Trace element and alkali metal mass balancing in fluidised bed gasification of miscanthus

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The section Thermal Power Engineering of Delft University of Technology does theoretical and experimental research in the area of energy conversion. Gasification of solid fuels is one of these areas. To obtain experimental data on an industrially relevant scale, a 1.5 MW_{th} PFBG (Pressurised Fluidised Bed Gasifier) has been constructed and operated. The PFBG test rig is operated at elevated pressures in the range of 3 to 8 bar and comprises a bubbling fluidised bed gasifier, a hot gas ceramic honeycomb filter and a modified gas turbine combustion chamber.

The influence of operating conditions on general gasification performance was studied. Main process parameters are fuel, additive, pressure and stoichiometric ratio. Most important performance criteria are product gas quality in terms of heating value, harmful components and fuel conversion grade. The Delft gasifier has a 2 m high bed zone with a diameter of 0.4 m and 4 meter high freeboard with a diameter of 0.5 m.

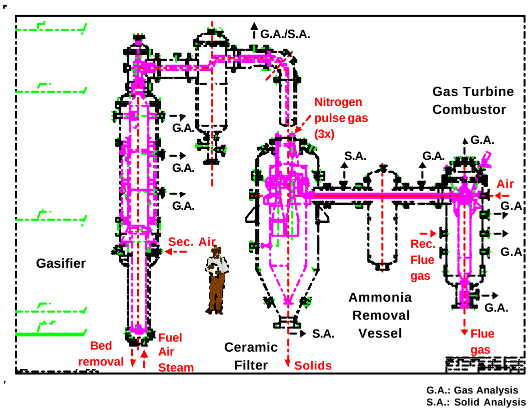

Figure 1: Delft gasification installation

Special sampling probes were designed and constructed to measure gaseous alkali and trace elements by means of wet trapping. The design is loosely based on designs published by VTT in literature [4]. The probes are ceramically lined and kept hot to prevent condensation and reactions in and with the probe. Measurements before an after the filter were carried out. Together with analyses of the bed material and fly ash a mass balances for the major components C, H, O, N, S, Cl and the ash can be made. Trace and ash elements can then be superimposed on the major component balance.
Chemical equilibrium calculations were carried out for the system using a modified version of NASA's CEA (Chemical Equilibrium with Applications) program [5]. Normally CEA can handle only pure condensed phases thereby excluding solid and liquid phase reactions. The program was therefore modified according to the RAND algorithm, [1], [2], [3] to include a mixed condensed phase.

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