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Assessment of the Effectiveness of Industrial Gas Purification with Diethanolamine

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Abstract: The presented work is devoted to the efficiency of industrial purification of DEA from sulfur compounds in gas. To evaluate the efficiency of DEA purification in laboratory conditions, studies were carried out that showed the presence of foaming on samples taken before entering activated carbon and at the exit after 60 days of carbon adsorption purification. To compare the results obtained, a foaming study was also carried out on fresh DEA. The content of high-boiling resinous substances in the composition of DEA was studied by chromatographic and photocolorometric methods of analysis.

Keywords: sulfur compounds, foaming, resinous substances, carbon adsorption purification, chromatographic and photocalorimetric methods of analysis, diethanolamine.

It is difficult to imagine the modern world economy without energy, transport, light, communications, radio, television, computer technology, automation equipment, space technology, etc., the basis for the development of which is the fuel and energy complex (FEC). The level of development of the fuel and energy complex reflects social, scientific and technological progress and often determines state policy.

Energy resources play a leading role in the modern economy. The level of development of the productive forces of each state is determined to a large extent by the scale of energy consumption. The important role of energy resources is evidenced by the fact that more than 70% of the world's mineral resources are energy sources.

The oil and gas industry in the economy of Uzbekistan occupies one of the priority areas, since it largely ensures the well-being of the country's population and affects not only the economic development of the country, but also its security and energy independence, therefore the formation of tasks facing the oil and gas industry of Uzbekistan is dictated by the need for progressive economic development and is associated with solving problems to ensure the profitable use of the fuel and energy complex of the republic, since oil and gas occupy the leading place in the structure of the country's primary fuel and energy resources - (96%). Along with this, special attention is paid to improving purification technology, increasing the stability of the physical and chemical properties of sorbents and improving the environmental conditions for processing secondary sorbents from oil and gas refineries.

Absorption desulfurization of gases using aqueous solutions of diethanolamine (DEA), monoethanolamine (MEA), triethanolamine (TEA), despite a high degree of purification, has a significant drawback associated with foaming of the absorbent and its carryover from absorption columns, leading to a decrease in the productivity of installations. The presence of intense foaming in the system leads to increased losses of absorbent and deterioration in the quality of

commercial gas. These factors, as well as an increased pressure drop in the absorber, can serve as evidence of foaming in the system.

DEA is used for non-selective removal of acidic components and provides the necessary purification of gas from H_2S and CO_2, however, the disadvantage of DEA is the increased foaming of the diethanolamine solution , as well as the heat costs required for the regeneration of the absorbent.

Increased foaming during absorption purification of natural gas from acidic components is a whole complex of problems caused by the presence of impurities of various origins in the amine solution. This undesirable effect is associated with the accumulation in solutions of tar-like substances and amine reaction by-products, which reduce the surface tension of DEA and promote the formation of stable foam, with a high volumetric rate of the process and the use of coal that has exhausted its adsorption resource.

Several methods are known to combat foaming: physical, mechanical, technological and chemical. Physical methods of combating foaming include: thermal effects (freezing, heating, hot steam treatment), electric current, acoustic waves (most often ultrasound), vibration, creating high capillary pressure in the foam, etc. The most effective means is the removal of impurities from the system by continuously filtering the amine solution.

The mechanical method of combating foam formation is carried out using various devices - a centrifuge, stirrer, etc. However, this method is ineffective.

Chemical defoaming is the most common and most effective method of combating foam formation, in which various antifoaming agents and defoamers are used . The fight against foaming is carried out with the help of special additives for extinguishing foam, vacuum distillation or extraction of foaming substances, by filtering spent amine solutions, as well as by changing the pressure of the medium.

Defoamers must be highly effective, have a high defoaming rate , work at low concentrations and have a prolonged effect; they should not change the properties of the intermediate product and complicate subsequent processing, should not have a toxic effect, and should be stable when exposed to high temperatures and storage.

To assess the effectiveness of industrial purification of DEA ohm, two samples were taken, one of which was taken before entering the activated carbon, and the other at the exit, after 60 days of carbon adsorption purification , and the parameters of their foaming were determined. To compare the results obtained, a foaming study was also carried out on fresh DEA. The content of high-boiling resinous substances in the composition of DEA was studied by chromatographic and photocolorometric analysis methods.

The results of chromatographic analysis showed that in the DEA solution selected before and after carbon adsorption purification, along with the peak of the main substance, there are broad peaks of high-boiling resinous substances, which color the DEA solution red-brown. This is confirmed by data obtained at FEC -2, when measuring the optical density of solutions before and after carbon adsorption purification.

However, as experience in the operation of coal adsorption plants shows, despite the use of carbon adsorption purification, in some cases it is not possible to avoid foaming, which may be due to three main reasons: poor adsorption capacity of the AG-3 coal used in relation to large molecules of impurities; high linear speeds of the gas absorption process; and with the duration of use of coal, which has exhausted its adsorption resource.

When processing natural gas to purify amine solutions from tarry, corrosive substances and decomposition products, the carbon adsorption purification method is widely used , in which regenerated amine solutions are passed through a filter filled with activated carbon. Assessing the quality of activated carbons used in the process is a primary task in amine desulfurization of

natural gas, because they directly affect the performance of the amine system and the quality of the resulting product. In addition, activated carbons used in adsorption plants must meet the following requirements:

1. have a high adsorption capacity (absorb a large amount of adsorbent at a low concentration in the gas or liquid phase);
2. have high selectivity (selectively absorb only one component from the mixture). The higher the value of the selectivity coefficient, the wider the scope of use, i.e. the possibility of its use for purifying gases with low concentrations of acidic components ;
3. be chemically inert with respect to the components of the mixture being separated;
4. have high mechanical strength;
5. easy to regenerate (the ability to restore original adsorption properties) for subsequent reuse;
6. have a low cost.

Assessing the quality of activated carbons used in the process is a primary task in amine desulfurization of natural gas, because they directly affect the performance of the amine system and the quality of the resulting product.

Foaming experiments were carried out in a laboratory setup. 50 ml of DEA solution was poured into a hollow cylinder with a diameter of 35 мм, into the base of which a filter schott was soldered, and air was passed through the lower tube using a compressor, which, passing through the volume of the solution, formed foam. It was also found that the height of the foam is directly dependent on the linear speed and degree of carbon adsorption cleaning. The linear speed of air supplied to the laboratory installation was in the range of 0.03 ÷ 0.14 m/s and covered the range of linear speeds (0.11 m/s) of the industrial installation.

Effect of linear speed on the height (cm) of DEA foaming

DEA solutions	Linear speed, m/s			
	0.14	0.07	0.04	0.03
DEA before cleaning	thirty	13	4.5	2.5
DEA after carbon adsorption purification	29	13	4.5	2.5
DEA fresh	2	Absent _	Absent _	Absent _

Reducing the linear speed by 2-3 times does not eliminate foaming, both in spent and purified DEA. In this regard, it was assumed that the coal used, after working for 60 days, does not provide the necessary degree of removal of the resulting impurities.

In addition, by changing the optical density of solutions, the degree of purification and foaming of solutions can be determined. To do this, a certain amount of AG-3 coal (0.05 ÷ 1 g) was poured into flasks containing 60 ml of spent DEA. The flasks were shaken on the device for 5 hours, after which the solutions were filtered and their optical density and the amount of foaming were determined.

Another reason for unsatisfactory purification of DEA may be due to the high volume load of activated carbon. It has been experimentally determined that effective cleaning is observed up to a volume load of 5 h^{-1} . A further increase in the volumetric load from 5 to 15 h^{-1} leads to a significant deterioration in cleaning, and at higher volumetric velocities practically no cleaning occurs.

This study showed that for effective industrial purification of DEA, it is necessary to reduce the operating time of AG-3 carbon, or use activated carbon with a higher adsorption capacity.

List of used literature:

1. S.V. Nabokov, N.P. Petkina Absorbents for gas purification from H_2S and CO_2: experience and prospects for the use of ethanolamines at gas processing plants of OJSC Gazprom // Scientific and technical collection of Vesti Gazovoy Nauki. 2015. – No. 1 (21). – P.3-8.
2. Afanasyev A.I., Stryuchkov V.S. Prokopenko Industrial experience in cleaning low-sulfur natural gas // Gas industry. – 1987. – No. 5. – P. 14–16.
3. B.E. Shermatov , M.S. Mansurova , E.Ya. Yalgashev , D.I. Ismatov , I.E. Abdirakhimov Innovative work in gas processing // Oil and gas complexida burghilash, kazib olish va kaita ishlash zharayonlarining zamonaviy tehnologiya - Republic of ilmiy-technician anjumani. Karshi. – 2018. – P. 3-6.