Spring 2014

Recovering A Liquid-Lignin Phase From Paper Mill Black Liquors

Julian Velez
Clemson University

Adam Klett
Clemson University

Mark C. Thies
Clemson University

Follow this and additional works at: https://tigerprints.clemson.edu/grads_symposium

Part of the Biochemical and Biomolecular Engineering Commons

Recommended Citation
Velez, Julian; Klett, Adam; and Thies, Mark C., "Recovering A Liquid-Lignin Phase From Paper Mill Black Liquors" (2014). Graduate Research and Discovery Symposium (GRADS). 103.
https://tigerprints.clemson.edu/grads_symposium/103

This Poster is brought to you for free and open access by the Research and Innovation Month at TigerPrints. It has been accepted for inclusion in Graduate Research and Discovery Symposium (GRADS) by an authorized administrator of TigerPrints. For more information, please contact kokeefe@clemson.edu.
Lignin: what is it and where do we find it?

- Lignin is one of the three major components of biomass along with cellulose and hemicellulose.
- Lignin is potentially a renewable substitute for many petroleum-based chemicals.
- Black Liquor is a lignin-rich by-product from the paper production process.
- Lignin can be precipitated from black liquor by lowering the pH with CO2, which forms carbonic acid in the black-liquor solution. However, that lignin typically contains ~25 wt % ash.

Lignin as a renewable biofuel or biopolymer

- The recovery of lignin as a renewable biofuel and/or biopolymer would greatly improve the economics of a bio-refinery operation.
- Lignin as a biofuel: Lignin pellets have a heating value similar to that of coal.
- Lignin has the potential to become an inexpensive precursor for the production of carbon fibers.
- Lignin could be used as a precursor in the production of polyurethane foams.
- For many applications the lignin stream needs to be clean, containing no more than ~1-3 wt % ash.

A reliable source of clean lignin, as well as a fundamental understanding of lignin properties, is necessary for the long-term implementation of lignin as a substitute for petroleum-based chemicals.

Sequential Liquid Lignin Recovery and Purification Process (SLRP® Process)

- SLRP Process is a patented new process from our collaboration with LLC, capable of producing low-ash lignin (1-2 wt% ash) from paper mill black liquor.
- SLRP Process is significantly more energy-efficient than alternative processes, and has lower operating and capital costs (Gooding, 2012).

Characterization of lignin at the molecular level: creating products for specific applications

- We are interested in characterizing lignin at the molecular level so that we can tailor our lignin product for a given application (e.g., biofuels or renewable biopolymers).
- Examples of fundamental characterization are the molecular weight and functional group content of the lignin.
- Phenolic hydroxyl content in liquid-lignin fractions increases as the recovery pH decreases during the CO2-acidification process (Hodge and co-workers at Michigan State U).
- High molecular weight liquid-lignin fractions precipitate first (i.e., at higher pHs) during the CO2-acidification process (with Hodge and co-workers).

Conclusions

- SLRP Process is a patented new process from our team capable of producing low-ash lignin (1-2 wt% ash) from paper mill black liquor.
- The recovery of lignin from biomass-processing plants via the SLRP Process would positively impact the economics of biorefinery operations.
- A fundamental understanding of liquid-lignin phase behavior has been critical in our development of processes for producing ultra-pure lignins.

Acknowledgments are made to the Energy for Sustainability program (Award No.1236759) at the National Science Foundation, the Department of Energy (Grant No. DE-SC0001312), Liquid Lignin Company (LLC), and the Center for Advanced Engineering Fibers and Films (CAEFF) at Clemson University.