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Publication date
2016

Document Version
Final published version

Citation (APA)
del Grosso, M., & de Jong, W. (2016). *Biomass gasification in a novel 50kWth indirectly heated bubbling fluidized bed steam reformer*. Abstract from Combura 2016, Soesterberg, Netherlands.

OCTOBER 5&6

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Biomass Gasification in a novel 50kW$_{th}$ Indirectly Heated Bubbling Fluidized Bed Steam Reformer

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In the global chase towards sustainability and cleaner ways of generating power, the utilization of biomass for clean energy conversion process has become increasingly interesting as biomass is potentially a CO_2-neutral energy source. Among the processes known to produce power, gasification represents an attractive and versatile technology to convert wide variety of biomass into product gas mainly composed by CO, H_2, CO_2, H_2O and CH_4, that can be used for (combined) heat and power (CHP) production, transportation fuels and chemicals. For small to medium scale biomass gasification, fluidized bed technology is attractive: the process takes place in a bed of small particles fluidised by a suitable gasification medium and the very good gas-solid mixing ensures temperature uniformity through the bed and leads to an excellent mass and heat transfer.
In indirectly heated gasification, also known as second generation or allothermal gasification, the heat needed for the desired reactions is provided by ex-situ oxidation reactions and this leads to a higher quality product.

The project, which started in May 2016, is a four years Doctoral research project carried out at the Delft University of Technology (TUD), in the Netherlands and it is in cooperation with the company Petrogas Gas-Systems, based in Gouda. In particular, Petrogas Gas-Systems and the TU Delft Process & Energy section are designing, engineering, and commissioning a small 50 kW$_{th}$ Indirectly Heated Bubbling Fluidized Bed Steam Reformer (IHBFBSR) heated by two radiant tube burners placed vertically inside the reactor.

The aim of the work is to study how the use of this new concept of indirectly heating based on combustion, biomasses with different characteristics, various operating conditions and bed with different particle size affects the product gas yield and composition, the cold gas efficiency and, in particular, the carbon conversion.

During the work, an experimental study on the heat transfer of radiant tube burners as well as an experimental gasification campaign will be carried out. Moreover, a process modelling by using the flow sheeting software package Aspen Plus™ and a model of the heat transfer inside the radiant tube burners and the reactor by using the computational fluid dynamics software package Fluent™ will also be developed.

Acknowledgments
The authors would like to acknowledge Petrogas Gas-Systems for co-financing the project.