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能源和环境工程

燃煤可吸入颗粒物在磁场中聚并脱除机理

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摘要 提出了燃煤可吸入颗粒物在均匀磁场中的二元碰撞聚并模型，应用该模型计算了大同烟煤飞灰粒子的聚并系数，在此基础上通过求解聚并动力学方程计算了粒子的聚并脱除效率，并与实验结果进行了对比。数值模拟结果表明，燃煤可吸入颗粒物聚并系数随粒径的增大而增大，粒径差异越大，重力对聚并的加强作用越大；粒径越大，布朗力对聚并的影响越弱；同聚并系数对外磁场强度的变化规律一样，粒子的聚并脱除效率随外磁场的增强而增大，在粒子饱和磁化后，聚并脱除效率达到最大值；延长粒子在磁场中的停留时间以及增大其质量浓度，都可以提高粒子的聚并脱除效率，在质量浓度和停留时间分别为40 g·m-3 和1. 2 s时，粒子聚并脱除效率可达44%；数值模拟结果与实验结果相一致。

关键词 磁聚并；燃煤；可吸入颗粒物；聚并系数；脱除效率

分类号

Aggregation mechanism of PM 10 from coal combustion in uniform magnetic field

Abstract

A binary collision-aggregation model of inhalable particles PM 10 from coal combustion in uniform magnetic field was developed for evaluating aggregation coefficient between two particles. The removal rate of fly ash particles from the boiler firing Datong bituminous coal was simulated by solving the general dynamic equation with the obtained aggregation coefficient. A comparison between numerical simulation results and experimental data was made. The simulation results indicated that the aggregation coefficient increased with particle size. The bigger the size difference between two particles, the stronger the action of gravity on aggregation,while the bigger the particle size, the weaker the action of Brownian force. With an increase in magnetic flux density, the particle removal rate increased at first, then approached its maximum, which was similar with the relationship between aggregation coefficient and magnetic flux density. With increasing particle residence time in the magnetic field or increasing mass concentration, the removal rate increased, and reached 44% while mass concentration and residence time was respectively 40 g·m-3 and 1. 2 s. Numerical simulation results were in good agreement with the experimental data.

Key words magnetic aggregation; coal combustion; inhalable particle; aggregation coefficient; removal rate

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