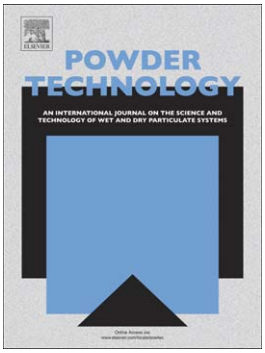

A new model for predicting drag coefficient and settling velocity of spherical and non-spherical particle in Newtonian fluid

Xianzhi Song, Zhengming Xu, Gensheng Li, Zhaoyu Pang, Zhaopeng Zhu

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A new model for predicting drag coefficient and settling velocity of spherical and non-spherical particle in Newtonian fluid

Xianzhi Song*, Zhengming Xu, Gensheng Li, Zhaoyu Pang, Zhaopeng Zhu
State Key Laboratory of Petroleum Resources and Prospecting, China University of Petroleum, Beijing 102249, China

Abstract

The settling process of particles occurs in many natural and industrial processes and the knowledge of drag coefficient and settling velocity of spherical and non-spherical particles is of fundamental significance in practical applications. In this paper, a visualization apparatus and high-speed camera system are used to record the settling behavior of spherical and non-spherical particles in Newtonian fluid. 336 tests involving particle density (2680, 4450, 7960 kg/m^3), fluid viscosity (0.135, 0.289, 0.6685 Pa·s), and particle shape (sphere, cube, cylinder) are conducted. A new and accurate correlation for the drag coefficient of spherical and non-spherical particles is been developed. This correlation has been formulated including the effect of the particle sphericity and the particle settling orientation. Besides, an explicit settling velocity equation which directly predicts settling velocity of both spherical and non-spherical particles in Newtonian fluid is proposed by correlating drag coefficient, the dimensionless particle diameter, sphericity and settling orientation. The average relative error is 3.52%, which indicates predictions of settling velocity are in good agreement with measured settling velocity. The model for predicting drag coefficient and settling velocity is valid with particle Reynolds number ranging from 0.001 to 100 and sphericity ranging from 0.471 to 1. And suitable particle shape range of this model is sphere, cube and cylinder. Besides, a trial-and-error procedure and an illustrative example are presented to show how to calculate drag coefficient and settling velocity in Newtonian fluid with known particle and fluid property.

Keywords: Drag coefficient; Settling velocity; Explicit equation; Spherical particle; Non-spherical particle; Newtonian fluid

* Corresponding author.
E-mail address: songxz@cup.edu.cn (X.Z. Song)