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能源和环境工程

基于NiO载氧体的煤化学链燃烧实验

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摘要

采用流化床反应器并以水蒸气作为气化-流化介质，研究了以NiO为载氧体在800～960℃内的煤化学链燃烧反应特性。实验结果表明，载氧体与煤气化产物在反应器温度高于900℃体现了高的反应活性。随着流化床反应器温度的提高，气体产物中CO_2的体积浓度(干基)呈单调递增;CO、H_2、CH_4的体积浓度(干基)呈单调递减;煤中碳转化为CO_2的比率逐渐递增，碳的残余率逐渐递减。反应器出口气体CO_2、CO、H_2、CH_4的生成率随反应时间呈单峰特性，H_2生成率的峰值远小于CO的峰值;且随反应器温度升高，CO_2生成率升高，CO、H_2、CH_4的生成率降低。反应温度高于900℃时，流化床反应器NiO载氧体煤化学链燃烧在9 min之内就基本完成，CO_2含量高于92%。

关键词

化学链燃烧 NiO载氧体 CO_2分离 流化床反应器

分类号

Chemical looping combustion of coal based on NiO oxygen carrier

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Abstract

Chemical looping combustion (CLC) is a novel combustion technology with inherent separation of the greenhouse gas CO_2.The feasibility of using NiO as an oxygen carrier during chemical looping combustion of coal was investigated at 800—960℃.The experiment used a laboratory fluidized bed as the reactor, where steam acted as the gasification-fluidization medium.The reaction between oxygen carrier and solid fuel occurred via the gasification intermediates, primarily CO, H_2 and CH_4.The oxygen carrier particles exhibited high reactivity above 900℃.The flue gas component variation as a function of reactor temperature and reaction time was discussed, respectively.With increasing CO_2 generation rate as the result of increased reactor temperature,C residual rate decreased correspondingly.At 800—960℃, CO_2 concentration (dry basis) in flue gas presented a monotone increasing curve, and CO, H_2 and CH_4 concentrations (dry basis) decreased monotonously.The variation of CO_2, CO, H_2 and CH_4 generation rates in exhaust gas as a function of reaction time presented a parabolic curve, respectively.Moreover, the peak value of H_2 generation rate was less than the value of CO.With an increase in reactor temperature, CO_2 generation rate increased remarkably, while CO, H_2 and CH_4 generation rates decreased rapidly.The reaction between oxygen carrier and solid fuel, or overall coal gasification was accomplished in nine minutes above 900℃, and CO_2 concentration was greater than 92%.

Key words

chemical looping combustion NiO oxygen carrier CO_2 separation fluidized bed reactor

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