Combustion of Corn Straw in a Fluidized-Bed Reactor

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Oxy-fuel combustion is characterized by the utilization of a mixture of pure O_2 and CO_2-rich gas (from the flue gas recycle). The temperature of combustion process is controlled by CO_2-rich recycle flue gas instead of being modulated by N_2 from the air. The CO_2-rich recycle flue gas ensures the process of fluidization in the case of the fluidized bed technology.

Oxygen is produced from air using well established cryogenic methods. This oxygen enriched air is available in industry as a by-product of nitrogen separation from the air. Nitrogen can be obtained from air using vacuum swing adsorption (VSA), pressure swing adsorption (PSA), or vacuum pressure swing adsorption (VPSA). Enriched air could be used as combustion gas for the combustion with the heat output of 5–50 MWt.

This project is particularly focused on the comparison of the efficiency of the combustion processes and the emission of pollutants in different combustion atmospheres (air, enriched air, pure oxygen with model dry flue gas – CO_2).The present work is focused on the utilization of oxy-fuel and enriched air combustion processes for the combustion of corn straw in the bubbling fluidized-bed reactor. Both processes are compared with the air combustion of corn straw. Fluidized bed temperature was about 750 °C. Fluidized bed material was "ceramsite" (calcined alumosilicate widely available in the Czech Republic). Regarding corn straw combustion with air, we furthermore examined the effect of the replacement of the sand with the ceramsite, as a fluidized bed material, on the efficiency of the combustion processes and then the emission of pollutants. Corn straw combustion with air using the ceramsite showed better results than using the sand, respectively. Concerning the efficiency of corn straw combustion in the different atmospheres (air, enriched air, pure oxygen with model dry flue gas – CO_2) and the emission of pollutants, the best results were achieved when corn straw was burnt in the enriched air atmosphere (30 vol. % of O_2 and 70 vol. % of N_2). The oxy-fuel combustion process of corn

straw (with 21 vol. % of O_2 and 79 vol. % of CO_2) was evaluated as the least effective process. Corn straw combustion by air (21 vol. % of O_2 in 79 vol. % of N_2) led to better results than oxy-fuel combustion with 21 vol. % of O_2 and 79 vol. % of CO_2, but provided worse results than the oxy-fuel combustion with 30 vol. % of O_2 and 70 vol. % of CO_2 and, of course, worse results than the combustion with enriched air.