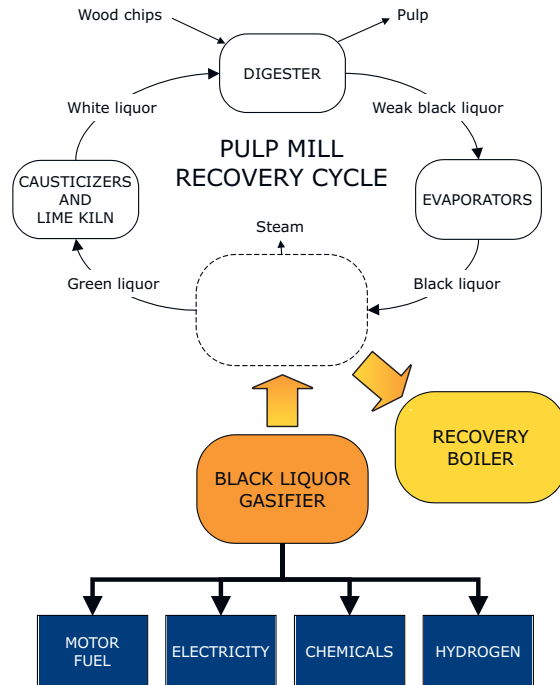


The modern pulp mill: A biorefinery

The wood chips entering a pulp mill are treated at elevated temperature and pressure with a chemical solution (white liquor) forming pulp and the by-product - black liquor.



The pulp is used to produce paper and the energy and chemicals in the black liquor are recovered. The energy efficiency of a pulp mill could significantly increase if the current combustion based energy recovery system was replaced by a black liquor gasification system.

With the introduction of black liquor gasification, the modern pulp mill has the potential to be transformed into a biorefinery that produces electrical power, fuels and valuable chemicals at competitive prices in addition to pulp. Estimates that have been made for Sweden conclude that about 30% of the national need for transportation fuels could be produced from the black liquor or 7% of current national electricity consumption.

Organization

Research

- Energy Technology Centre (ETC), Rikard Gebart, www.etcpitea.se
- Luleå University of Technology, Lars Westerlund, www.ltu.se
- Umeå University, Anders Nordin, www.umu.se
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- Corrosion Institute, Lars Troselius, www.corr-institute.se
- Chemrec, Ingvar Landälv, www.chemrec.se

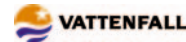
Sponsors

- MISTRA, www.mistra-research.se
- Swedish Energy Agency, www.stem.se
- Norrbotten County Administrative Board, www.bd.lst.se
- Sveaskog, www.sveaskog.se
- Vattenfall, www.vattenfall.se
- Kappa Kraftliner, www.kappa-kraftliner.com
- SCA, www.sca.se
- Södra, www.sodra.se
- Chemrec, www.chemrec.se

CHEMREC



MISTRA



SVEASKOG



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THE BLACK LIQUOR GASIFICATION PROGRAM



The 100 MSEK Swedish national Black Liquor Gasification (BLG) program is carried out in cooperation between industry, authorities, universities, and institutions during the period 2004-2006.

The BLG-program comprises two parts, the erection and operation of the DP-1 plant in Piteå, Sweden and the carrying out of a dedicated R&D program with 8 subprojects.

www.etcpitea.se/blg

Objective

A successful outcome of the BLG-Program will result in a verified process, ready for scale up, based on sound operational and scientific understanding of the important sub-processes in high temperature black liquor gasification. In addition, the system will be optimized for integration with the pulping cycle. This is intended to remove hesitation from the industry, to adopt the new technology based on technical arguments and lead to a better and more environmentally friendly utilization of the spent cooking liquors from pulping processes.

Black liquor – a green fuel

- By-product from pulping (used cooking chemicals, lignin and other wood components and water)
- Liquid biomass, thus a renewable fuel
- Approximately half the wood used for pulp production ends up in the black liquor
- Heating value of ~14 MJ/kg DS (Oil: ~42 MJ/kg)
- Smelly (sulphur compounds)

Currently, the energy in the black liquor is recovered by combustion with subsequent steam production in a recovery boiler. In a novel BLG system the energy would be recovered as synthesis gas and steam. The gas can be used for production of electricity, automotive fuels, hydrogen or chemicals.



Two main tasks

The BLG program has two main tasks which are strongly linked together:

- Construction, start-up and operation of the Chemrec DP-1 plant.
- Fundamental and applied research in the field of black liquor gasification. The program is strongly linked to the operation of DP-1.

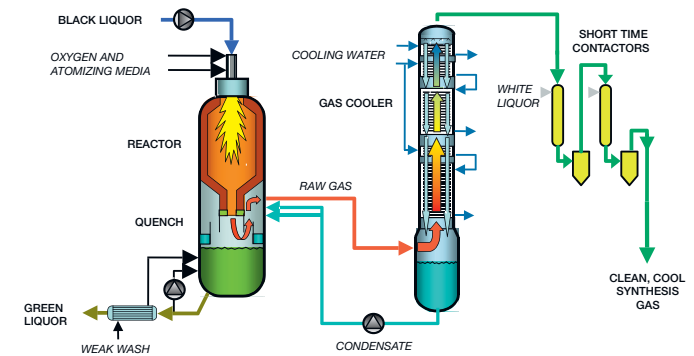


Research Activities

There are several research challenges for the pressurized BLG technology to become commercial. To fully optimize the gasification system there is a need for improved understanding of the process and its kinetics, increased insight into construction material durability and impact of the gasification system on the overall operability of the mill.

The research efforts in the BLG program are divided into sub-projects where each subproject focuses on a specific research challenge.

- Development of computer models for process design, optimization and scale-up
- Chemistry and kinetics in the gasifier
- Chemical equilibrium and thermodynamic data
- Materials for hot green liquor
- Mill integration of black liquor gasification
 - New improved pulping methods for increased pulp yield
 - Control and management of trace elements
 - Autocausticization with borates



The CHEMREC DP-1 Plant

The DP-1 plant in Piteå, Sweden includes process units for gasification and quenching, gas cooling and gas cleaning. The core of the unit is the gasifier, an entrained flow reactor, where concentrated black liquor is gasified at approximately 30 bar and at a temperature of about 1000°C. Oxygen is used as the oxidant. The capacity of the DP-1 plant is 20 ton DS/day (~3 MW_{th}).

Chemrec's main goals for the operation of the DP-1 plant are to validate operational data from previous pilot plant operations and to gain sufficient experience from continuous operation to move on to the demonstration phase. The demonstration plants call for an approximately 15 times scale up. During the first period of operation Chemrec will focus on heat and material balances, construction materials, trace component management and green liquor quality.

