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Deep eutectic solvents' ability to solubilize lignin, cellulose, and hemicellulose; thermal stability; and density

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Abstract

An environmentally-friendly method to separate cellulose and hemicelluloses from lignin in recalcitrant biomass for subsequent conversion is desirable to reduce greenhouse gas generation. Easily-prepared, deep eutectic solvents (DESs) have low volatility, wide liquid range, non-flammability, nontoxicity, biocompatibility, and biodegradability. This study shows the DESs (formic acid: choline chloride, lactic acid: choline chloride, acetic acid: choline chloride, lactic acid: betaine, and lactic acid: proline) to be capable of preferentially dissolving lignin at 60 □. Thermogravimetric analysis show DES to be stable at typical biomass processing temperatures. Pretreating loblolly pine in one DES increased glucose yield after enzymatic hydrolysis to more than seven times that of raw or glycerol-pretreated pine. The density of DES-pretreated biomass was found to be 40% higher than the untreated pine's density.

1. Introduction

The increase in methane and carbon dioxide in the atmosphere has produced a "greenhouse effect," seen in unpredictable weather that has jeopardized the agricultural sector (Malcolm et al., 2012; Thomson et al., 2005). New ideas are needed to mitigate disastrous climate change.