

Thermodynamic assessment of the absorption of acid gases by calcium-based sorbents during the gasification of solid fuels

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The combustion of fossil fuels and municipal solid wastes are the two main potential sources of environmental pollution, caused by HCl and SO₂. Among the widely used methods for reducing acid gas emissions, the addition of calcium-based sorbents is effective and easy to implement.

To assess of the absorption of acid gases by calcium-based sorbents at filtration combustion of real systems in reactors, thermodynamic calculations were carried out using the Terra program. The case of a stationary wave in a continuous gasifier is considered, in which the porous solid fuel moves countercurrent to gas flow containing water vapor.

The regularities of HCl release from calcium chloride and SO₂ from calcium sulfate during steam-air gasification of solid fuel in the filtration combustion mode were studied. The limiting amounts of HCl and SO₂ released into the gas phase under real conditions of a shaft kiln gasifier were estimated. It was shown that the most important factors responsible for the stability of CaCl₂ are the humidity of an oxidant gas and the process temperature, while only the temperature affects the stability of CaSO₄. The decomposition of calcium chloride starts at about 800°C, and the decomposition of calcium sulfate - at about 1200°C. The amount of hydrogen chloride and sulphur dioxide released into a gas phase on the passage of a high-temperature combustion wave does not increase with the mass fraction of chloride or sulfur in the solid phase. Thermodynamic calculations were compared with experimental results on the absorption of acid gases during coal gasification in the filtration combustion mode.

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