Alkaline pretreatment of ligno-cellulosic biomass

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Lignocellulosic biomass represent the most promising alternative energy resources that can be converted by pretreatment, hydrolysis and fermentation into valuable chemical compounds. The pretreatment is required in order to remove the lignin and to liberate hemicellulose and cellulose from lignocellulosic matrix. Different pretreatment techniques have been applied for reducing recalcitrance and enhance enzymatic saccharification of lignocellulosic materials, such as alkaline, steam explosion, hydrothermal, and organosolv pretreatments [1-3]. One of the most used pretreatment is chemical process using an alkaline solution. During the alkaline treatment the material cell wall is swelled and as well as hemicelluloses and lignins are removed, and the cell wall recalcitrance is reduced.

Sonication is a new method used for the pretreatment of lignocellulosic biomass. Ultrasound waves produce both physical and chemical effects which alter the morphology of lignocellulosic biomass. Ultrasound treatment leads to formation of small cavitation bubbles which rupture the cellulose and hemicellulose fractions thereby increasing the accessibility to cellulose degrading enzymes for effective breakdown into simpler reducing sugars [4].

The aim of this paper is to develop a method of alkaline treatment of lignocellulosic biomass assisted by ultrasounds under mild conditions (weak alkaline solutions, low temperatures and shorter treatment times) and testing the pretreated material in the enzymatic hydrolysis reaction. The raw material is sawdust waste from a furniture factory that contains equal proportions of hardwood (hardwood - beech) and softwood (fir). In this research, the influence of the alkaline pretreatment combined with ultrasound on lignin separation from extracted lignocellulosic material was studied. The sawdust was subjected to alkaline pretreatment with 1M NaOH solution and ultrasonication using different ultrasound equipments (Vibracell VCX probe, Hilscher probe and ultrasonic bath). By comparing the results obtained after pretreatment with those obtained with untreated sawdust, it can be observed a doubling of the amount of reducing sugars obtained from enzymatic hydrolysis.

The influence of the various pretreatment parameters on the delignification process and the sugars content resulting from enzymatic hydrolysis was studied. Continuous sonication, the application of higher ultrasound powers, the increase of pretreatment temperature and the decrease in the ratio of sawdust / alkaline solution (w/v) led to an improvement in the delignification process and an increase in the amount of sugars obtained from enzymatic hydrolysis.

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