发电

用简化PDF模型对气化炉运行特性的分析

吴玉新[1];张建胜[1];王明敏[1];岳光溪[1];吕俊复[1]

清华大学热能工程系热科学与动力工程教育部重点实验室[1]

摘要
应用CFD(computational fluid dynamics) 软件FLUENT对某化肥厂Texaco水煤浆气化炉进行三维数值模拟，计算采用贴体网格，简化PDF方法模拟湍流燃烧，编制UDF分别考虑了焦炭同O_2、H_2O、CO_2和H_2的反应。计算考察了改变水煤浆浓度及[C]/[O]原子比等重要参数对气化炉运行特性的影响。焦炭仅同氧气反应时的转化率为32%，而总转化率为95%，说明焦炭同H_2O、CO_2和H_2的异相反应在气化过程中占重要作用；煤粉粒度越大，碳转化率越低，粒度为175 mm时，碳转化率仅为72%；气化温度是影响气化反应的决定性因素。随着水煤浆浓度的增高，CO摩尔分数明显升高、H_2O和CO_2摩尔分数明显降低，H_2摩尔分数略有降低。随着[O]/[C]原子比的增加，H_2摩尔分数明显降低，CO和CO_2摩尔分数几本不变。出口温度和碳转化率随煤浆浓度和[O]/[C]原子比的增加而增高。冷煤气效率随煤浆浓度的提高而提高，随[O]/[C]比的增加会在1~1.05之间出现峰值。

关键词　　数值模拟　O/C　煤气化　运行特性

分类号　TQ171；TQ54

Analysis of Gasification Performance of a Texaco Gasifier Based on Presumed PDF Model

WANG Ming-min

Abstract
Based on CFD software Fluent, a 3-d simulation was conducted on a Texaco gasifier with boundary fitted coordinate system. Pre PDF model was use to predict species profile with b function. A UDF (user defined function) function was introduced to simulate heterogeneous reactions between char and O2, H2O, CO2 and H2. Effects of some industrial operation parameters, such as coal slurry oxygen, [C]/[O] and particle diameters, et al, on the gasification performance were analyzed. The coal conversion rate (CC) is 32% during coal combustion with O2 process, while the total CC is 95%, which shows that heterogeneous reactions of char with H2O, CO2 and H2 plays an important role in the whole gasification. CC is inverse proportional to the particle size. The CC is only 72% when the particle diameter is 175mm. Operation temperature is the most important parameters that affects gasification process. As the slurry concentration increases, the mole fraction of CO increases quickly while the mole fraction of H2O and CO2 drops sharply, H2 mole fraction drops a little at the same time. When [O]/[C] atom ratio increases, H2 mole fraction decreases sharply while CO and CO2 mole fraction almost doesn't change. Both outlet temperature and CC are proportional to coal slurry concentration and [O]/[C] ratio. Cold gas efficiency is proportional to coal slurry concentration. The peak value of cold gas efficiency appears when the [O]/[C] ratio is 1 to 1.05.

Key words　 Numerical Simulation　O/C　Coal Gasification　gasification performance

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通讯作者　吕俊复 lvjf@mail.tsinghua.edu.cn
作者个人主页　　吴玉新 张建胜 王明敏 岳光溪 吕俊复

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