Biomass and fossil fuel conversion by pressurised fluidised bed gasification using hot gas ceramic filters as gas cleaning

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Gasification of biomass and older fossil fuels, like brown coal, hot gas cleanup using a ceramic filter and combustion of LCV product gas in a combustor was performed using a 1.5 MW_{th} test rig (PFBG) at Delft University and a 10-50 kWth at Stuttgart University (DWSA) in the framework of experimental pilot plant research on efficient, environmentally acceptable large scale power generation systems based on fluidised bed gasification technology.

The influence of operating conditions (pressure, temperature, stoichiometric ratio) on gasification performance (gas composition, conversion grades) was studied. The gasifiers were operated at pressures in a range of 1.5 – 10 bar and maximum temperatures of circa 900 °C. The Delft gasifier (see figure 1b) has a 2 m high bed zone (diameter of 0.4 m) followed by a freeboard approximately 4 m high (diameter of 0.5 m). The IVD gasifier (see figure 1a) has a diameter of 0.1 m and has a total reactor length of 4 m. Both gasifiers are equipped with a hot gas cleanup ceramic filter and a pressurised combustor.

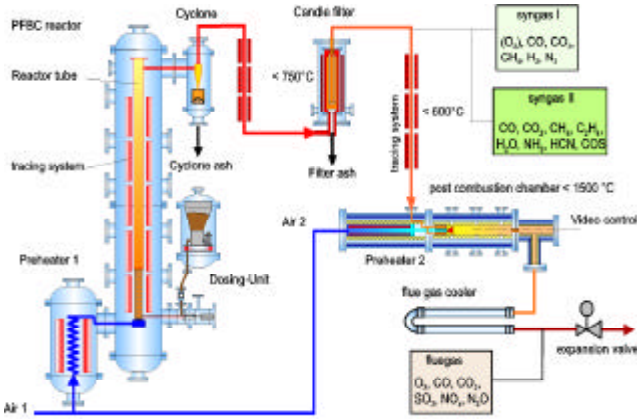

Figure 1a: IVD test rig

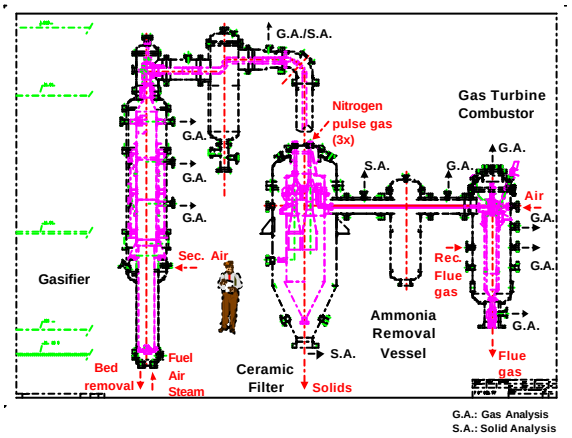

Figure 1b: Delft gasification installation

Carbon conversions during the pressurised fluidised bed gasification experiments of wood, miscanthus and brown coal were well above 80%. Fuel-nitrogen conversion to ammonia was above ca. 50% and the highest values were observed for biomass compared with solid fossil fuel. The results are in-line with other pressurised fluidised bed gasification investigations with bottom feeding of biomass [1]. Significant deviation occurs as compared with top feeding [2].

Measurements from both gasifiers are compared with simulation results of a reaction kinetics based model (implemented into the flowsheeting package ASPEN PLUS) using homogeneous elementary reaction chemistry published in [3],[4] and heterogeneous gas-char reactions e.g. [5] related to emission of environmentally harmful components, like fuel-nitrogen derived species (NH_3 and HCN).

Data from literature regarding the initial biomass flash pyrolysis step in the gasification process are used in the gasifier model and compared with simulation results from the FG-DVC model based on biomass [6]. The results obtained are presented and analysed. Measurements and gasification model predictions were in quite good agreement with each other.

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