Bed Agglomeration for Low-Temperature Black Liquor Gasification

J. David Dunaway, Dr. Larry Baxter, Dr. Dale Tree

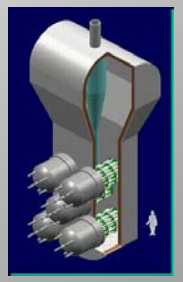
BYU
BRIGHAM YOUNG
UNIVERSITY

Research Objectives:

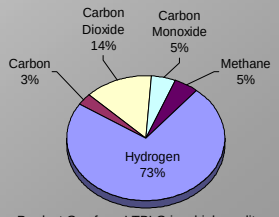
- Develop a prototype bench scale fluidized bed reactor
- Measure temperature and pressure profiles in the reactor
- Determine operating windows in terms of temperature and bed composition
- Determine effects of different bed constituents ($CaCO_3$, $NaSO_4$) on agglomeration
- Develop a simple model of a fluidized bed gasifier
- Develop a reactor that will be used to measure properties of a fluidized bed, including pressure and temperature profiles

Low-Temperature Black Liquor Gasification

MTCI Fluidized Reformer



Steam fluidized at 580-620ºC. Superficial Gas velocity ~ 1.4 ft/sec



Product Gas from LTBLG is a high-quality, medium-BTU fuel at 350 BTU/scf. It provides all the necessary fuel for the pulsed combustors.

Steam reacts with the carbonaceous components of black liquor to form hydrogen and carbon monoxide

$$H2O + C + Heat = H2 + CO$$

A water-gas shift also occurs, creating hydrogen and carbon monoxide

$$H2O + CO = H2 + CO2$$

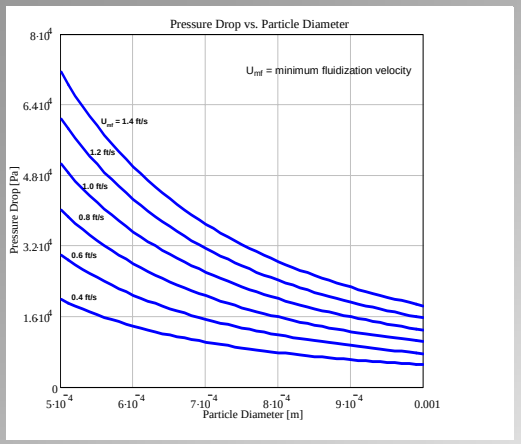
Sulfur in the feed is converted to hydrogen sulfide and is scrubbed from the product gas.

Sodium and potassium present in the liquor form carbonates and remain as solids in the bed. These have the potential to lower the bed melting temperature and decreasing operating temperatures and overall carbon conversion

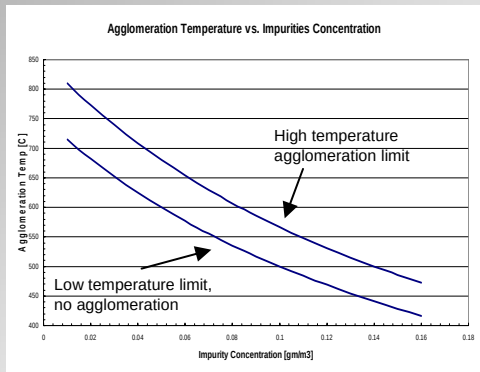
Bench Scale Fluidized Bed Reactor

Fluidized Sodium Carbonate at 150˚C

As particles agglomerate pressure drop through the reactor decreases.



Future work will show the operating window for LTBLG by plotting agglomeration temperatures vs. impurity concentration



Acknowledgements: Department of energy, MTCI, TRI, University of Utah, and Brigham Young University

References: www.tri-inc.net, M. Momtaz, R. Candran, L. Rockvam, *The evolution of and advances in the steam reforming of black liquor*, Manufacturing and Technology Conversion International, Inc. 2003.