



INDUSTRIAL TECHNOLOGIES PROGRAM

Materials for High-Temperature Black Liquor Gasification

Improved Refractories and Nozzle Materials Will Enable Energy- Efficient Industrial-Scale Gasification Technology

Many of the 278 black liquor boilers in the U.S. forest products industry need to be replaced or rebuilt. New black liquor gasification technology is both a complementary and alternative technology to existing recovery boilers. Gasification of black liquor with combined-cycle cogeneration of steam and electricity can result in greater energy output per unit input for the forest products industry. However, high alkali concentrations and high temperatures result in a significant loss of refractory materials and metallic components, creating structural and safety issues, thermal efficiency losses, and unacceptable maintenance costs and downtime. The current

refractory lifetimes of approximately six months and nozzle lifetimes of three to six months need to be extended to a minimum lifetime of one year.

This project will focus on the development of degradation-resistant materials that will enable high-temperature black liquor gasification units to attain a service life of at least one year. Improved refractories and wear-resistant nozzle materials will be developed through an understanding of the failure mechanisms of existing materials and through modeling to understand fluid flow inside the gasifier.

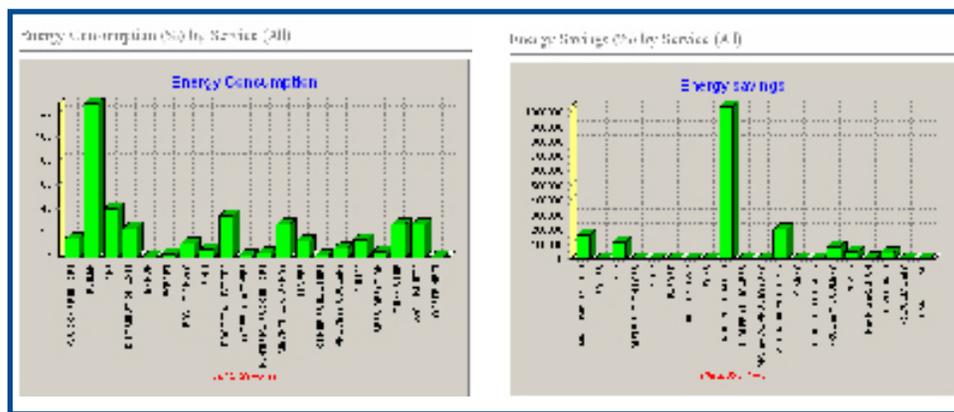


Benefits for Our Industry and Our Nation

The use of new materials in black liquor gasifiers will provide economic benefits through improved product quality, reduced downtime, and improved productivity. Significant energy benefits will be achieved through the use of new gasification technology.

Applications in Our Nation's Industry

The new materials developed in this project will find applications not only in black liquor gasifiers for the forest products industry, but also in other systems, including boilers, furnaces, gasifiers, and kilns. The technology will be applicable to the chemicals, glass, forest products, and petroleum industries.



Sample PEP Reports showing energy consumption and savings by system

Download the PEP tool and other software tools at www.eere.energy.gov/industry/energy_systems/tool_development.html or participate in an on-line forum to discuss using the PEP tool.

Project Description

The goal of this project is to develop improved corrosion-resistant refractories and nozzle materials for use in high-temperature, atmospheric-black liquor gasifiers.

Barriers

Major barriers to be overcome include:

- Lack of understanding of the failure mechanisms of refractories and nozzle materials;
- Lack of knowledge of flow behavior on the wear of injection nozzles and refractories; and
- Lack of information on the performance of candidate materials in an industrial gasification environment.

Pathways

The objectives of the project will be achieved through (1) identifying the failure mechanisms of current refractory materials and liquor injection nozzles; (2) computational fluid dynamics modeling of injection nozzles to understand flow characteristics; (3) developing new degradation-resistant refractories and wear-resistant nozzle materials; (4) testing the performance of materials in simulated industrial environments; (5) fabricating advanced materials on an industrial scale; and (6) evaluating the in-service performance of advanced materials in an industrial-scale gasifier.

Progress and Milestones

- Model flow and temperature profile using computational fluid dynamics (Complete)
- Develop industrial-scale refractory fabrication protocols for refractories and surface-treated materials (Complete)
- Evaluate currently available monolithic refractories in gasifier environments (Complete)
- Develop new refractories for gasifier environments (Complete)
- Manufacture and install a panel of new refractories in a commercial gasifier (Complete)
- Manufacture nozzles and thermocouple protection sheaths with optimum materials and design (Complete)
- Evaluate the in-service performance of the industry-produced refractories and nozzle materials (Complete)
- Decide on the replacement of a major portion of refractory gasifier lining (Complete)

Commercialization

This project team includes a national laboratory, a university, companies engaged in computational fluid dynamics modeling, manufacturers of refractories, and an end-user of black liquor gasification. This structure ensures an effective pathway for industrial adoption of the new degradation-resistant materials that will be developed as a part of this project. For example, the refractory company will be able to market the new technology to various industrial sectors.

Project Partners

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Process Simulations Ltd.
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Simulent Inc.
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University of Missouri-Rolla
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Vesuvius-Monofrax Refractories
Falconer, NY

Weyerhaeuser Co.
Federal Way, WA

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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Ending FY06

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