CATALYTIC TAR REFORMING TO UPGRADE SYNGAS QUALITY AND YIELD FROM BIOMASS GASIFICATION

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Using biomass as a carbon source contributes to the reduction of greenhouse gas emissions, as biomass absorbs CO_2 during its growth. Among the available thermal conversion paths, gasification is one of the most adopted because the obtained syngas can be used as a clean fuel or a source of chemicals, including e-fuels. The biomass gasification is carried out with a sub stoichiometric input of oxygen respect to the combustion. This leads to the thermal decomposition generating as main product synthesis gas (the syngas) composed of CO, H_2, CO_2, as well as hydrocarbons with a wide range of molecular complexity. Subsequently, technologies such as catalytic steam reforming can be used to convert the complex hydrocarbons into new hydrogen and cleaning the syngas to produce a stream usable, for example, in methanol or Fischer - Tropsch synthesis.

The work we are presenting was designed to assess the efficiency of using two types of catalysts operating in series, the final goal was achieving tar reforming to clean syngas and increase hydrogen content in the upstream. Using two catalysts, one cheap and moderately performant, the other more expensive and complex to synthesise is an effective strategy to clean up syngas from tar and increase the hydrogen production from biomass.

First, the raw syngas was passed through a bed of dolomite, which is quoted to provide conversion of tar among 44% - 97% and, moreover traps CO_2, sulphur and chlorinated compounds. Then, the partially cleaned syngas passed in a bed of $Ni/CeO_2/Al_2O_3$ that is quoted to provide conversion higher than 98% because of the intimate interaction between Ni and CeO_2 that can play important role on the steam gasification of organic molecules, in particular avoiding coke deposits.

For the study a side stream of the ENEA's gasification plant PRAGA (uP dRAft GAsification) was used, the pilot has a nominal input of 20-30 kg/h of feedstock. Updraft configuration is a valuable option for the gasification occurring at low temperature characterized high energy efficiency, simple and robust operation, but also producing relatively large quantity of organic volatiles.

The tar contained in stream of syngas from pilot gasifiers was reacted up to the conversion higher of 98 %, moreover, the H_2 production increased up to 137%, part was from the conversion of CO by WGS (34%) while most was from the steam reforming of tar.

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