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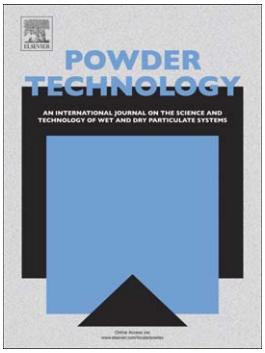

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The role of fuel mixing on char conversion in a fluidized bed

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Abstract

Operational conditions, such as the fluidization velocity and the solids cross-flow, affect the degree of char conversion in a fluidized bed by influencing the different mechanisms related to the fuel mixing. Char conversion is influenced by fuel mixing in both the lateral direction (affecting the fuel residence time) and the axial direction (affecting the char gasification rate). In the present work, this effect is investigated through a combination of dedicated experiments in a cold unit, in which the effect of the excess velocity on the char segregation is quantified, and validated mathematical modelling. The case of indirect gasification of wood pellets in the Chalmers 2–4-MW indirect gasifier is used to exemplify the findings.

The experimental investigation shows that char segregation strongly decreases as the excess velocity is increased over a certain threshold. The larger the char particle, the higher is the threshold fluidization velocity above which the char particle becomes immersed in the dense bed. The model shows that the degree of char conversion in the gasification chamber of an indirect gasifier decreases strongly as the fluidization velocity is increased, due to the decrease in the fuel residence time caused by enhanced lateral mixing. Neglecting the effect of fuel axial mixing on the gasification rate results in modelled char conversion degrees up to 1.3 times higher than when axial mixing is accounted for. This impact of fuel axial mixing increases with the solids cross-flow. While both axial and lateral mixing affect the degree of char conversion in the indirect gasification chamber studied, the effect of fuel lateral mixing is much stronger than that of fuel axial mixing, for the conditions investigated in the present work.

Keywords: fuel mixing; char conversion; fluidized bed; char segregation; biomass gasification.

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