Agglomeration mechanism in biomass fluidized bed combustion – Reaction between potassium carbonate and silica sand

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Agglomeration is one of the operational problems in fluidized bed combustion of biomass, which is caused by interaction between bed materials (e.g. silica sand) and the biomass ash with a high content of potassium species. However, the contribution of different potassium species to agglomeration is not fully understood yet. In the present work, the reaction between K_2CO_3 and silica sand has been studied extensively by thermogravimetric analysis. The reacted samples were analyzed by SEM-EDX to reveal the reaction mechanism. The results indicated that the reaction occurs in a solid-solid phase already at temperatures around 700°C. The reaction rate increases with increasing temperature, but decreases with an increase of CO_2 partial pressure. Using smaller particle size and well mixed solid reactants results in an increased reaction rate. It is observed that the reaction initiates in the contact area between K_2CO_3 and silica sand, forming a thin product layer. The layer acted as a reactive media further reacting with K_2CO_3 and silica sand. The results provide a basis for understanding of potassium induced agglomeration process in fluidized bed biomass combustion.

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