ABSTRACT

The present study reports the particle size effect on corn stover pretreatment and enzyme hydrolysis, focusing on the changes of biomass due to Cellulase Activity and Hot Water Pretreatment. This, combined with analyses of sugars released during pretreatment and enzyme hydrolysis, provides insights into enzyme mechanisms at a cellular level.

Scanning electron microscopy (SEM) shows that both liquid hot water pretreatment and enzyme treatment induce pores or hollows in the cell wall, leaving hollow areas. However, pretreatment generates more pores or enlarges pore size, thus enhancing enzyme accessibility.

EXPERIMENTAL PROCEDURE

- Grinding and sieving through a series of Fisher Brand standard sieves to select representative samples.
- Enzyme hydrolysis of liquid hot water pretreated corn stover is connected to pore formation (during pretreatment) and enlargement (during hydrolysis).
- Enzymatic hydrolysis of pretreated corn stover is more efficient compared to native corn stover, due to pretreatment generating more pores or enlarging pore size, thus enhancing enzyme accessibility.

RESULTS

- Shape distribution based on particles orientation (SEM)
- Cross-sectional view (200X)
- Longitudinal view (200X)
- Particle splitting
- Particle at various orientations

CONCLUSIONS

- Ultramicroscopic changes occur for 425 to 710 μm and 53 to 75 μm corn stover particles: (1) similar during pretreatment and enzymatic hydrolysis; (2) large particles are degraded to small particles gradually; (3) 53 to 75 μm size is more susceptible to enzyme hydrolysis than 425 to 710 μm—pretreatment with water at 190°C, 15 min, diminishes this difference.

- Enzyme action on native corn stover (1) point-digestion; (2) cut large particles into smaller pieces; (3) digest particle from a cross section along longitudinal dimension.

- Enzyme hydrolysis of liquid hot water pretreated corn stover is connected to pore formation (during pretreatment) and enlargement (during hydrolysis).

- Disruption of particles on pretreated corn stover during enzymatic hydrolysis is more significant than enzyme action on native corn stover since pretreatment generates more pores or enlarges pore size, thus enhancing enzyme accessibility.

- The 5 to 8 times higher glucose yield upon enzymatic hydrolysis and SEM micrographs show enzyme hydrolysis of pretreated corn stover is related to the exposed plant cell wall surface structures and/or enzyme-accessible pores.

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