Success Story

Conversion of Biomass Wastes to Levulinic Acid and Derivatives

The catalytic process for methyl tetrahydrofuran production, developed at Pacific Northwest National Laboratory, is being licensed to Biofine Corporation for use with their levulinic acid production technology.

Biofine, a technology development company, is actively marketing their levulinic acid process. With the combined processes, they can manufacture an alternative fuel from renewable farm crops or other biomass wastes.

For more information, contact

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The Biofine process economically converts cellulosic biomass feedstock, a renewable resource formerly considered waste material, into levulinic acid. Once limited to high-value specialty applications, this platform chemical can be converted to a variety of other chemicals, including direct substitutions for petrochemicals, such as methyl tetrahydrofuran (MTHF), an oxygenated fuel additive that is becoming increasingly important. A process advanced by Pacific Northwest National Laboratory is helping to produce MTHF at market levels.

The U.S. Department of Energy (U.S. DOE) recently approved MTHF as a component in "P-Series" alternative fuels. The large market existing for these fuels is driven by the fleet vehicle requirements of the Energy Policy Act of 1992. The MTHF derived from levulinic acid greatly reduces waste and energy use, as determined by a U.S. DOE quality metrics evaluation, and checked and verified by A. D. Little, an independent consulting firm.

Levulinic acid (also known as 4-oxopentanoic acid) traditionally is prepared by treating cellulosic biomass with acid, which results in low yields and significant amounts of unwanted side products. Biofine's process, instead, favors high-yield production of levulinic acid for as low as $0.04-0.10/lb at large scales. Feedstocks tested include paper mill sludge, municipal solid waste, unrecyclable waste paper, waste wood, and agricultural residues.

The advantages of the Biofine process are extended when combined with catalysts and processing conditions identified by researchers at Pacific Northwest for increased MTHF production. Laboratory-scale continuous reactor work has optimized a single-bed catalytic hydrogenation process, using a proprietary catalyst at elevated temperature and pressure. The levulinic acid undergoes multiple hydrogenations (three moles of hydrogen per mole of acid) and two dehydrations in a single processing step. Laboratory tests indicate high yields are attainable on both a theoretical (molar) basis (83%) and on a weight basis (63 pounds of MTHF for every 100 pounds of levuilinic acid). In comparison, literature values using competing processes suggested low yields (3%) of MTHF as a minor byproduct.

Continuing Development

Plans are underway to scale up MTHF production (to about 20 gallons per day) from levulinic acid in a mobile processing unit at Biofine's demonstration plant in South Glens Falls, New York. Patent claims for the catalyst composition and the operating parameters have been allowed, and a patent is expected to be issued to Pacific Northwest in early 1999.