Contribution ID: **92** Type: 口头报告

基于 **SABCM** 转捩模型的管内圆球绕流数值模拟

摘要

高温气冷堆采用气力输送实现不停堆换料。然而输送过程中气流雷诺数很高，若要进一步提高输送效率，可能面临阻力危机现象。气力输运过程可看做圆管内圆球绕流流动，存在边界层分离和漩涡脱落等复杂特征。当圆球直径与管内直径之比（阻塞比）较大时，管壁会影响圆球绕流流动。目前很少有针对大阻塞比下管内圆球绕流阻力危机的数值模拟研究。本文基于 OpenFOAM 植入 Spalart-Allmaras BCM 转捩模型（SABCM 转捩模型），采用零压力梯度平板算例验证植入代码的正确性，选取四种湍流模型模拟管内圆球绕流流动模拟。数值结果表明：在所选模型中，SABCM 转捩模型的预测结果与实验值吻合最好，且所需的计算资源最少。因此，可考虑将 SABCM 转捩模型用于研究阻力危机现象。

关键词

圆球绕流、阻力危机、转捩模型

Abstract

In High-Temperature Gas-Cooled Reactors (HTGRs), pneumatic conveying is used to achieve continuous refueling without shutdown. However, the conveying process operates at high Reynolds number, further efficiency enhancement may induce drag crisis. The pneumatic conveying process can be modeled as the flow past a sphere in a pipe, exhibiting complex flow features such as boundary layer separation and vortex shedding. When the ratio of the sphere diameter to the pipe diameter (blockage ratio) is large, the pipe wall will significantly influence the flow past a sphere. Currently, there are few numerical simulation studies on the drag crisis of flow past a sphere in a pipe under high blockage ratios. In this study, the Spalart-Allmaras BCM transition model (SABCM transition model) is implemented in OpenFOAM. The validation of SABCM transition model code is performed using two zero-pressure-gradient flat plate cases. Four turbulence models are selected to simulate the flow past a sphere in a pipe. Among the four turbulence models, the simulation results of SABCM transition model agree best with the experimental data while requiring the least computational resources. Therefore, the SABCM transition model is capable to predict the drag crisis phenomenon.

Keywords

flow past a sphere, drag crisis, transition model

Author: Mr 安祥, 马 (核能与新能源技术研究院)

Co-authors: Dr 云梦, 穆 (核能与新能源技术研究院); Prof. 彬, 吴 (核能与新能源技术研究院)

Presenter: Mr 安祥, 马 (核能与新能源技术研究院)

Session Classification: 核能科学与工程

Track Classification: 03 口头报告: 核能科学与工程