**N2 explosive decompression pretreatment of biomass for lignocellulosic ethanol production**

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The pretreatment is essential step prior to the conversion of the lignocellulosic material to ethanol, which could be used as a liquid fuel in engines. However, most traditional pretreatment methods have low efficiency, use chemicals or vast amount of energy in the process. The costs of chemicals and power requirement of these pretreatment methods are relatively high and therefore, these processes might not be economically feasible. A novel biomass pretreatment method will be presented which opens up the biomass structure for more efficient enzymatic hydrolysis. No catalysts or chemicals are used in the process thereby, making it economically and environmentally attractive.

In this method the biomass is exposed to a high pressure using N2 gas, and temperature to break the hemicellulose and lignin seal around the cellulose macro fibrils in the cell walls of the lignocellulosic biomass. Under pressure, cells of the lignocellulosic biomass are filled with a solution saturated with nitrogen. When the pressure is suddenly released, the feedstock is exposed to an explosive decompression and the dissolved nitrogen is released from the solution. Sudden change in the volume breaks the cell walls and opens the biomass structure resulting in increased surface area of the substrate for enzymatic hydrolysis.

In this research, a range of different pressures (1-60 bar) and temperatures (25-175°C) were applied to barley straw to evaluate the efficiency of the pretreatment. The pretreatment was followed by enzymatic hydrolysis and fermentation. Resulting glucose and ethanol concentrations were measured and the yields were considered as an estimate for the most suitable set of pretreatment conditions.

The results indicate that the highest glucose yield and hydrolysis efficiency were gained at 150°C and 10-30 bars where the glucose yield was between 278 to 338 g/kg depending on the pressure. The fermentation efficiency was lower at higher temperatures. However, in spite of the decrease in ethanol yield when pretreatment temperature was increased, the highest ethanol yield was gained at 150°C and in 10-30 bars since the high glucose yield at pretreatment temperature 150°C enables to gain high ethanol yields in downstream process.

**Keywords:** lignocellulosic ethanol; biomass pretreatment; biofuels; bioethanol; explosive decompression;