Cleaning and treatment of Product Gas from biomassgasifiers optimisation of the H2:CO - ratio in synthesis gases for the production of 2nd generation biofuels

Partners:

- Technical University Vienna (AT, coordinator)
- REPOTEC Environmental Technologies ltd (AT)
- Biomass Power Plant Güssing ltd (AT)
- CUTEC Institut ltd (DE)
- H.C. Starck ltd (DE)

Abstract from the report

Biomass gasification is a possibility to produce from a solid fuel a synthesis gas, which can be used for many different applications (production of chemicals like ammonia, production of heat and electricity, production of 2nd generation biofuels like FT diesel). In this project two different gasficiation technologies are utilised:

• Allothermal steam gasfication, developed by TUV

• Autothermal oxygen steam gasification developed by Cutec.

In this project the optimisation of the gas composition for the Fischer Tropsch synthesis and other possible synthesis reactions are investigated. This includes the reforming of hydrocarbons and the CO-shift reaction to adjust the correct H2:CO ratio.

The biomass CHP Güssing uses the allothermal steam dual fluidised bed gasifier and produces a high grade product gas, which is used at the moment for the CHP in a gas engine. As there is no nitrogen in the product gas and high hydrogen content, this gas can be also used as synthesis gas. At the biomass CHP Güssing there are about 10vol% of methane in the product gas, which means, that about 1/3 of the chemical energy is bounded in the methane and cannot be utilised in the Fischer Tropsch reaction. The aim of this project is to convert this methane over a steam reforming step to hydrogen and carbon monoxide and to increase the conversion efficiency from biomass to FT fuels in this way.

In the first experiment it was shown, that the reactor itself has no catalytic effects and the gas composition does not change over the reactor. It was also recognised, that there is soot formation, if the steam carbon ratio is too low.

In the experiments with the methane reforming catalyst it was shown, that the higher hydrocarbons are reformed almost completely, but the methane conversion was not as high as expected. Also a deactivation of the catalyst by carbon formation occurred.

The other 2 types of catalysts worked well without any deactivation by carbon formation or sulphur poisoning. With both types a parameter variation was done and with the aromatics reforming catalyst also long term experiments were done.

In the parameter variation the optimal temperatures and steam-carbon ratios were found , but it was not possible to get 100% conversion of methane. For the higher hydrocarbons 100% of conversion was reached, but for methane only about 50% of conversion could be reached. This was mainly due to the fact, that the heat transfer in the reactor was not good enough. To reach higher conversion not a 2 step reactor as used in this project, but a 3 stage reactor would be necessary.

Based on the results of WP2 the mass- and energy balances for a commercial plant were calculated. Here 5 different cases were done. As final product on the one side FT products on the other side hydrogen was used for the simulation. The results are also compared with previous results, where the steam reforming step was not included into the overall system.

Based on the simulation results an economic analysis of the overall system was done and also with previous results compared, where the steam reforming step was not included. The main result of the economic evaluation is that hydrogen can be produced at costs between 20-30 Eurocents per Nm^3 or 6-9 Eurocents per kW and FT fuels at costs between 0,8-1 € per litre or 8-10 Eurocents per kW.