REACTOR DESIGN OPTIMIZATION IN THE PROCESS OF OXIDATION DESULFURIZATION

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Sulfur-containing compounds are compounds, which content is strictly standardized in motor fuels due to a negative impact on the environment, the operation of an internal combustion engine and fuel quality. The main process aimed at reducing the sulfur content in the fuel is hydrotreating. The process facilitates the removal of polycyclic aromatic compounds, which affect the operation of the internal combustion engine by changing the throttle response and smokiness [1], and nitrogen compounds, which are catalytic converters.

The production of diesel fuel at Russian refineries in accordance with the requirements of European environmental standards is possible only following the modernization of existing hydrotreating plants. Therefore, the global challenge is to develop innovative methods for low-sulfur fuel generation, or to improve existing hydrotreating plants. The conversion of sulfur compounds occurs in the processes such as oxidative desulfurization, extraction, ozonation, etc. A promising method of desulfurization is the process of oxidative desulfurization [2].

The aim of this work is to optimize the reactor of the oxidative desulfurization block.

The most common oxidizing agent is hydrogen peroxide, as it is low-cost, non-polluting, and commercially available. The oxidative desulfurization process takes place at atmospheric pressure and at a temperature of up to 80°C, with a high conversion of aromatic compounds and without using hydrogen. The degree of sulfur and nitrogen conversion reaches 92 %wt. and 59 %wt. respectively. Using a mathematical model, the optimal parameters of the process have been determined: contact time – 30 minutes, temperature – 70 °C, ratio S: $H_2O_2 = 5:8$, $H_2O_2 : HCOOH = 5:7$. Due to these parameters a reduction in the units of equipment used and electricity occurs [3].

For the reactor design a horizontal type with vertical mixers, separated by partitions, has been selected, the number of sections in the reaction zone is 5, the second part of the reactor is a settling zone for separating diesel fuel and oxidation products from the oxidizing mixture and oxidation water (Fig. 1).

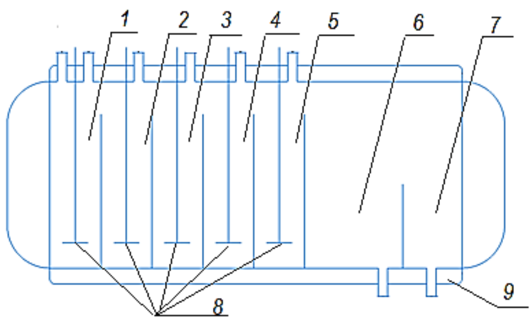

Fig. 1. *Scheme of a horizontal cascade reactor:*
1–5 – sections of the reactor; 6, 7 – sedimentary zones; 8 – mixers; 9 – shirt.

When designing the reactor, the material and thermal balances and structural dimensions have been calculated, an automation circuit has been drawn up, and control sensors have been selected.

The dimensions of the reaction part are: the length of a section 1 is 2 m and the diameter of the reactor is 4.5 m. The reactions are endothermic; therefore, a tank jacket, which is 4.9 m in diameter, is provided in the reactor.

The flow rate of the oxidizing mixture, supplied to each section, has been calculated to ensure a high degree of conversion, and three-blade mixers have been selected.

A sensor for measuring temperature, which will be controlled by supplying the steam to the jacket, has been selected to monitor the desulfurization process in the reaction part of the reactor. The level of oxidizing mixture and diesel fuel will be monitored in the settling zone.

As a result of the design the reactor has been developed for the oxidative desulfurization of diesel fuel using hydrogen peroxide and formic acid.

References

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PROPERTIES OF TANTALUM POWDERS IN ARGON AND HELIUM ATMOSPHERES

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Tantalum is one of the widespread metals in manufacturing of solid-state capacitors which have high permittivity, therefore it can accumulate a large supply of energy [1]. With the growing requirements for reliability and the minimum size of electronic devices, the study of this metal in these niches is still continued, as well as ways of development of it such as the main component.

Several methods of obtaining tantalum nanopowders are known in the world, and one of them is

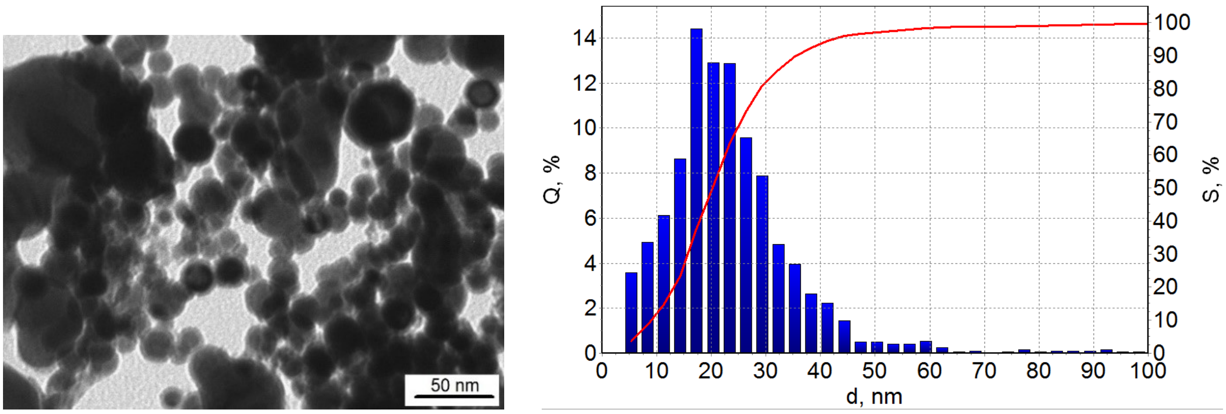

Fig. 1. *The photograph of powder particles obtained in a helium atmosphere, the histogram of particle size distribution*

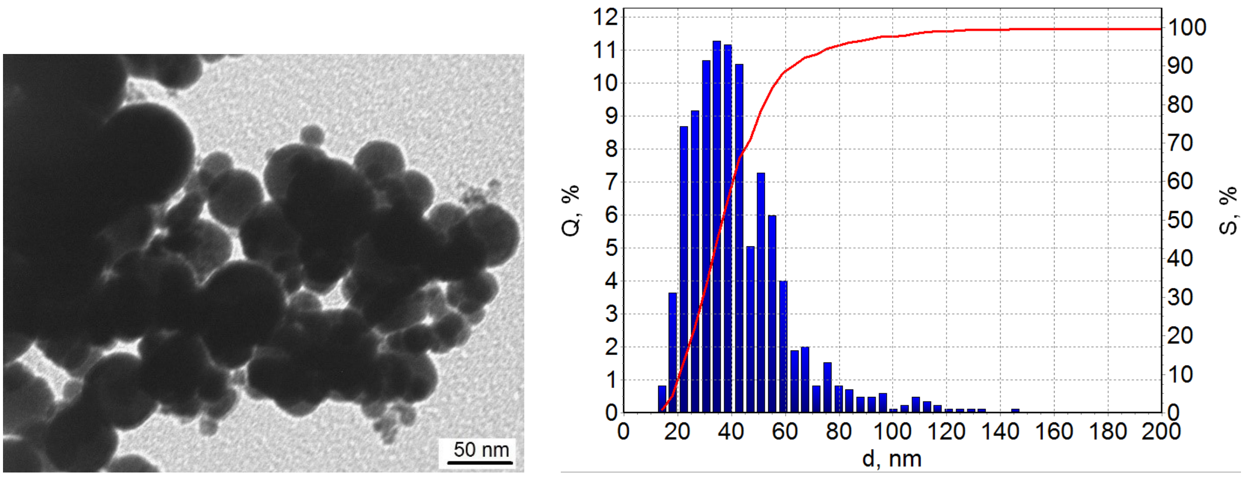

Fig. 2. *The photograph of powder particles obtained in argon atmosphere, the histogram of particle size distribution*