Clemson University Research Foundation

Improved Purification and Control of Molecular Weight of Lignin (2014-078)

Renewable Solvent of Hot Acetic Acid-water Mixture Purifies and Controls the Molecular Weight of Lignin

Market Overview

This renewable solvent system consisting of hot acetic acid-water mixtures can simultaneously purify, fractionate, and solvate lignins. This approach to purifying and controlling the molecular weight of lignin improves the pulping process and its output. Previous processes can be expensive and have poorly controlled molecular or chemical properties. Using traditional methods, less than 0.2 percent of the 50 million tons/yr of Kraft lignin is recovered for use in value-added products because of high ash content and poorly controlled molecular and chemical properties. Clemson University researchers have developed a hot acetic-water solvent system that can obtain ultra-pure lignin (UPL). This unique, multifunctional method for solvation will enables direct processing of lignin into microstructure-controlled, high performance carbon fibers and coatings. This form of ultra-pure lignin has potential to replace petroleum-derived polymers in a wide variety of applications.

Application

Carbon fibers, Industrial and Food additives, Biofuels

Stage of Development

Prototype

Advantages

- Utilizes a continuous process that can be significantly scaled up, resulting in a cost effective and easily commercialized product
- Allows adjustment of the solvent composition (i.e., the AcOH/H2O ratio), enabling one to isolate lignin fractions from each of the liquid phases with the desired molecular weight, chemical functionality, and ash/metals purity

Technical Summary

This approach uses a renewable solvent system that can simultaneously purify, fractionate and solvate lignins. The process operates at an elevated temperature in the presence of the hot acetic acid-water mixture, making the formation of a liquefied lignin phase. A key element of this process is tuning the compositions of the solvent system so as to split the lignin into two phases, a solvent-rich and a lignin-rich phase. This phase split is the key to the highly versatile purification, fractionation/molecular weight control, and solvation of the lignin. The ultra-pure lignins produced have broad potential use as carbon fiber.

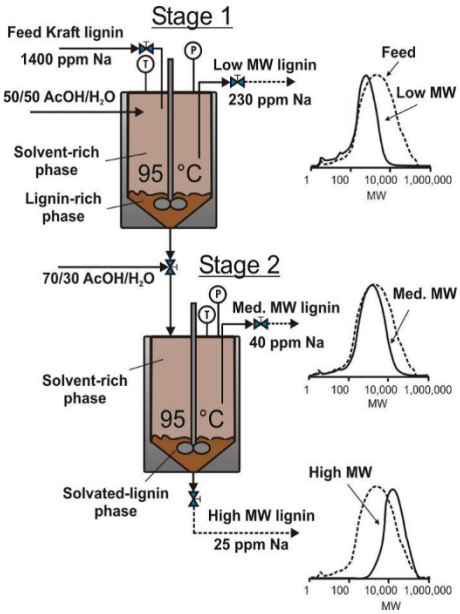

Figure 1: Two-stage extraction for producing UPL using "hot acetic acid-water mixtures." Both high and med MW (mol wt) fractions are ultrapure. Actual GPC plots are of feed (dotted lines) and fractions (solid lines).

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App Type	Country	Serial No.	Patent No.	CURF Ref. Number	Inventors
Utility	United States	14/945,846	NA	2014-078	Mark Theis, Adam Klett, David Bruce

About the Inventors

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Dr. David Bruce is a Professor of Chemical and Biomolecular Engineering at Clemson University. He earned his Ph.D. from Georgia Institute of Technology. His research interests include catalysis, kinetics, mass transfer, and molecular modeling.

For More Information

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