

Thesis Title	A Study of Bed Agglomeration in Biomass-fired Fluidized Bed Combustor
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Candidate	Mr. Pawin Chaivatamaset
Thesis Advisors	Assoc. Prof. Dr. Suvit Tia Prof. Dr. Bernd Bilitewski Asst. Prof. Dr. Panchan Sricharoon
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Department	Chemical Engineering
Faculty	Engineering
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Abstract

Bed agglomeration behaviors were investigated when palm shell, corncob, palm empty fruit brunch and rice straw as the representative biomass were combusted in the fluidized bed reactors. The focus of this study was the influences of biomass characteristics and the operating conditions of fluidized bed on the bed agglomeration tendency, and the behaviors of ash forming elements. The mathematical models to predict the bed agglomeration behaviors were also proposed. The bed agglomeration tendency was described by the defluidization time (t_{def}) and the extent of potassium into the bed as K/Bed . It was experimentally found that the defluidization caused by the agglomeration of bed particles can be observed by the abnormal decrease in bed pressure drop, more clearly than the deviation from relatively uniform bed temperature. The defluidization was developed steadily from partial to complete by an extension in an increase and growth of agglomerates. The bed defluidization increased as the increase of bed temperature, static bed height and bed particle size and the decrease of fluidized air velocity. The biomass fuel with relatively high alkali and chloride contents, as used in this study, was likely to increase the bed agglomeration problem. The SEM/EDS analysis on the features of the agglomerate samples indicated that the bed agglomeration is mainly attributed to the formation of the ash derived potassium silicate compounds as liquid phase during combustion. This was initiated by the burning char particles. The propagation of ash formed material inward the sand grains could be observed, which may cause by the gaseous/aerosol alkali species. In this study, the migration of ash forming elements from fuel particle to bed particle was likely dominated by the collision. The agglomeration process was the reactor scale independent. The plot of EDS data employing ternary phase diagram showed that the compositions of the coating and neck fused materials were mainly located in the low Ca and high Si region where the eutectic composition is nearby, and the relatively large amount of the melt (70-95%) in fused materials at relatively low temperature (740-800 °C) was estimated using lever bar rule for all biomass samples studied, which seemed likely that the melt formation controls the agglomeration. The order from high to low of the bed agglomeration tendency of the biomass samples were palm brunch, corncob, rice straw, and palm shell, respectively. The fairly well to good satisfactory in the model predictabilities were obtained.

Keywords : Bed Agglomeration / Fluidized Bed Combustion / Biomass Combustion / Palm Shell / Corncob / Palm Fruit Brunch / Straw