



Production of Levulinic Acid and Gamma-Valerolactone from Biomass-Derived Cellulose

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WARF: P110125US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a streamlined method for producing levulinic acid and gamma-valerolactone (GVL) from biomass.

Overview

New, renewable sources of transportation fuel and commodity chemicals are needed to meet continuing demand. Biomass has tremendous potential as a renewable resource for the production of fuels and chemicals because it is inexpensive and readily available from crop residues and forests.

Levulinic acid is a biomass-derived compound that can be obtained in high yields from a variety of waste cellulose-containing materials. It has been identified as a top biomass-derived chemical due to its ease of production for both five and six carbon sugars and its useful functional groups, a ketone and a carboxylic acid. Levulinic acid is a platform chemical for forming other, more valuable reactive chemicals such as GVL.

However, making fuels and chemicals from biomass is complicated by the need to separate and purify the intermediate platform molecules at high yields. Conventional approaches to making useful chemicals from biomass typically require very difficult and economically unfeasible separation and purification steps.

The Invention

UW–Madison researchers have developed a streamlined process for making and extracting levulinic acid from aqueous solutions. First, levulinic acid is produced through the acid-catalyzed deconstruction of biomass in an aqueous solution. Then the levulinic acid is extracted from the aqueous solution using one or more alkylphenol solvents (see WARF reference number P110124US01).

The levulinic acid can be separated from the solvent by distillation or another means or further processed, e.g., by hydrogenation, to yield derivatives such as GVL. Both levulinic acid and GVL are value-added platform compounds that find commercial use as intermediates or reactants in many industrially useful processes, including the production of liquid transportation fuels.

Applications

- Cost-effective production of levulinic acid and sulfur-free GVL from biomass

Key Benefits

- Unlike existing approaches for purifying levulinic acid for further processing, this method does not require costly evaporation steps, expensive or rare catalysts or chemically resistant construction materials.
- Some embodiments allow more than 99 percent of the acid used to be recycled.

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- Because the GVL product is stable during the hydrogenation of levulinic acid, the concentration of GVL in the product mix can be increased through successive cycles of cellulose deconstruction, levulinic acid extraction and levulinic acid hydrogenation to GVL, enabling the easy and cost-effective separation of GVL from the solvent by simple distillation.
- Alkylphenols allow catalytic conversion of intermediates without purification.
- Alkylphenol solvents do not extract water or acids, enabling recycling of water and the acid catalyst for further biomass deconstruction.
- Water does not need to be separated from the reaction products by evaporation at any stage, reducing energy demands.

Additional Information

For More Information About the Inventors

- [Thatcher Root](#)

Related Technologies

- [WARF reference number P110124US01 describes an efficient process for extracting levulinic acid from water.](#)
- [For information about producing liquid fuels from levulinic acid, see WARF reference number P09298US.](#)
- [For information about producing methyl vinyl ketone from levulinic acid, see WARF reference number P09350US01.](#)
- [For information about producing gamma-valerolactone \(GVL\) and olefins from levulinic acid, see WARF reference number P100099US01.](#)

Related Intellectual Property

- [View Continuation-in-Part Patent in PDF format.](#)
- [View Continuation-in-Part Patent in PDF format.](#)

Publications

- Gürbüz E.I., Alonso D.M., Bond J.Q. and Dumesic J.A. 2011. Reactive Extraction of Levulinate Esters and Conversion to γ -valerolactone for Production of Liquid Fuels. ChemSusChem. 4, 357-361.

Tech Fields

- [Clean Technology.: Biobased & renewable chemicals & fuels](#)

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854

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