Energy Production from Waste Reduction, Phase III: Experimental Design Optimization of Surfactant Enhanced Waste Paper Hydrolysis

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The purpose of this project was to optimize enzyme catalyzed waste paper hydrolysis to make fermentable sugars for biofuel production. During phase I enzyme composition, hydrolysis temperature and time were optimized, where quantitative sugar concentration was measured from DNS reagent assay. During phase II the effect of surfactants on cellulose conversion was evaluated by exploring two different surfactant variables: surfactant type and surfactant concentration. In phase III, process variables (enzyme concentration, surfactant concentration and reaction time) were optimized using design of experiment methodology. More specifically, the Box-Behnken Design was used to generate contour plots that were used to identify the optimum range of variables giving the highest sugar yield. The results show that a blend of cellulase and cellobiase enzymes resulted in maximum sugar yield. Moreover, the addition of a non-ionic surfactant to paper improved cellulose conversion by up to 50%, while ionic surfactants had a negative impact on the reaction. Also, increasing the non-ionic surfactant concentration resulted in a maximum sugar production at twice the critical micelle concentration of the surfactant. This study demonstrated that the Box-Behnken design adequately identified a relatively wide range of optimum process variables indicating the feasibility of converting waste paper to fermentable sugar.

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