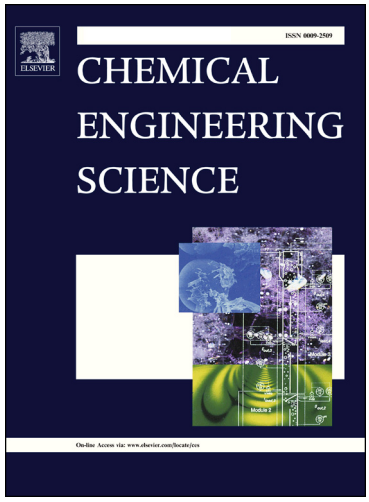

Whole-field imaging of temperature and hydrodynamics in a gas fluidized bed with liquid injection

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PII: S0009-2509(17)30277-4
DOI: http://dx.doi.org/10.1016/j.ces.2017.04.030
Reference: CES 13564

To appear in: *Chemical Engineering Science*

Please cite this article as: T. Kolkman, M. van Sint Annaland, J.A.M. Kuipers, Whole-field imaging of temperature and hydrodynamics in a gas fluidized bed with liquid injection, *Chemical Engineering Science* (2017), doi: http://dx.doi.org/10.1016/j.ces.2017.04.030

Whole-field imaging of temperature and hydrodynamics in a gas fluidized bed with liquid injection☆

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Abstract

This work presents results of experiments on thermal effects and flow dynamics in a flat-bed geometry gas-fluidized bed at atmospheric pressure, with and without liquid injection. Whole-field measurements have been performed using a combination of thermography, particle image velocimetry and digital image analysis. A first series of experiments demonstrates the mixing of two layers of particles at initially different temperature for a sequence of injected gas bubbles. It is shown that the pulse duration strongly affects the solids mixing and that the influence of diffusion on thermal equilibration is limited without convective mixing. Subsequently liquid has been injected into the fluidizing bed, which has been carried out with water, isopentane and hexane. Owing to the use of a combination of infrared and visual cameras, under particular conditions liquid-solid conglomerates can be observed in situ. Under the conditions applied, the flow dynamics are not clearly affected by the liquid injection. The thermal behavior of the bed is not found to be strongly dependent on which of the model liquids is injected, but more on the cooling capacity obtained by evaporating the injected amount of liquid at the selected injection rate, and the mode of operation.

Keywords: Thermography, fluidized, heat transfer, liquid injection, agglomerates

1. Introduction

For application in chemical processes, gas fluidized beds have the advantage over fixed beds of operation at relatively uniform temperature [Kunii and Levenspiel, 1991]

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