

Landfill to Car Fuel: Using Surfactants to Increase Cellulosic Ethanol Production from Waste Paper

Yitalo, Maxwell

The purpose of my project was to optimize enzymatic hydrolysis of waste paper to make fermentable sugars for biofuel production. I focused on adding surfactants to the paper to improve cellulose conversion into sugar. I hypothesized that non-ionic surfactants would improve sugar production by aiding in enzyme desorption from cellulose fibers. Also that sugar production would peak at the critical micelle concentration of the surfactants. I used a 75-25 blend of two enzymes (Cellulase and Cellobiase) in combination with different surfactants to hydrolyze waste paper. I calculated the amount of sugar formed in each experiment using a DNS reagent test since DNS reacts with reducing sugars, darkening in color proportional to the concentration of sugar in the sample. Light absorption of the sample was measured using a 96-well plate reader. Two different surfactant variables were tested: surfactant type and surfactant concentration. Overall, 20 combinations were analyzed, and each experiment was repeated 5 times totaling 100 experiments. My results indicated that the addition of a non-ionic surfactant to paper improved cellulose conversion by up to 50%, while ionic surfactants (cationic, anionic, and zwitterionic) had negative impact on the reaction probably because ionic compounds deactivated the enzymes. In addition, increasing the non-ionic surfactant concentration resulted in a maximum sugar production at twice the critical micelle concentration of the surfactant, and a reduction in sugar production when the surfactant concentration was further increased. This observation was explained by the enzymes getting trapped in micelles formed by excess surfactant in the sample.