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The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

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Hydrodynamic Study in a Shallow Rectangular Spouted Bed Using Image Analysis and Pressure Signals

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This work is based on two projects of the Thermal Science Team in U.S. Department of Energy's National Energy Technology Laboratory (NETL) to study the hydrodynamic characteristics of the spouted bed, which play an important role in the whole bed's practical performance. Two distinctive formations, the jet and fountain are characterized and various influence factors including the superficial gas velocity, initial static bed height and nozzle size are investigated in a lab-scale rectangular spouted bed with a dimension of 30.2 mm × 101.6 mm. The rectangular configuration is chosen due to its particular advantage in heat transfer and reaction control especially in the reactor development including multiple combustion and reaction chambers. Four different kinds of particles classified in both Geldart groups D (nylon and alumina) and B (glass beads (GB) and High density polyethylene (HDPE)) are used as bed materials. The investigation adopts both image analysis and bed pressure drop signals. First, a systematic and integrative image analysis technique is proposed to determine different flow patterns. Secondly, different flow regimes are distinguished through profiles of the bed expansion ratio and bed pressure drop with detailed dynamic information of the jet and fountain. Finally, correlations predicting the fountain height (Hf), peak pressure drop (ΔPmax) and external spouting velocity (Ues) of Geldart D and B particles are developed to support the design of spouted bed reactors. The predicted values show good agreement with the experimental data under the operating conditions in the present study. The comparison slop and adjusted R2 of (Hf, ΔPmax and Ues) are (1.002, 0.997 and 0.998) and (0.978, 0.998 and 0.998) respectively in a 95% confidence interval.