Refereed Proceedings

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

Engineering Conferences International *Year* 2010

FLUIDIZED BED GASIFICATION OF BIOMASS: A SUBSTANCE FLOW ANALYSIS

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ABSTRACT

A natural biomass was fed in a pilot scale bubbling fluidized bed gasifier, having a maximum feeding capacity of 100kg/h. Measurements included the syngas composition, the mass flow rate and composition of entrained fines collected at the cyclone and purge material from the wet scrubber, and the bed material characterization. The performance of the whole gasification plant and of its specific components as well as the validity of some design solutions and operating criteria have been quantitatively assessed by means of a substance flow analysis.

INTRODUCTION

Different gasification technologies are today available to convert biomass in a syngas able to provide a wide range of products, extending from clean fuel gas and electricity to bulk chemicals (1, 2). Fluidization is the most promising among all biomass gasification technologies, for a series of attracting reasons, such as the possibility to utilize different fluidizing agents, reactor temperatures and gas residence times, to inject reagents along the reactor height and to operate with or without a specific catalyst (3, 4).
Since the markets for biomass gasifiers without gas cleaning are rather limited, the key to achieving economically and environmentally efficient energy recovery from natural and waste biomass gasification is to overcome problems associated with the formation and release of different contaminants (tars, heavy metals, halogens and alkaline compounds) that can cause environmental and operational troubles. The syngas cleaning approaches can be divided in treatments inside the gasifier (primary methods), such as adequate selection of main operating parameters, use of a proper bed additive or catalyst, specific gasifier design modifications, and hot gas cleaning after the gasifier (secondary methods), such as thermal or catalytic tar cracking and mechanical methods (cyclones, ceramic, fabric or electrostatic filters, and wet scrubbers). It is likely that an adequate combination of primary and secondary treatments may optimize the gasifier performance and allow to produce a syngas that meets the cleaning requirements of different end-use devices (1, 2, 5).

This study combines a series of experimental results obtained from a pilot scale bubbling fluidized bed gasifier fed with a natural biomass fuel, together with a recently