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Agglomeration in Fluidized Bed Gasification of Biomass

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Abstract

Fluidized beds (FB) are widely applied to gasification of biomass due to its advantages of high fuel flexibility and conversion. However, bed agglomeration induced by the high content of alkali compounds can have strong impact on the operation of a FB gasifier and may lead to defluidization and unscheduled plant shutdown in severe cases. Agglomeration at high temperature, such as combustion and gasification, is mainly attributed to the presence of molten phase, i.e. the low melting point alkali containing compounds originated from biomass. During gasification, the alkali species in biomass can be transformed into gaseous phase, such as KCl and KOH vapor, and condensed phase, such as K_2SO_4 aerosols and K-silicates particles, depending on the local conditions. The interactions of the alkali species with bed materials (mainly SiO_2) may result in the formation of molten phase, causing agglomeration. However, the agglomeration tendencies and mechanisms during biomass gasification with different gasification agents are still not fully understood.

In this work, the agglomeration behaviors of different types of biomass during gasification are studied in a lab-scale fluidized bed reactor. The impact of the composition of biomass, e.g. types of biomass, and the operational conditions, such as temperature and gasification agents (steam and CO_2), are studied. The different agglomeration mechanisms are revealed based on SEM-EDX analyses of the agglomerate samples and chemical equilibrium calculations.