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 **Co-solvent System for Sugar Production from Lignocellulosic Biomass Using Biomass Derived γ-valerolactone**

A biphasic system of γ-valerolactone (GVL), water, and co-solvent enables facile recovery of lignocellulosic sugars and lignin after biomass deconstruction.

**The Science**

Recovering sugars and lignin from the deconstruction solvent GVL relies on methods that are expensive or may inhibit downstream conversion of sugars to biofuels. A new method examines the use of co-solvents1 and their impact on sugar yield and economics of biofuel production.2

**The Impact**

Separation of lignocellulosic biomass components from GVL deconstruction solvent via salt or liquid carbon dioxide is inhibitory to downstream conversion microbes, or cost-prohibitive and a safety hazard, respectively. However, the use of a co-solvent, which renders the GVL system monophasic at reaction temperatures but biphasic at lower temperatures, enables facile recovery of high-yield sugar streams and a substantial portion of the lignin on par with previous methods.

**Summary**

Biomass deconstruction utilizing the solvent γ-valerolactone (GVL), water, and an acid catalyst is a potentially game-changing approach, providing a number of distinct advantages over traditional deconstruction methods. For example, the GVL method avoids the use of expensive enzymes for biomass hydrolysis, is largely agnostic to biomass type, and is renewable since GVL can be generated from biomass and recycled. Recovery of sugars from the GVL system requires separation into aqueous and organic phases, elicited by the addition of salt or liquid carbon dioxide (CO2). However, high salt concentrations are inhibitory to bioconversion microbes downstream whereas the high pressures required for liquid CO2 extraction lead to safety concerns and high capital and operating costs. A recently described alternative method used a variety of co-solvents, which render the GVL system monophasic at reaction temperatures but biphasic at lower temperatures, thus resulting in spontaneous separation of sugar and lignin streams from GVL/co-solvent, a significant advantage over prior recovery methods.1 A second study examined hypothetical biorefinery configurations and technoeconomic analysis (TEA) for production of ethanol using the GVL system with toluene as a co-solvent.2 TEA indicated that the minimum selling price (MSP) of ethanol was reduced to $2.95 per gasoline gallon equivalent (GGE), 12.5% lower than that achieved by the GVL/CO2 extraction method and 9.7% lower than that of the benchmark enzymatic strategy.

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**Publications**

1Motagamwala, A.H. et al. “An engineered solvent system for sugar production from lignocellulosic biomass using biomass derived γ-valerolactone.” *Green Chemistry* **18**, 5756 (2016), DOI:10.1039/c6gc02297a.

2Won, W. et al. “A co-solvent hydrolysis strategy for the production of biofuels: process synthesis and technoeconomic analysis.” *Reaction Chemistry and Engineering* (2017), DOI:10.1039/c6re00227g.

**Related Links**

None

**PM Recommendation for SC Web Publication**

[Yes or No]