MULTISCALE MODELING OF PATTERN FORMATION IN PULSED FLUIDIZED BEDS: CONTINUUM AND DISCRETE APPROACHES

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It has been demonstrated experimentally that, under certain experimental conditions, a periodic flow can induce the formation of sub-harmonic bubble patterns in gas-solid fluidized beds (1). In spite of their potential for structuring and scaling up fluidized beds (2), very little progress has been achieved so far and the pattern formation mechanism still remains largely unknown.

In quasi-2D bubbling beds, bubbles rise forming hexagonal configurations, alternating their position at every pulse, with a characteristic length independent of bed dimension. The formation of patterns is not just a singular feature of the dynamics, but emerges as a consequence of extensive coupling between multi-scale physical phenomena. The striking visual manifestation and the complexity of the underlying physics make pattern formation excel as a validation tool for computational fluid dynamics (CFD) models (3).

Over the last two decades, CFD codes have been successfully used in modeling and investigating fluidization. Granular media are commonly modeled at two different scales, namely by local averaging (4) and individual tracking (5). Both can predict various fluidization behaviors satisfactorily. However, it is remarkable that, so far, CFD has not been able to convincingly reproduce the experimental patterns of bubbles (6)

In this work, we show the results of our study comparing different modeling strategies, using both a two-fluid model and a discrete element method, in terms of their ability to reproduce the experimentally witnessed patterns (Fig. 1). We also discuss our recent insights in the dominating parameters and closures necessary to capture the underlying physics of this fluidized state correctly.

SECOND PAGE: FIGURES AND TABLES OF THE ABSTRACT

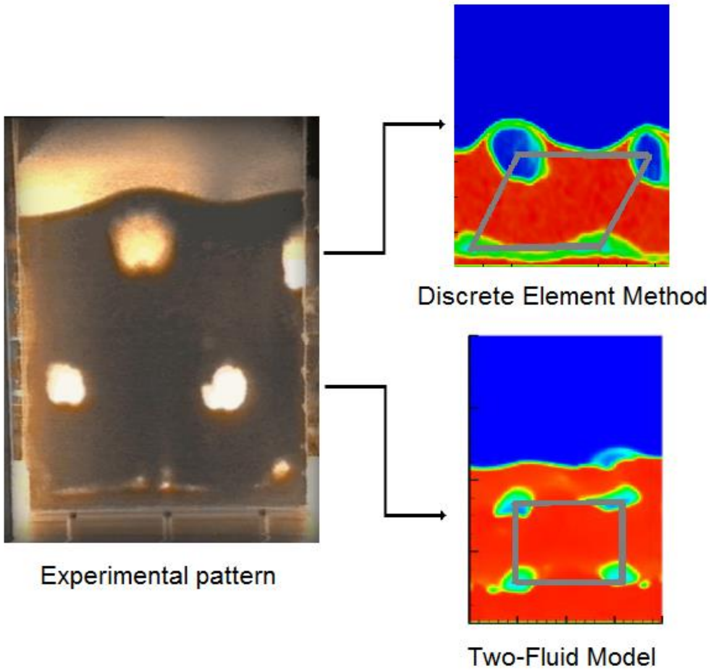

Fig.1 Comparison of the pulsed fluidized bed bubble patterns captured with Two-Fluid model and Discrete Element Method.

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