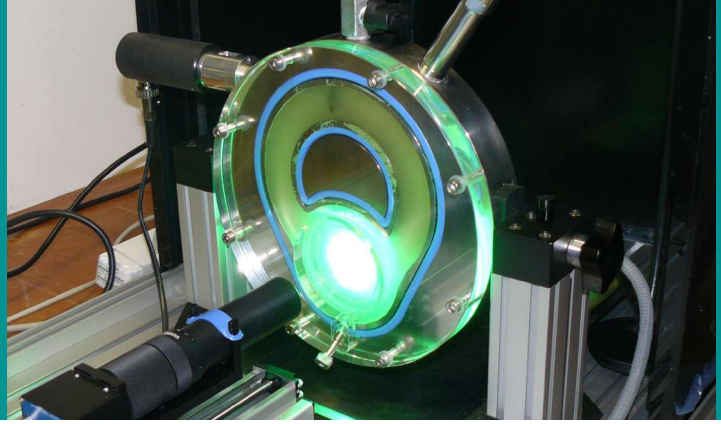

© Marie-Francoise Devaux - Torus reactor

Kinetics of physical state changes accompanying chemical degradation of lignocellulosic biomass

Read more

Barron C. *et al.*

Enzymatic degradation of maize shoots: monitoring of chemical and physical changes reveals different saccharification behaviors

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Context

Overcoming the recalcitrance of biomass to enzymatic deconstruction is a key issue for biorefinery development. The factors involved in the phenomenon of recalcitrance are still under debate. Taking into account the heterogeneity of the biomass by looking at the changes in the physical state that accompany saccharification could shed new light on the breakdown process.

Results

Dry fractionation was used to separate maize straw into five fractions based on particle size and electrostatic properties: one 'coarse' fraction, two 'medium' fractions and two 'fine' fractions, composed of particles with median diameters of around 300 µm, 200 µm, and less than 100 µm, respectively. The physical changes (particle size and number) and saccharification were monitored using a torus reactor to collect hydrolysates and acquire images of particles during degradation by a commercial enzymatic cocktail.

Saccharification and the decrease in particle number and size were significant and rapid in both fine fractions. In contrast, in the coarse fraction, the saccharification rate was low and the physical state changed very little. The two middle fractions showed comparable saccharification rates but different physical-state changes. For one of the medium fractions, the reduction in the total number of particles was similar to that obtained for the fine fractions, but was slower. For the second medium fraction, the reduction in the number of particles was lower, similar to the coarse fraction and more gradual. The small decrease in particle size at relatively high hydrolysis rates for the fine and medium fractions suggests that the enzymes diffuse and act within the particles. The linking of the fractions with the physicochemical characteristics shows that saccharification is controlled by the volume of pores accessible to the enzymes within the particles, while the lignin content contributes to preserving the macroscopic structure of the particles.

Future outlook

The next step will be to examine the degradation process at the particle level. The addition of a dry fractionation step in a biorefinery process could allow for better exploitation of biomass by diversifying the uses according to fraction reactivity.

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