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ASSESSMENT OF THE PYROLYSIS, COMBUSTION AND FRACTAL DIMENSION OF FRAGMENTED OIL SHALE PARTICLES

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Abstract

The main objective of this study is to examine the effects of temperature and residence time on oil shale size fragments in terms of the fractal dimension. A series of tests consisting of the pyrolysis and combustion of oil shale particles followed by mechanical impact shattering was carried out to evaluate the fractal dimension of the fragmented particle distribution. The effects of oil shale parent size fragmentation after aging at different oxidation times on the fractal dimension and fragments size distribution were investigated quantitatively. A mass based fragmentation approach rather than a number fraction method was used. Any set of n fragments obtained during oil shale break has its own fractal dimension. A decrease of fractal dimension in the range of 20% -30% was observed after shale particle gasification. The results show that increases of the oxidation time and temperature of the pretreatment increase the number of fragments for a fixed impacting energy. Dimensions of 2.7-2.9 were related to a lower temperature pretreatment and reduced oxidation times, while dimensions of 2.2-2.4 were attributed to a high temperature pretreatment and longer oxidation times.

The fractal dimension nature was conserved despite the fact that different values were obtained for different retorting/combustion conditions. It was found that multi-fractal dimensions of fragmented oil shale particles retorted at fixed temperature with corresponding mass extent can be fitted with functions that characterized mass and size of particle progeny.

The fractal dimensions and energy density for fracturing demonstrate a good linear relationship showing that the energy of fragmentation is affected by the scale effect.

Keys words:

Oil shale, fractal, pyrolysis, combustion, particle size distribution, fragmentation.

HIGHLIGHTS

- Tarfaya (Morocco) Oil shale particle fragmentation.
- Effect of impacting energy on fragmented oil shale particles progeny.
- Fractal dimension evolution with conversion time and impacting energy.
- Fitting model of impacting energy, extent of retorting reaction and fractal dimension.

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