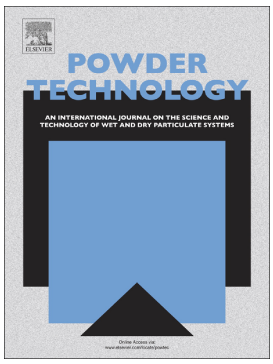

The effect of particle morphologies on the percolation of particulate porous media: A study of superballs

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PII: S0032-5910(18)30377-2
DOI: doi:10.1016/j.powtec.2018.05.015
Reference: PTEC 13388

To appear in: *Powder Technology*

Received date: 8 December 2017
Revised date: 14 April 2018
Accepted date: 10 May 2018

Please cite this article as: Jianjun Lin, Huisu Chen , The effect of particle morphologies on the percolation of particulate porous media: A study of superballs. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Ptec(2017), doi:10.1016/j.powtec.2018.05.015

The effect of particle morphologies on the percolation of particulate porous media: a study of superballs

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Abstract

Particle morphology is a crucial factor of influencing the prediction of percolation threshold in the study of continuum percolation of particle systems. Previous works on the percolation of particle synthesis mainly focused on spheres, ellipsoids and spherocylinders. In this paper, the newly synthesized superballs which smoothly interpolate between octahedrons, spheres and cubes are introduced, and a simple contact detection algorithm for superballs is proposed. By combing Monte Carlo method and percolation theory, the continuum percolation of randomly orientated congruent overlapping superballs is investigated in detail. The global percolation threshold ψ_c for superballs with shape parameter m in [0.5, $+\infty$) are obtained in terms of a finite-size scaling technique. Finally, an analytical approximation for percolation threshold ψ_c of superballs is derived and verified by existing data from literature. It is found from the study that when the parameter m varies between 0.5 and 1.0, the percolation threshold ψ_c significantly increases with the increasing m, whereas the value of m continues to increase from 1.0 to $+\infty$, the percolation threshold ψ_c will gradually decrease. We hope this study can provide good guidance for the development of percolation theory about non-spherical particle packing systems.

Keywords: Porous media, Overlapping superballs, Contact detection, Particle morphologies,