

能源和环境工程

油页岩及其半焦混烧特性的热重试验研究和动力学分析

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摘要

利用热重分析仪对桦甸油页岩燃烧时的双峰现象以及与其500℃半焦按不同比例混烧时单样相互影响程度、颗粒特性、着火温度和燃烧特性指数进行了考察;利用DAEM模型解析了混烧动力学参数。结果表明:油页岩燃烧DTG曲线在500℃附近的双峰活性参数值相差不大,分别为0.79和0.73,反映油页岩燃烧DTG曲线双峰归因于脂类有机质与干酪根中芳香烃的燃烧;混样中各单样在不同温度段相互影响程度不同,表现影响程度系数 f 的值均小于1。在燃烧过程中颗粒的缩核形状和表面分形维数并不是固定不变的,在低温段接近长圆柱体,在高温段接近平板,当浓度级次 $\beta=0.6$ 时,低温段分形维数接近3,在高温段接近1;着火温度随半焦掺混量的增加呈线性递增;混样燃烧特性指数介于单烧之间并且存在掺混效果明显区;试样表现活化能在燃烧前期变化比较缓慢并呈下降趋势,大约在60~90 kJ·mol⁻¹之间,在后期剧烈增加,当转化率在0.60~0.75之间时表现活化能从80 kJ·mol⁻¹剧增到200 kJ·mol⁻¹。

关键词

[油页岩](#) [半焦](#) [混烧](#) [颗粒特性](#) [燃烧特性指数](#) [DAEM](#) [分形维数](#)

分类号

Thermo-gravimetric study and kinetic analysis of blended combustion characteristics of oil shale and semi-coke

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Abstract

Thermo-gravimetric analysis was performed to study dual peaks of Huadian oil shale combustion and influence on each other by oil shale and semi-coke, particle characteristics, ignition temperature and combustibility index during blended combustion of oil shale and 500℃ semi-coke at the different blended proportions. Blended combustion kinetics was analyzed by using the distributed activation energy model (DAEM). The results indicated that dual peaks reactivity parameter of DTG burning profile around 500℃ was 0.79 and 0.73, which suggested that double peaks could be attributed to the combustion of aliphatic components and aromatic moieties in kerogen. The influence on each other was different at different temperature zones. The apparent degree coefficients of mutual influence were less than 1. Four consecutive stages were experienced in shrinking core shape and surface fractal dimension. Shrinking core shape was close to long cylinder at the low temperature zone, close to plate at the high temperature zone. Fractal dimension was near 3 at the low temperature zone, near 1 at the high temperature zone, when concentration level (β) was 0.6. Ignition temperature increased linearly with the increase of semi-coke blended proportion. Blended combustion index exhibited a transition from semi-coke to oil shale, with an evident intermediate zone of mutual influence. The apparent activation energy of samples decreased slowly at the earlier stage between 60 and 90 kJ·mol⁻¹, but at the latter stage increased strongly from 80 to 200 kJ·mol⁻¹, while the conversion was from 0.60 to 0.75.

Key words

[oil shale](#) [semi-coke](#) [blended combustion](#) [particle characteristics](#) [combustibility index](#) [distributed](#)

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