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能源和环境工程

谷壳气化过程中颗粒物理化学结构的演化

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摘要

对生物质气化过程的研究通常着眼于对气相组分分析，而很少对颗粒相的演化进行探讨。本文通过氮气等温吸附/脱附法(-196℃)、压汞法(414 MPa)、真密度仪(He)等详细研究了在气化条件下谷壳的物理结构的演化，同时利用元素分析和傅里叶红外对颗粒化学结构进行分析。结果表明，在气化的不同阶段，颗粒内孔的结构发生改变。BET比表面积在反应开始时增加缓慢，当反应率达到0.6以后其增加速度明显加快。由压汞法测定得到的大孔（macropore）演化规律与微孔不太一致，在反应初期大孔所占比例较高，随气化进行，这一比例快速下降，但大孔的绝对数量还是在一直增加。通过比较真密度仪和压汞法测定的结果发现，颗粒真密度与视密度变化正好相反。元素分析结果表明，在气化过程中O、H、N、S的变化规律各不相同。而红外分析也表明随反应率增加，颗粒表面上的OH、CO、CH以及Ar—H等基团快速消失。

关键词

谷壳 吸附/脱附 压汞法 真密度 傅里叶红外 元素分析

分类号

Physical/chemical structure evolution of rice husk particles during gasification process

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Abstract

Most studies about biomass gasification focus on the analysis of synthetic gas.The characteristics of particles are seldom discussed.In this paper, the physical characteristics of rice husk and char particles prepared under different gasification processes were studied by physical adsorption/desorption measurements of N_2 (-196℃), mercury intrusion porosimetry (414 MPa) and true density measurement (He).Chemical structures of parent sample and its char particles were discussed with the help of ultimate analyses and FTIR.Based on the analysis result, it was shown that the pore structure of char particles changed with reaction process.BET surface increased rapidly after reaction ratio reached 0.6.But, macropores in char particles had different evolution characteristics.At the beginning of reaction, most pores were macropores.The percentage of macropore decreased with the gasification process.But the absolute number of macropore increased continuously.The comparison results of true density measurement and mercury intrusion porosimetry showed that true density had an opposite changing trend with bulk density during gasification process.Ultimate analyses showed that O,H, N and S had different evolution characteristics during gasification.OH, CO, CH and Ar—H functional groups on particle surface, which were measured by FTIR, consumed rapidly with the gasification reaction.

Key words

rice husk adsorption/desorption mercury intrusion porosimetry true density measurement； FTIR； ultimate analysis

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