

How can we enhance the key, “liquefaction” step, of lignocellulosic biomass deconstruction?

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Enzymatic deconstruction of lignocellulosic material at high substrate concentrations is challenged by rheological problems that make mixing of the catalytic reaction difficult. However, the use of high substrate concentrations at low enzyme loadings will be required if we are to achieve cost-effective enzymatic deconstruction of biomass to fermentable sugars. It has been shown that, over the course of enzymatic deconstruction, slurry viscosity decreases and flow dynamics improve, analogous to the so-called “liquefaction” step of industrial starch hydrolysis. However, while the liquefaction of starch is typically assessed by measuring the reduction in viscosity and involves the synergistic action of only a few enzymes, the “liquefaction” of biomass slurries is difficult to quantify and involves the deconstruction of a complex, insoluble, recalcitrant substrate requiring the cooperation of many enzymes. The “liquefaction of biomass” is still poorly understood and little is known of the mechanisms through which the lignocellulosic slurry viscosity is reduced. For example, which substrate characteristics most influence “liquefaction”, how can substrates be modified to enhance “liquefaction”, and what role do each or combinations of the “deconstruction” enzymes play in defining an enzyme mixture that is effective at low enzyme loadings and high substrate concentrations? A range of model and “realistic” lignocellulosic substrates were used to assess the influence that mechanisms such as particle fragmentation, particle smoothing, etc., have on influencing enzyme-mediated “liquefaction” of biomass. Although changes in the water retention of enzymatically treated biomass have been used by some groups to quantify “liquefaction”, a good correlation was not apparent.

