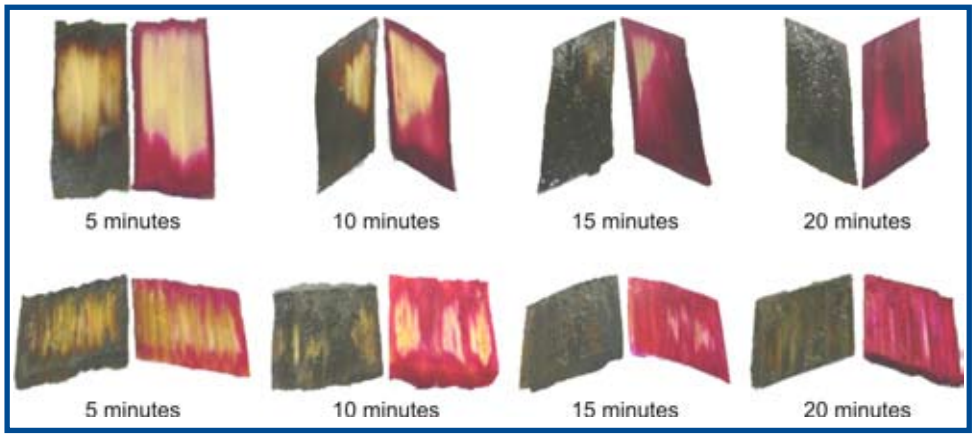
Highly Energy Efficient D-GLU (Directed Green Liquor Utilization) Pulping

Novel Process Offers Improved Energy Efficiency and Productivity

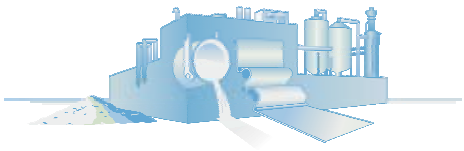
In an effort to address increasing wood cost and stagnant mill productivity, the pulp and paper industry has made maximizing the economics of its pulping operations a high priority. However, the high cost of capital retrofits for improving the pulping processes can be prohibitive.

Results from a previous project demonstrated in pulp mills in Finland, showed that the novel pulping innovation employing directed green liquor utilization (D GLU) can provide important energy benefits for mills in the U.S. In addition, pretreatment of pulp before cooking with controlled delivery of mill green liquor (GL) in a mild pretreatment phase (temperature and time), has proven to significantly enhance pulp properties. By rerouting a significant portion (20 to 30 percent) of the GL flow from causticizing to the pulp digester, kraft pulp mills typically handling North American furnishes (i.e., Southern pine) could significantly improve energy efficiency and productivity.

The figures below demonstrate how diffusional differences may affect pulping kinetics, especially if a pretreatment is applied before pulping. Each chip was exposed to a uniform environment of hydroxide and hydrosulfide, halved, and then dyed to show the absorption profile of one of the two chemicals. The black color (right) half chips demonstrate sulfide penetration, while the red half chips (left) demonstrate hydroxide penetration. Because of obvious differences between the two chemicals' absorption profiles, kinetic differences in pulping are expected and may be subject to control.



Top row: Penetration of sulfide (left) and hydroxide (right) into sweet gum chips at 103°C.
Bottom row: Penetration of sulfide (left) and hydroxide (right) into Southern softwood chips at 103°C.



Benefits for Our Industry and Our Nation

D-GLU pulping will provide increased pulp yield, higher fiber strength, lower H-factor at similar control cook kappa numbers, reduced digester alkali demand by as much as 50 percent, offloading of the lime kiln by up to 30 percent, higher pulp bleachability, and reduced energy use by up to 25 percent. This valuable and economical pulping innovation is optimized to provide significant energy savings and increased productivity in the U.S. pulp and paper industry.

Applications in Our Nation's Industry

The novel D-GLU pulping technology will be a retro-modification to kraft pulp mills producing linerboard and bleachable grade pulp.

Project Description

This project seeks to develop feasible chemical modifications during kraft pulping operations to obtain significant energy and product benefits for U.S. kraft pulp and paper mills. This project will also focus on providing a cost-effective retro-modification to kraft pulp mills (i.e., linerboard and bleachable grades), in addition to developing an engineering design and implementation plan for the additive-enhanced GL process.

Barriers

- Engineering of capital, liquor flows, and recovery for maximum benefits
- Environmental and scaling issues regarding nitrogen emissions during recovery due to inclusion of the organic additive, higher sulfide off gassing in cooking, and scale in the digester and/or evaporators
- Understanding the function of the nitrogen-based organic additives

Pathways

The objectives of this project will be achieved through (1) determining how to handle the GL flows; (2) performing applied and fundamental studies for the pulping catalyst; (3) selecting a mill and exploring any mill-specific issues related to odor, environmental concerns, solid impacts, and corrosion; and (4) performing mill trials.

Progress and Milestones

- Address questions to feasibility and planning of GL pulping process in target mill by combinatorial mill testing (Completed)
- Perform both initial and expanded mill trials by securing multiple corporate sponsors
- Analyze economic use and application of additive-enhanced GL pulping in order to entice corporate testing and participation
- Research mechanisms of scale build-up downstream in the pulp and its effects on the pulping process (Completed)
- Determine possibility of significantly altering green liquor recausticization and the economic viability of this avenue
- Demonstrate 15% energy savings during D-GLU pulping mill trials

Commercialization

The industrial sponsors will provide mill pulping facilities, personnel, and other resources (i.e., chips, liquors) to implement work and coordinate mill trials. Success in this program will generate interested stakeholders and ultimately increase market penetration.

Project Partners

North Carolina State University
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Georgia Institute of Technology
Atlanta, GA

Evergreen Pulp
Samoa, CA

Inland
Orange, TX

Potlatch
Lewiston, ID

Lincoln Paper and Tissue
Lincoln, ME

Wego Chemical & Mineral
Great Neck, NY

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

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