Black Liquor to Liquid Fuels: Aspen Plus Modeling

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Introduction

Current Process:

Black Liquor i Recovery Boiler i Electricity

Black Liquor worth $13.78/ton

REPLACE WITH

Proposed Process:

Black Liquor i Gasifier i Fischer-Tropsch Reactor i Biodiesel

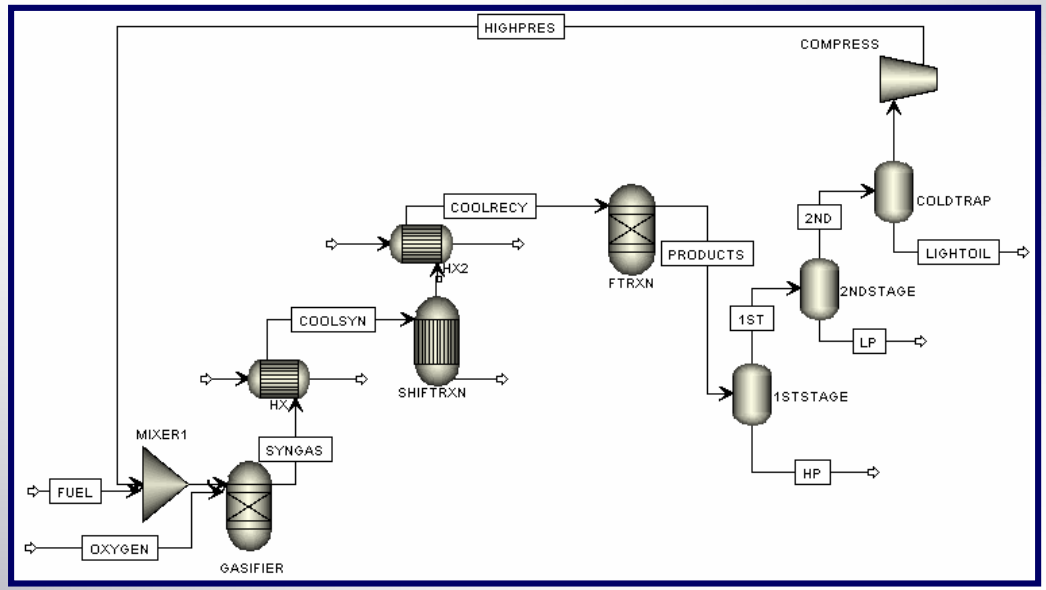
Black Liquor worth $73.14/ton

* Potential production = 280 million barrels oil/yr
* Replaces 7% of U.S. oil imports with domestic, renewable fuel

Objectives

Develop an Aspen Plus model to:

- ✓ Calculate improved energy and mass balance
- ✓ Change process operating conditions and quickly analyze effects
- ✓ Create a more sophisticated economic analysis



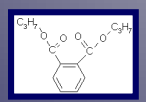
Future Work

- Correct current process errors
- Include impurities and their cleanup (S, N, halides, etc.)
- Optimize operating conditions
- Economic analysis

Model Development

Feed

•Fuel used to model black liquor: Dipropyl-phthalate, $C_{14}H_{18}O_4$



Gasifier

•20 bar

•1550 ^oC

•Reactor minimizes Gibbs free energy

•Products: CO, CO_2, CH_4, C(s), $C_{10}H_8$, H_2, H_2O

Water-Gas Shift Reactor

•20 bar

•530 ^oC

•Reactor calculates equilibrium based on stoichiometry

$$CO + H_2O \rightarrow CO_2 + H_2$$

•Products Stream H_2:CO ratio of 2

Fischer-Tropsch Reactor

•17 bar

•250 ^oC

•Anderson-Schulz-Flory product distribution

•CH_4 to $C_{10}H_{22}$

•Currently determining best reactor type

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