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PII: S1385-8947(18)30267-5
DOI: https://doi.org/10.1016/j.cej.2018.02.065
Reference: CEJ 18544

To appear in: *Chemical Engineering Journal*

Received Date: 17 December 2017
Revised Date: 11 February 2018
Accepted Date: 12 February 2018

Please cite this article as: M. Du, S. Hu, J. Chen, X. Liu, W. Ge, Extremum Characteristics of Energy Consumption in Fluidization Analyzed by Using EMMS, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.02.065

Extremum Characteristics of Energy Consumption in Fluidization Analyzed by Using EMMS

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Abstract

This paper investigates the landscape of extremum characteristics for different energy consumption terms in gas-solid fluidization based on the Energy Minimization Multi-Scale (EMMS) model. The influence of typical cluster correlations on the extremum characteristics is also investigated to consolidate the study results. The energy consumption terms are resolved into three types, i.e. suspension ("s"), transport ("t") of the particles and pure dissipation ("d") caused by their collisions and acceleration. Three regimes which are particle dominant (PD), fluid dominant (FD), and particle-fluid compromising (PFC) respectively subject to the extrema of ε = min, W_{st} = min and N_{st} = min, are investigated. Then the same procedure is extended to individual and combined terms (i.e. "s", "t", "d", "s + t", "t + d", "d + s") of energy consumption with respect to unit mass of particles ("*N*") and to unit volume of bed ("*W*"). The study of extremum characteristics reveals an enclosure structure which features an upper voidage regime corresponding to minimum energy dissipation rate (MinED), a lower voidage regime to maximum energy dissipation rate (MaxED) and a so-called mesoregime in between. The landscape of extremum characteristics reveals that the stability condition must be constructed according to clear