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METHODS OF PREVENTING FOAM IN DEVICES FOR CLEANING GAS FROM NORMIC COMPONENTS

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Abstract. The choice of the technology of purification of natural gas and condensate depends on the contained acidic components. The absorption methods are the most widely used industrial techniques, where alkanolamines are used as absorbents. One of the major problems associated with the use of ethanolamine is increased foaming of the working solution, resulting in the disruption of the process and overrunning of the reagent. The main ways of solving this problem is to use defoaming reagents and purify the active amine solution from the accumulated impurities by filtration. It is proposed to use reagents of brand "Penta" as defoamers, their effective concentrations are determined. The possibility of applying the nanomaterial "Tekhnosorb 1" in the process of purification of the amine solution from the impurities, which will improve the filtration efficiency, is studied.

Key words: alkanolamines, absorbent, adsorbent hydrogen sulfide, carbon dioxide, silicon defoaming agents.

ANALYSIS AND METHODS.

The choice of technology for cleaning natural gases and condensates depends on the

acidic components they contain. The most widely used industrial methods are absorption methods, in the implementation of which alkanolamine solutions are used as absorbents. One of the main problems associated with the use of ethanolamine is the increased foaming of the working solution, leading to disruption of the technological process and excess consumption of the reagent. The main ways to solve this problem are the use of defoaming reagents and purification of the working amine solution from accumulated impurities by filtration. It is proposed to use Penta reagents as defoamers, their effective concentrations are determined. The possibility of using the Technosorb 1 nanomaterial in the process of cleaning the amine solution from impurities is studied, which will improve the filtration efficiency.

Compared to other fossil fuels, natural gas is the most widely consumed fuel in the world. The reserves of natural gas are quite large, one-third of them are deposits of sour components. The content of hydrogen sulfide in the gas fields of the system of the Hisar region of the Republic of Uzbekistan is 1.2%, and the component content of the gases supplied to the Mubarak gas processing plant is 1.8%. That is why two different technologies are used for gas purification. In the next period, the strong development of machine building in the industry and the increased demand for electric energy sharply increased the consumption requirements for natural gas raw materials. The high negative impact of the harmful components released from the composition of natural gases during the exploitation of mines on the human body and the environment, the corrosive effect on the equipment, the possibility of poisoning of the catalysts that have been processed, put before the gas industry the problem of cleaning such raw materials in modern ways. As a result of the explosion of the gas well in the field named “25th anniversary of Uzbekistan”today, it is impossible to estimate the impact on the environment, the living population and the animal world.

Methods of purification of natural gases containing acidic components. The traditional absorption purification method for extracting sour gases from natural gases is carried out by means of various sorbents, most often with the help of alkanolamines. The process of cleaning with a solution of absorbents is widely used in the gas industry, and the choice of the composition of solvents depends on technological issues.

A 40% solution of diethanolamine (DEA) is used in Astrakhan and Orenburg large gas processing plants belonging to “Gazprom” industrial JSC. When DEA is used as an absorbent, it provides high and reliable gas purification regardless of the partial pressure of hydrogen sulfide and carbonic acid, the low viscosity of aqueous absorber solutions, the low absorption of hydrocarbons, that is, it guarantees the high quality of sour gases and is considered to be used as a raw material in the extraction and production of sulfur.

RESULTS.

During the purification of natural gases from acidic components, a number of negative effects occur. Serious situations in the process include foaming and corrosion due to the chemical action of the amine solution, which causes a lot of consumption due to the breakdown of the expensive absorbent, and a part of it is removed with the purified gas [1, 15]. Corrosion products of equipment (iron sulfide, iron oxide, sulfur compounds, etc.), amine degradation products when various compounds (mechanical compounds, liquid hydrocarbons, various surfactants (SFM), corrosion inhibitors) enter the solution together with gas is one of the serving reasons [2].

The condition of foaming leads to the malfunction of the device and the deterioration of the quality of the purified gas. In most cases, such defects can be eliminated by adding anti-foam compounds to the solution or by removing foam-forming substances from it. Silicones or high-boiling alcohols are used as antifoam compounds [15]. Di and triethyleneglycols can be included in this quality, in exchange for which foaming does not occur in glycolamine cleaning devices [16].

Currently, silicon organic high molecular compounds (silicone foam extinguisher) are used as the most convenient solution due to their low price and good quality ratio compared to organic foam extinguishers. In our opinion, there are no observable processes with foam formation, which are less effective. These substances are chemically inert at high temperature values, strong and effective, characterized by low surface tension, good spreading coefficient, low environmental impact.

Silicone organic foam suppressant in the form of a polymer mixture with a linear structure (polydimethylsiloxanes: $(CH_3)_3SiO$-$[(CH_3)_2SiO$-$]nSiO(CH_3)_3$ with various degrees of polymerization - n [3]). Polydimethylsiloxane is an oily, colorless clear liquid with different viscosity and surface tension depending on the degree of polymerization. The main chain of the polymer has an inorganic structure, and the side methyl groups are organic, which generally determines the most complex properties of silicone oils. The polymer does not undergo any reaction during operation, it is well adsorbed in the sediment, that is, the main amount of polydimethylsiloxane introduced in it is deposited together with the sediment, and then it undergoes abiotic decomposition into hydrogen sulfide gas, water and silicon dioxide [4].

Polydimethylsiloxanes are rarely used in their pure form, their mixtures or solutions are more commonly used in organic compounds. Polydimethylsiloxanes are often used in the form of an aqueous emulsion. Its emulsification allows to achieve a significant decrease in the consumption of the main agent at the same efficiency of the foam extinguishing agent.

When a mixture with a complex composition is used as a disintegrant, the guidelines for obtaining a stable mixture are recommended, according to which one of the disintegrants must be well soluble in the organic phase and poorly soluble in water, and the other vice versa, well

soluble in water and insoluble in the organic phase. To increase the effectiveness of silicone foam extinguishers, a moderator such as silicon oxide is often added to it. The effectiveness of such foam extinguishers depends on their chemical structure [5] and may be enhanced by introducing COOH, $(CH_2)_2CN$ group, etc., or by additional technological operations, for example, by heat treatment. In order to improve the defoaming properties of silicones, it is recommended to introduce atoms of other elements into their molecules, such as sulfur and boron.

A silicone foam suppressant is made on the basis of polydimethylsiloxane oil, which has the property of quickly spreading over the surface of the liquid. The active silicone ingredient distributed in the foam is mixed with the molecules of SFM on the surface of the bubble. Due to this, due to destabilization and breaking up of bubbles, the veil becomes thinner. Particles of silicon dioxide mix on the surface of the foam bubble, further destabilizing the foam. The bubble of the foam bursts and the trapped air comes out.

The fading of the foam occurs due to the thinning of the curtains. Silicone foam extinguishers instantly spread the liquid on the surface, creating a positive effect. To obtain a positive coefficient, the surface of the foam quencher must be very thin.

A number of organizations are involved in the process of synthesizing reagents with the characteristics of foam suppressors in order to produce them in sufficient quantities. The chemical composition of the products offered by the authors [6-9] is different, but most of the reagents have not been able to take their place in this field due to the properties of cleaning high-sulfur gases.

Defoaming is done by removing the foaming agent from the solution. For this purpose, passing it through a filter, the absorbent solution is quenched or retained in the filter. Activated carbon is used as a filtering agent [10].

Practical experiments show that when billions of cubic meters of gas are processed, a significant amount of impurities accumulates [1]. In this case, a small part of the circulation of the DEA solution enters through the existing filtration units, it is not always technologically efficient, and the carbon adsorbers are quickly filled with tar matter. In this case, the state of regeneration of activated carbon does not occur, that is, it leads to the consumption of additional resources.

An alternative option for adsorption cleaning is extraction [11] or vacuum cleaning [12] technology. The extraction technology was implemented at the Orenburg GPP, and the construction of a vacuum device was considered in the reconstruction project at the Astrakhan GPP.

It is determined that the most active work was carried out to increase the percentage of the relative surface and the marginal volume of the sorption space of macro- and mesoporosities

(passing pores). Taking into account this tradition of foreign companies in the purification of amine solutions, a number of modified brands of activated carbons have been developed. SGL Canada's Travis Calgary firm developed this bituminous coal, and French firm Sutclife Speakmen Carbons Ltd developed the 207-A coal brand. It can be seen that the specific mesoporosity surface of AG-3 coal is 33 m^2/g, while in SGL and 207-A coals, this parameter is equal to 950-1050 and 1000-1200 m^2/g, respectively, that is, it is several times larger. As expected, coal grade 207-A has the largest adsorption capacity, followed by coal grades SGL and AG-3, which have a marginal adsorption capacity of 29 and 52%, respectively [13].

DISCUSSION.

It should be recognized that the possibilities of modified activated carbons are limited and to achieve a new quality indicator in increasing the efficiency of filter materials can be achieved only by creating new carbon adsorbent materials - nanomaterials. First of all, their high efficiency is characterized by the fact that the surface area is greatly enhanced - up to 2000 m^2/g, the anisometry and specific structure of the particles, the hydrophobicity and, accordingly, the oleophilicity of the material in relation to non-polar molecules, and the very high activity of the nanostructured complexes [14, 15].

Studies have shown that the reagents Tesil-201, 201A, DEM-VS-97D, Penta 4613 have antifoam properties when used in their pure form. But the property of extending their service life is very low, and the height of the foam is completely restored in a short period of time. In addition, the reagents have low thermal stability, that is, the temperature regimes of the device cannot be allowed. Reagents Penta 470, 480B, 4609 have shown to have satisfactory defoaming properties, so their use in the form of aqueous solutions has resulted in saving reagents. Common to these reagents is the nature of the emulsifier's oxyethyl higher fatty alcohols and modifiers, and in return, mixing of SFM molecules on the bubble surface, film thinning, and bubble disintegration can occur.

Reagnet Penta 470 has been industrially tested, and is currently used in gas scrubbing and pressurization devices, condensate stabilization and ventilation, and sour components in gas processing plant (GPP). It can be used after the modernization of the transmission node of foam extinguishers, ensuring continuous transfer of aqueous solutions of given reagents and automatic transmission of its compounds during foaming.

Based on the available data, in the first approximation, the dependence of the consumption of foam quenching reagents on the circulation of the absorbent and the concentration of the regenerated amine was obtained. In practice, having primary average daily data (the amount of amine circulation, the amount of defoamer and the concentration of

regenerated amine), with the help of diagrams, it is necessary to determine the content of defoaming reagents in the amine system of the gas treatment plant in GPP in the first approximation and, apparently, to determine its amount, to prevent foam formation. is considered

Adsorption capacity of “Technosorb 1” sorbent was studied in order to determine the possibility of using new materials in the conditions of GPP. A number of aqueous solutions were prepared for the study of DEA with a mixture of mixtures of different origins, the selection of which was based on the results of the study presented in [14]. Each prepared solution was passed through a stable bed of adsorbent through a real-scale industrial carbon filter analogue. The main indicators of the analysis were the foamability of the solution and the coefficient of surface tension at the boundary of the phase separation.

A non-significant effect on the characteristics of the operation is shown by the regeneration properties of the adsorbent. Regeneration of activated carbon leads to high temperature reprocessing with steam according to regulation. But in this case, the compounds adsorbed on the coal are polymerized, as a result of which the absorption capacity is lost, the carbon filter is not regenerated in the device for cleaning the gas from sour components in GPP, and in necessary cases, a complete replacement is carried out. The obtained results are presented in Table 1.

Table 1

Results of determination of adsorption properties of "Technosorb 1" adsorbent

Model solution	Reduction of foam height, %		Decrease in foam stability, %		Change in surface tension, mN/m	
	AG-3	Technosorb 1	AG-3	Technosorb 1	AG-3	Technosorb 1
1% sulfonol solution	75	86	77	86	1,96	2,25
Degradation product of amine	4	13	58	69	0,84	1,13
Contaminated mixture	75	86	77	86	1,96	2,25

In order to determine the regeneration ability of the "Technosorb 1" adsorbent, a working solution of amine is passed through the layer of the adsorbent before and after regeneration, determining the foam characteristics and the surface tension coefficient.

SUMMARY

When researching experimental test brands of "Penta" reagents into variants, the results of laboratory and experimental-industrial tests of such parameters showed the nature of the emulsifier, as well as its satisfactory characteristics and the possibility of use in temperature regimes in GQIZs. With the help of the obtained connections, it was possible to add the required

amount of antifoam to the absorbent solution to prevent it from foaming.

Laboratory research data of Technosorb 1 adsorbent for purification of the working solution of DEA shows the positive dynamics of the basic qualitative characteristics of absorbent solutions during their purification with the help of Technosorb 1 material, i.e., information is provided about the sufficient sorption capacity of the contaminated absorbent and the required pore size for particle capture. Regeneration of "Technosorb 1" adsorbent provides a great opportunity to save resources.

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