MICROWAVE ENHANCED ENZYMATIC SACCHARIFICATION OF CELLULOSIC BIOMASS

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Lignocellulosic biomass present a good and low-priced raw material for bioenergy sector, chemical and food industry, especially if it produced as waste stream in agriculture or food industry. But processing of lignocellulose into monomeric sugars necessitate harsh pre-treatment step. Because of the intensive and selective heating effects, microwave irradiation is suitable to decompose the cellulose structure which can be manifested in higher saccharification degree.

In our present work the effect of microwave irradiation with different intensities and the combined microwave/chemical pre-treatments on enzymatic saccharification of corn cob residues was investigated. Cellulose degradation was detected by reducing sugar (RS) measurements. In order to compare the efficacy of microwave pre-treatment with different power intensities the energetic efficiency of process was also determined.

Our results verified that microwave pre-treatment could improve the cellulose originated substrate availability for xylanase (Trichoderma longibrachiatum) enzyme. Applying microwave energy irradiation of 30 kJ/g_{DM} with power intensity of 250 W and 500 W RS yield increased by 89% and 96%, respectively. Effect of power intensity on cellulose degradation was stronger if lower microwave energy intensity was applied. Combined microwave-alkaline pre-treatment resulted in higher RS yield and accelerated enzymatic degradation. With an alkaline dosage of 130mg_{NaOH}/g_{DM} the RS yield increased by further 45% compared to the RS yield obtained for sample irradiated by 30 kJ energy, at a power intensity of 500 W. Beside the higher cellulose degradation degree, the advantage of combined microwave-alkaline pre-treatment method has manifested in higher energy efficiency. With alkaline dosage the specific energy demand of RS production (given in mg_{RS}/kJ energy unit) decreased by 68-96%, depending on the irradiated energy and power intensity applied. It can be concluded, that during microwave irradiation the acidic condition assist to degrade the cellulose structure. But the inhibitory compounds, formed at low pH and high temperature range, decreased the overall efficiency of subsequent enzymatic hydrolysis.

Keywords

microwave, biomass, saccharification, enzymatic degradation

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