

Neutralization of sulfur compounds by calcium-based additives in the filtration combustion processes

Vladimir Kislov, Maxim Tsvetkov, Yulia Tsvetkova, Marina Salganskaya, Andrey Zaichenko, Eugeny Salgansky, Dmitry Podlesniy

Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry RAS,
Semenov ave., 1, Chernogolovka, Russia, 142432

vmkislov@icp.ac.ru

Sulfur is a part of many solid fuels and combustible waste. The use of such fuels in modern conditions without capture and neutralizing acid gases (H_2S , SO_2) formed during combustion is unacceptable. The requirements for the purity of industrial emissions are constantly being tightened, therefore, new methods of sulfur capture are being actively developed and improved.

The aim of this work was to evaluate the effectiveness of using marble additives to neutralize sulfur during filtration combustion of the most common sulfur fuels and waste.

Two model compositions with additives of iron (II) sulfide and copper sulfate, sulfur dioxide and automobile tires were selected as objects of research.

The experiments were carried out in a laboratory quartz reactor with a diameter of 45 mm. In the course of the experiment, the temperature was recorded in five points of the reactor and samples of gaseous products were taken. Elemental analysis of solid and liquid combustion products was also performed.

Experiments have shown that during the filtration combustion of fuels containing sulfur, the addition of marble leads to a significant increase in the proportion of sulfur transferred to solid combustion products. Calcium carbonate absorbs the sulfur in the fuel in sulfide form most effectively: the addition of 50% marble allows 72% sulfur to be absorbed, and the addition of 90% marble – 85% sulfur. Similar additives of 50 and 85% marble to a model fuel containing copper sulfate can absorb only 15 and 31% sulfur, respectively.

For sulfurous coals the sulfur including is mainly in the form of sulfides, the addition of up to 50% marble to the charge allows, with a relatively small decrease in the heat of combustion of the product gas, to increase the proportion of absorbed sulfur by 3 times (up to 37%), and in some cases by 5 times (up to 60%).

At recycling of tires with organic sulfur, adding up to 50% marble to the charge allows to increase the proportion of absorbed sulfur by 2 times (up to 40%).

The obtained values of the degree of sulfur capture are not maximum, and can be increased by replacing marble with a more chemically active alkaline additive.

The measurements of the elemental composition of the materials used and the combustion products were carried out using the equipment of FRC PCP MC RAS.

This work funded by the Ministry of Science and Higher Education of Russian Federation, theme #FFSG-2024-0016.