能源和环境工程

简化PDF模型对Texaco气化炉的三维数值模拟

吴玉新，张建胜，王明敏，岳光溪，吕俊复

清华大学热科学与动力工程教育部重点实验室，清华大学热能工程系

摘要

应用商业CFD软件Fluent建立气化过程热态模型，对某化肥厂Texaco水煤浆气化炉进行了三维数值模拟。计算中采用简化PDF模型描述炉内的化学反应，将水煤浆看作燃料流，氧气看作氧化剂流；根据对冷态流场的计算，采用六面体结构网格为主的网格划分；Realizable k-ε湍流模型封闭湍流方程；dpm模型考察气体和颗粒相耦合；随机轨道模型对颗粒相进行追踪，P-1辐射模型计算炉内辐射特性；同时编制UDF函数模拟焦炭和O_2、H_2O、CO_2以及H_2的颗粒异相反应。通过与工业数据的对比，证明该模型能够真实反应气化炉内的物理特性，同时表明工业炉内的同相反应基本达到化学平衡。

关键词

[数值模拟](#)　[简化PDF](#)　[异相反应](#)

分类号

3D numerical simulation of Texaco gasifier using assumed PDF model

WU Yuxin, ZHANG Jiansheng, WANG Mingmin，YUE Guangxi, Lü Junfu

Abstract

Based on commercial CFD software Fluent, numerical simulations of the coal gasification process for a Texaco gasifier was investigated with a comprehensive model, which contained several simplified sub-models.Chemical process was described with assumed PDF model.In this model, coal slurry was defined as the fuel stream, pure oxygen was defined as the oxidizer stream.According to the numerical simulation of the cold flow field, the mesh mainly composed of hexahedral structure was adopted and realizable k-ε turbulent model was used.The coupling effect between gas phase and discrete phase was considered by using Particle Source In Cell (PSIC) model.A stochastic tracking method was used to simulate turbulent dispersion of the particles.P-1 model was also adopted to include the radiation in the gasifier.Heterogeneous reactions, including carbon with O_2, H_2O, CO_2 and H_2, were considered by User Defined Functions (UDF).The comparison between the industrial performance and the prediction data showed that the model could describe the gasification process correctly.The gasification process in an industrial gasifier could be regarded as in kinetic equilibrium.

Key words

[numerical simulation](#)　[assumed PDF model](#)　[heterogeneous reaction](#)

通讯作者　吴玉新 <u>wuyx02@mails.tsinghua.edu.cn</u>

通讯作者　吴玉新 <u>wuyx02@mails.tsinghua.edu.cn</u>