolve in 0.7~2 s to form 'biomass solution' that is further rapidly hydrolyzed in a homogeneous phase to sugars and sugar oligomers. Figure 1 depicts the equipment proposed for the continuous 'fast hydrolysis' process.

The patent is the latest development in a 23-year effort by Professor Zhen Fang in the study of biomass hydrolysis process, aimed at a simple, fast and low-cost method for a novel biorefinery. 'Fast hydrolysis' process will be the technological key to economic utilization of abundant lignocellulosic biomass as viable feedstocks for the production of industrial sugar, ethanol and chemicals. His pioneering work opens the door to the possibility of developing industrial-scale technology at competitive costs for producing biofuels and value-added products from lignocellulosic biomass based on the 'fast hydrolysis' process in a flow reactor.

This patent is the ninth patent issued to Professor Fang adding to its portfolio of 3 pending international and 13 pending Chinese patent applications which cover various features of biorefinery technologies.

The newly issued patent is accessible on the USPTO's website at http://portal.uspto.gov/external/portal/pair.

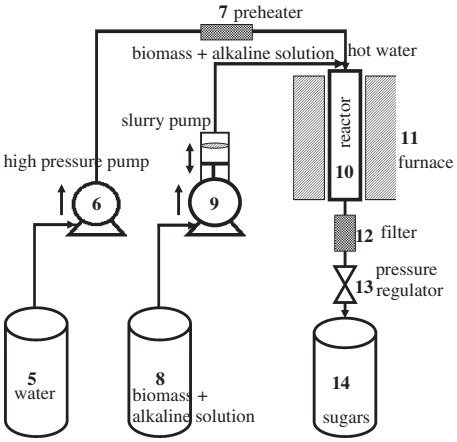

Figure 1. Fast hydrolysis of biomass.

Sasaki M, Fang Z, Fukushima Y, Adschiri T, Arai K. Dissolution and hydrolysis of cellulose in subcritical and supercritical water. Ind Eng Chem Res 2000; 39:2883–90.

Fang Z, Fang C. Complete dissolution and hydrolysis of wood in hot water. AIChE J 2008; 54:2751–8.

Zhen Fang
Chinese Academy of Sciences,
Biomass Group,
Xishuangbanna Tropical
Botanical Garden,
88 Xuefulu, Kunming,
Yunnan 650223, China.
E-mail: zhenfang@xtbg.ac.cn

Patents form a key part of the scientific literature surrounding bio-based fuels, chemicals and energy. *Biofpr* is keen to highlight key, newsworthy patent developments that are especially relevant to the field of biofuels, bioproducts or biorefining. Please email the editorial team at biofpr@wiley.com with news of any patent developments that you would like to share with this community.

