Refereed Proceedings

The 13th International Conference on Fluidization - New Paradigm in Fluidization Engineering

Engineering Conferences International *Year* 2010

CO-GASIFICATION OF COAL AND WOOD IN A DUAL FLUIDIZED BED GASIFIER VARIATION OF FLUIDIZATION CONDITIONS AND LOAD RATIO

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ABSTRACT

Within this work the use of coal has been tested in a dual fluidized bed 100 kW -steam blown- gasifier originally designed for wood. With adjustments like fluidization conditions and fuel load, it is possible to gasify coal in load-ratios from 0 % to 100 % with this technology.

INTRODUCTION

Coal as substitute for oil is nothing new, during the oil crises in the 1970s until the middle 1980s coal was already used as a substitute for oil (Prins et al (1)). But in these days not only an oil substitute is required but also a way to minimize carbon dioxide emissions which many countries agreed to in the Kyoto protocol. Since carbon dioxide emissions from biomass are perceived as neutral (Prins et al (1)) and coal is a fuel with high availability (especially in political stable countries) and less expensive than oil, gasification of mixtures of these two oil alternatives is a natural consequence. The availability of biomass is mostly fluctuating with the season (André et al (2)), hence the idea of gasifying mixtures within a wide range in one plant looks like an economic advantage. Within this work the suitability of coal in an already existing 100 kW biomass gasifier pilot plant has been tested. This technology is demonstrated in the 8MWth combined heat and power plant in Guessing (Austria) and the results gained in the experiments are useful for upgrading (Pfeifer and Hofbauer (3)). To guarantee a save test run at the Guessing plant test runs to optimize the fluidization conditions as well as the fuel load had to be done which are presented in this work.

EXPERIMENTAL

Assembling and Function of the dual fluidized bed steam gasifier

The 100 kW dual fluidized bed gasifier (DFB) at VUT (Pfeifer and Hofbauer(3), Soukup, et al.(4), Wolfesberger, et al (5)), was originally designed for wood chip gasification. This reactor's basic idea is the separation of the gasification zone from the combustion zone.

Therefore two fluidized beds which are connected via an upper and a lower siphon are used for gasification and combustion (Pfeifer, et al (6)). The bed material circulates continuously between these two reactors. As the bed material is used as heat supply for gasification it is heated up by about 50 °C in the air blown transporting fluidized bed of the combustion reactor. The flue gas stream is separated from the hot bed material and then the bed material is transported via the upper siphon into the gasification reactor. Within the bubbling fluidized bed of the gasifier gasification occurs. The fluidization medium for the gasification zone as well as for the two siphons is steam. Residual char and bed material is conveyed from the gasification reactor through the lower siphon into the combustion part of the facility. The residual char provides not enough energy therefore oil is used as additional fuel in the test facility. In industrial sized plants a part of the producer gas is burned in the combustion zone. The regulation parameter for the gasification temperature is besides the circulation rate the additional fuel therefore it is needed in any case.

To gasify coal in this reactor the fuel feeding system had to be adjusted. Since two fuels had to be fed into the reactor at the same time, a mixing chamber and a new hopper was installed. Coal and wood are fed from two separate hoppers and mixed before being fed via a plug screw into the gasifier. For a good reaction and mixture in the fluidized bed the fuels are fed directly into the bubbling fluidized bed. In the test facility the gas streams from both zones are measured separately and burned unified in a combustion chamber. Figure 1 shows the principle of the gasifier and the main assembled parts. After the producer gas cooler gas samples are taken for producer gas measurement is essential to stop all gasification reactions within the gas stream as well as for sampling of impurities (tars, ammonia, hydrogen sulfide etc.).

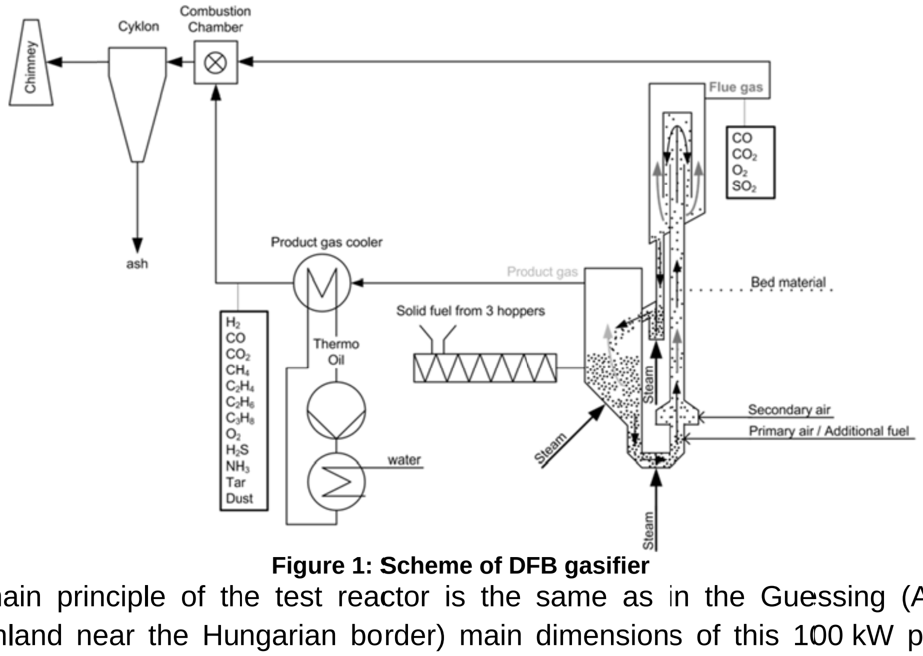

Figure 1: Scheme of DFB gasifier

The main principle of the test reactor is the same as in the Guessing (Austria, Burgenland near the Hungarian border) main dimensions of this 100 kW process development unit as well as of experimental conditions.

For this experiments hard coal from Poland was used, because it is low in sulfur and typically used in several power plants in Austria and therefore easily available. The