BIOFUELS

Breaking down biomass

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To convert cellulose into ethanol biofuel via fermentation, cellulose must first be broken down into glucose in a process named saccharification. Cellulose is difficult to deconstruct and is poorly soluble; therefore, saccharification typically necessitates the use of aggressive reagents such as strong acids or hazardous solvents. Cellulase enzymes also catalyse the cleavage of cellulose, but current processes based on enzymes require the cellulose to be pretreated and often make use of large-volume suspensions, giving rise to waste management issues. To address this matter, Tomislav Friščić, Karine Auclair and colleagues at McGill University present a method for cellulose saccharification that couples enzymatic breakdown with mechanochemistry (the facilitation of reactions using mechanical energy), which proceeds without the use of bulk solvent and yields glucose at concentrations more than three times higher than conventional routes.

The researchers use microcrystalline cellulose as a model substrate for the saccharification reactions, which take place in a ball mill — a type of grinding device. Using water volumes on the order of 0.5–1.0 μL per mg of cellulose plus enzymes, once milling commences, the mixtures resemble a thick paste as opposed to the larger liquid volume suspensions typical of conventional processes. The process can be optimized by alternating between 5 minutes of milling and 55 minutes of aging, cycled 12 times, resulting in 50% conversion of microcrystalline cellulose, challenging existing methods using similar enzyme loadings. The process can also be used on raw biomass samples, such as hay and cedar wood saw dust.

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