INCREASING THE EFFICIENCY OF CLEANING NATURAL GASES FROM SOUR COMPONENTS

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Abstract: The analysis of conditions and criteria for choosing the optimal absorbent for sour gas purification is considered in the article. Various methods of amine cleaning have been considered using mono- and diethanolamine hydrogen sulfide, mercaptans and carbon gas absorbers. It is determined that the effect of preventing foaming of the absorbing solution and the structural properties of the absorber in effective cleaning of chemical reagents has been considered. In work, it is recommended to use a column type absorber. Factors influencing the efficiency and feasibility of amine purification of acid gases are discussed.

Keywords: corrosion, degradation, modeling, ion exchange resins, heat-resistant salts, formate, oxalate, acetate, electrodialysis.

LITERATURE ANALYSIS AND METHODS.

The main process that takes place in amine desulfurization is the

absorption of hydrogen sulfide, mercaptans and carbon dioxide in the column apparatus (absorber) provided in mass exchange devices. The type of absorbers and mass exchangers used will depend on the performance of the desulfurizer, the quality of the gas treatment, and the selectivity. A large number of different types of absorbers are designed and manufactured for cleaning processes [1].

In the course of work, the following are determined: the component composition of the expander and sour, raw and purified gases, the composition of the saturated solution in the consumption of the gas to be purified depending on the consumption of the regenerated sour components and the absorber, the dependence on the purification indicator of the main process, hydrogen sulfide, mercaptans and carbon dioxide in the purification of amine sulfur is the absorption occurring in the column apparatus provided in the mass transfer devices.

Performance indicators of the desulfurization device, the quality and selectivity of gas cleaning depend on the type of mass exchangers and absorbers used. Changes in absorbers and gas-solution contact time, specific consumption of absorbers, absorption capacity, regimes of steam consumption and parameters of the process, and the amount of substance formed in the solution during absorption and desorption processes are processed and produced in a large concentration [1, 2] .

Along with hydrocarbons, natural gases contain sour gases, carbon dioxide (CO_2), hydrogen sulfide (H_2S), mercaptans (RSH) and others, which complicates the process of transportation and use of gases under specific conditions. In order to prevent possible complications in processing, transportation and use, a plan of necessary measures aimed at achieving the established regulatory indicators for the composition of unnecessary components in natural gas will be developed in advance. Taking this into account, the main criteria for the selection of gas cleaning process technologies and absorbers are the ability to achieve a defined deep removal of "unwanted" components and to produce the desired products from them.

RESULTS.

A large number of methods and technologies are used in the manufacturing industry, which differ in terms of cleaning agents (absorbers), cleaning indicators of sour components and volumes of raw materials to be processed.

The Shurtan Oil and Gas Production Department is designed for the purpose of processing high-sulfur natural gases (hydrogen sulfide content of 0.08%) that meets the requirements of UzDSt 948 for obtaining commodity gas and obtains SUG (liquefied hydrocarbon gas), stable condensate, and elemental sulfur. Currently, the content of hydrogen sulfide in natural gas raw materials is 0.12-0.14%. The process of removing sour gases is carried out by the adsorption method based on zeolites. In the normal operating modes of the zeolite adsorption treatment plant, the regeneration gases of natural gas saturated with sour gas components (H_2S and CO_2) are formed, which are directed to the ASO-1, 2 amine desulfurization plant. ASO-1,2 device is designed for purification of regeneration gas from sour components (H_2S and CO_2) with diethanolamine absorbent. Products of ASO-2 are purified from sour components during gas regeneration, which is directed to main gasification. An aqueous solution of 20-25% DEA was used as an absorbing solution during the cleaning process. In the process of gas regeneration cleaning, concentrated sour gas is separated, which is directed to the device for the extraction of elemental sulfur with proper oxidation under conditions of variable hydrogen sulfide loading.

In the ASO-2 facility ("Shurtan Oil and Gas Production Department"), diethanolamine as an amine absorbent in the process of gas purification regeneration is characterized by disadvantages, i.e., a high level of corrosion activity, high solvent consumption, a relatively large loss of solvents, high energy consumption for its regeneration process, and Deficiencies such as DEA's relation to properties have been encountered. The main goal of the research is the process of cleaning gas from sour components using amine cleaning methods, and it is required to quickly solve the issues affecting the efficiency of the problems in the process of its

operation.

The interaction of H_2S and CO_2 with amines occurs depending on the type of amines. The presence of a substituent on the nitrogen atom depends on the reactivity of the amine.

Compared with MEA and DEA, MDEA (tertiary amine) is more selective in removing hydrogen sulfide, that is, it is usually characterized by the amount of unabsorbed carbon dioxide [2, 3].

Differences in the rate of reaction of H_2S and CO_2 with amines, that is, the mass transfer resistance in the absorption of H_2S with amines is concentrated in the gas phase, and in the absorption of CO_2 - absorption in the liquid. The difference in reaction rates of MDEA with H_2S (instant reaction) and CO_2 (slow reaction) is very fast compared to secondary amines. The effect of the fast reaction with hydrogen sulfide and the slow reaction with CO_2 is used in the selective removal of hydrogen sulfide from the mixture with H_2S methyldiethanolamine. In this case, the absorber must be sized to provide a gas contact time sufficient to practically absorb all hydrogen sulfide, but not sufficient to remove a practical amount of carbon dioxide. The selectivity of the process for hydrogen sulfide increases with decreasing gas-liquid contact time.

DEA is used for non-selective removal of acidic components. Gas purification process with 20-30% DEA solution ensures the necessity of gas purification from H_2S and CO_2, but the disadvantage of DEA is to increase the heat costs in the regeneration of the absorbent and reduce the amount of CO_2 in the product gas [3].

MDEA provides the ability to selectively remove H_2S in the presence of CO_2, thereby increasing the proportion of H_2S in the sour gas. MDEA's advantage is shown as a selective absorber in the treatment of low-sulfur gases where the ratio of H2S to CO_2 is less than 1.

The disadvantage of the selective technology is the increase of CO_2 ballast in the transported commodity gas.

Combined absorption is a positive feature of DEA and MDEA, but creates difficulty in keeping the amines in precise proportions.

Advantages of MDEA over DEA:
- high thermal stability and low corrosion activity of the

solution in comparison with DEA;

- H_2S and CO_2 reaction heat is small, that is, the possibility of reducing the amount of heat for the regeneration of the absorbent;

-does not form non-regenerative amides in reaction with carbonic acids and corrosion inhibitors, so amine loss does not occur, solid deposits do not form on the internal surfaces of the heat exchanger;

- due to the low pressure of saturated vapors, the loss of amine due to volatility is reduced;

-The required costs of MEA and DEA are slightly higher than MDEA.

MDEA has great absorption activity against hydrogen sulfide. The slow reaction rate of MDEA with CO_2 can be overcome to a practical extent by adding one or two chemically active primary or secondary amines to form a mixture of amines in water.

In addition, the slow reaction rate of MDEA with CO_2 can be achieved by parameters, constructions, type of plates (nozzles) in the absorber, i.e., a suitable time of its presence in the liquid (contact) is provided. In order to effectively use MDEA to remove the bulk of CO_2, it needs to be in the liquid phase long enough for the CO_2 to react. At lower pressures, the addition of a highly reactive amine enhances the ability of the solution to remove CO_2 [3, 4].

DISCUSSION.

Thus, in the field where MDEA is used, where commodity gas requirements are not met, the use of an amine mixture may improve device performance.

The chemical action reaction takes place in the liquid phase on the contact surfaces of the nozzle (plate) of the absorber, that is, in the contact of the raw materials streams in continuous counterflow: natural gas — from the bottom up and amine solution — from the top down.

In the process of phase contact, H_2S and CO_2 are chemisorbed by forming chemical compounds with liquid absorbers [5,6].

Saturation of amine solutions with sour components

regenerates the amine in the evaporation column in the desorber, where the chemical reaction to amine and the decomposition of gases in the absorption of heat (endothermic reaction) take place. The desorption process takes place due to a decrease in pressure and an increase in temperature. In order to ensure a stable mode of operation, anti-foaming agent is introduced into the system. The filtration part of the regenerated amine solution is passed through activated carbon to remove contamination.

The reliability of the gas desulfurization device with amine solutions decreases under the following conditions:

- destruction of amines due to additional reactions and thermal decomposition;
- corrosion of equipment and product transmissions;
- tarnishing;
- foaming in the gas cleaning (drying) system;
- deposition of solid mixtures on the surface of pipes and equipment.

The presence of foaming acceleration in the system leads to the loss of absorbent and deterioration of the quality of the commodity gas. External signs of foam formation are a sudden increase in pressure drop in the column.

Corrosion rate depends on many variables. The corrosion activity of the applied amines is reduced in the following order: MEA, DEA, MDEA.

Corrosion rates are also affected by the relative amounts of SO_2 and H_2S in the sour gas. CO_2 in sour gas is more corrosive than carbon dioxide H_2S. In this case, the concentration of CO_2 and H_2S in the sour gas is not considered an absolute determining parameter, their concentration ratios determine the composition of the boiling amine solution. In addition, corrosion is affected by physical and chemical parameters, and the corrosion process also depends on the type of steel the equipment is made of [7, 8].

The rate of corrosion increases with the increase in temperature and the concentration of CO_2 in the solution, so it is necessary to increase the amount of solution given to filtration when their content increases in the solution.

A protective film is created when there is no erosion of iron sulfide on the surface of the metal. Taking this into account, the most saturated solution is allowed to degas a low content of CO_2 and a high content of H_2S [9, 10, 11].

CONCLUSION

The application technology of composite absorbents used in the purification of natural gases from acidic components has been researched. The component composition of raw and purified gases, the composition of the saturated solution in the consumption of purified gas depending on the consumption of regenerated sour components and absorbers, the dependence of the purification index of the main process was determined.

Accumulation of heat-resistant salts in the absorption system causes problems in the operation of the equipment, i.e. lowering the absorption properties of CO_2 and reducing its physico-chemical properties, as well as increasing the corrosion activity, clogging and erosion of the equipment.

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