



Hydrothermal Gasification of Woody Biomass

Catalytic Process Engineering – M.H. Waldner, F. Vogel

Introduction

Wet biomass (liquid manure, wood) contains **large energy potentials**. Synthetic natural gas (SNG) is produced today by a conventional route (gasification of biomass to syngas, gas cleaning and methanation to SNG). The hydrothermal route is a promising new technology, as the **thermal efficiency** is higher and **nutrient salts** can be extracted from the biomass for further use. In addition, the expensive process of **drying** has become **obsolete**.

Experimental

Equipment:

- **Batch reactor** (316SS) for high feed conc. ($w_{\text{wood}} < 30 \text{ wt\%}$); with cooler or as bomb
- Heating in a fluidized **sandbath**
- **Quenching** by immersing into waterbath
- **Online data** analysis with LabView software

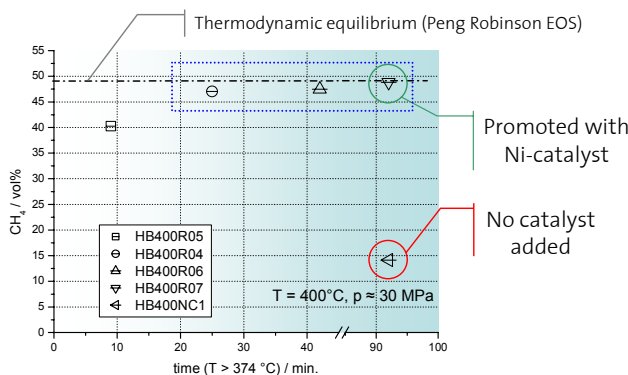
Analytics:

- Gas Chromatography & HPLC
- Dohrmann DC-190 TOC Analyzer
- Karl Fischer Titration
- XPS / TPO



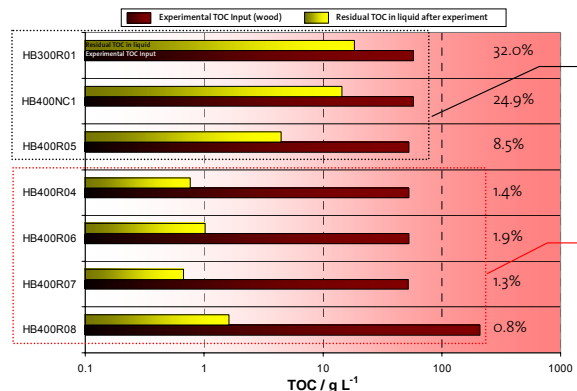
Results

Gas composition achieved (selected experiments):



Very close to thermodynamic equilibrium

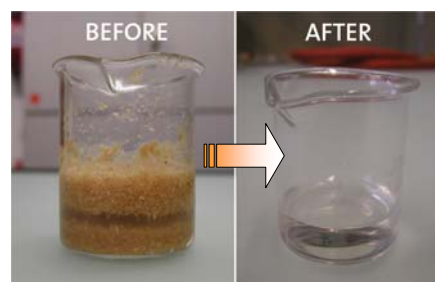
Residual carbon in liquid product (water):



Liquefaction, Products w/o catalyst and quench experiment

„Successful“ gasifications

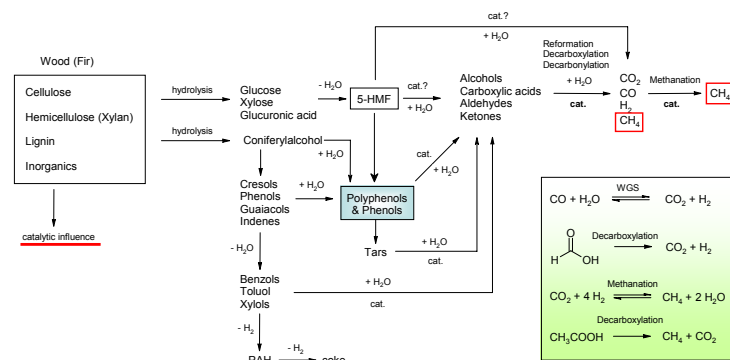
Reactant mixture and liquid product:



Complete Conversion

Products: pure water and gases

Proposed reaction network:



Economics: Vogel F., Hildebrand F. (2002) Catalytic Hydrothermal Gasification of Woody Biomass at High Feed Concentrations. Chem. Eng. Trans., 2: 771-777.

For a 20 MW_{th} plant (70% thermal process efficiency), SNG can be produced at a cost of:

- 10 USD/GJ for wood (price for wood 3.5 USD/GJ)
- 6 USD/GJ for zero-cost liquid manure