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# Enhanced Hydrolysis of Mechanically Pretreated Cellulose in Water/$CO_2$ System

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**Abstract**

The aim of this work was to study promotion of ball milling and $CO_2$ assistance on cellulose hydrolysis kinetics in water medium. Kinetic behaviors were analyzed based on first-order and shrinking core models. The results showed that cellulose hydrolysis is enhanced by ball milling and $CO_2$ assistance. Ball milling reduced crystallinity and particle size of cellulose, resulting in high cellulose conversion, while hydrolysis promoted by $CO_2$ assistance was weaker. Double-layer hydrolysis was observed for ball-milled cellulose, and rate constant in active layer is higher. Based on double-layer shrinking core model (DL-SCM), activation energy of cellulose conversion decreased from 73.6 to 39.8 kJ/mol when ball milling and $CO_2$ assistance were applied. Hydrolysis active layer was about 0.9 μm, representing activated thickness of ball-milled cellulose. Hydrolysis promotion by crystallinity and particle size reduction was distinguished via DL-SCM, and crystal evolution possesses greater improvement than particle size decrease on hydrolysis of ball-milled cellulose.

**Key word**

Cellulose, ball milling, $CO_2$ assistance, hydrolysis kinetics, shrinking core model