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Gaseous Fuel Preparation for Power Plants Using a New Adsorbent-Indicator From Solid Waste From Industrial and Energy Complex Enterprisesd

Antonina Andreevna Filimonova, Alena Vlasova, Iliya Iliev, Ivan Beloev

Kazan State Power Engineering University Kazan, Russia: aachichirova@mail.ru., vlasovaay@mail.ru.
University of Ruse, Ruse, Bulgaria: iki@uni-ruse.bg, ibeloev@uni-ruse.bg.

GOAL OF THE STUDY

The paper presents research on the development and laboratory testing of an indicator sorbent. The indicator sorbent is necessary to determine the degree of saturation of the main adsorbent and to capture "slipped through" sulfur compounds.

METHODOLOGY OF THE INVESTIGATION

The authors have developed a new composition of the indicator sorbent. This sorbent changes color from light gray to intense yellow when sulfur compounds "slip through" the adsorber, for example, in the case of an increased content of hydrogen sulfide in incoming gases from oil production. A change in color indicates the need to replace the adsorber load. The solid indicator sorbent is loaded after the main adsorbent and acts as an indicator-sorption layer, the volume of which is 1-5% of the total volume of the adsorbent. A composition based on calcium carbonate (72%) is used as an indicator sorbent, to which cadmium acetate dihydrate (7%) is added, the rest of the volume is water (21%). A thick mass is prepared by sequential mixing, then the composition is placed in molds and dried at a temperature of 105°C. The resulting solid porous granules are spherical in shape, from white to light gray in color (figure 1).

Fig.1.Change in color of the indicator sorbent during the experiment

Laboratory studies were carried out to determine the ability of the indicator sorbent to detect the presence of sulfur compounds. To carry out the experiments, a laboratory installation was assembled, which is presented in figure 2.

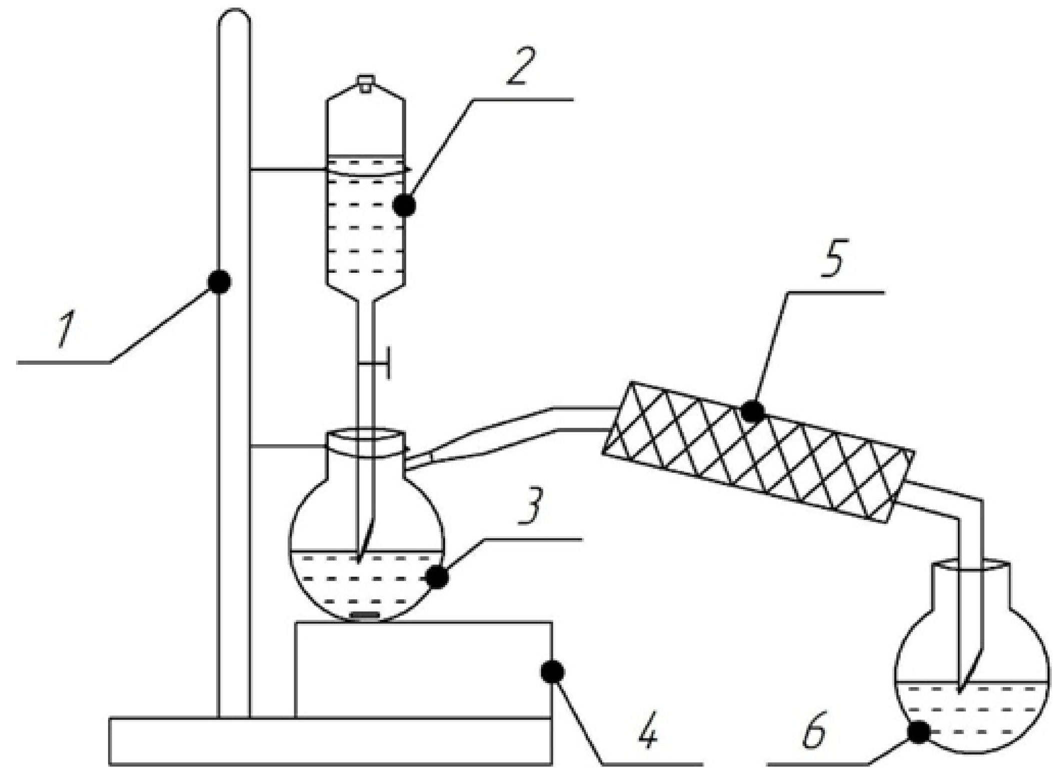

Fig. 2.Layout of a laboratory installation for determining the presence of sulfur compounds.

To obtain hydrogen sulfide, a funnel for dosing hydrochloric acid 2 and a receiver flask with a solution of sodium sulfide 3, located on a magnetic stirrer 4, were needed for better interaction.

The amount of hydrogen sulfide obtained as a result of the reaction of a solution of sodium sulfide and hydrochloric acid depends on the concentration of the sodium sulfide solution. Therefore, to effectively assess the sorption properties of adsorbents, it was necessary to select the optimal concentration of sodium sulfide solution. The concentration was selected experimentally.

As a result of the reaction, hydrogen sulfide is formed, which is discharged into the adsorber 5 through the gas outlet. It is worth noting that all installation connections are made hermetically. Hydrogen sulfide enters adsorber 5 with an indicator sorbent. The efficiency of hydrogen sulfide absorption by the adsorbent was assessed by the amount of zinc sulfide formed in the absorbing solution of zinc acetate using a spectrophotometric method. The more hydrogen sulfide "slipped through", the more zinc sulfide was formed.

CONCLUSIONS

The work presents the composition of the indicator sorbent, which was developed in laboratory conditions and tested in a hydrogen sulfide recovery installation. According to the results of experiments, good absorption capacity in relation to sulfur compounds has been proven. This indicator sorbent can be used as a second layer after the main adsorbent and occupy 1-5% of the total volume. When the indicator sorbent comes into contact with hydrogen sulfide, the color changes from light yellow to intense yellow, which depends on the concentration of sulfur compounds in the gas. The higher the concentration of sulfur compounds, the more intense the color. If the color of the entire indicator sorbent layer changes, it must be replaced. This composition cannot be regenerated and therefore is further sent for disposal.

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