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ASSOCIATED PETROLEUM GAS TREATMENT

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Introduction

Associated petroleum gas (APG) is a form of natural hydrocarbon gas found with deposits of petroleum either dissolved in oil or presented in oil and gas-condensate fields. The volume of APG can vary from one to several thousand cubic meters. [1]

APG is a by-product of oil extraction. Russia, Saudi Arabia, USA are the leading countries possessing large oil deposits. Therefore, the issue concerning associated petroleum gas treatment is very topical in the Russian Federation. [2]

The reason for incomplete APG utilization is the substandard infrastructure and the composition of casing-head gas. [4].

Results and Discussions

Due to the necessity of gas treatment and its processing the scheme for associated gas preparation for small and medium size fields utilizing gas-piston installation aimed at production electrical and thermal energy was developed.

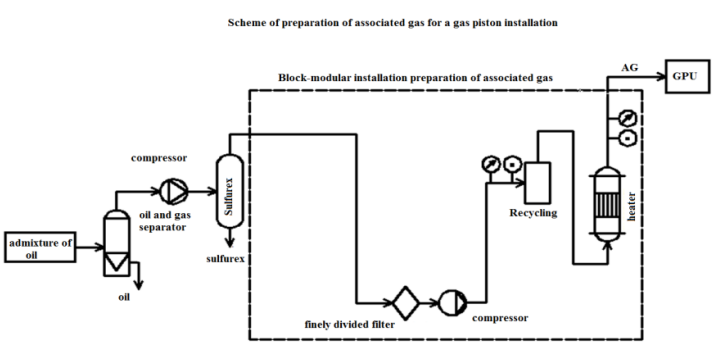

Fig. 1. Scheme of associated gas preparation for a gas piston installation

The sulfur purifying installation “Sulfurex” is equipped with an oil and gas separator used for gas separation from oil and a compressor, located after separator and intended to control the pressure increase and decrease till the desired one (0,1 – 3,0 MPa).[3]

At present sulfur purifying is an important and essential condition for normal operation of the equipment used for industrial development of oil and gas deposits. Desulfurization of pipe lines has to be done to avoid corrosion, faults, wear and tear of equipment caused by hydrogen sulfide presented in associated gases.

To understand more precisely the whole process it is necessary to consider the operation of sulfur purifying installation called “Sulfurex.”

The desulfurization process is intended for small and medium size volumes of gases and has the following advantages:

- Does not require any considerable capital costs;
- Low water and chemical agent consumption;
- Absence of chemical waste.

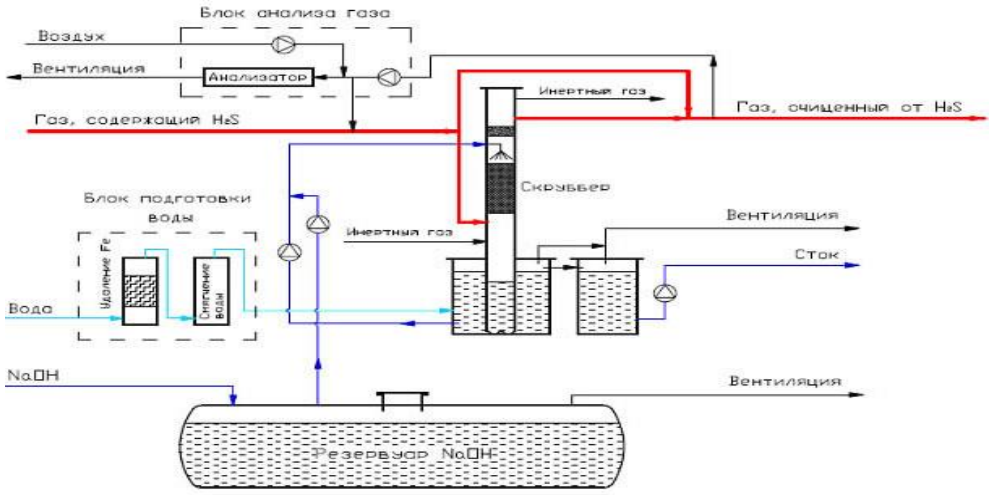

Fig. 2. Schematic diagram of desulfurization installation based on the «Sulfurex» method

Let us consider the scheme of associated petroleum gas cleaning treatment. Gas subjected to cleaning treatment is supplied to the bottom part of the scrubber and flows through it to the top. Alkaline solution from the tank is delivered to the reflux. The specified concentration of alkaline solutionis is maintained by prepared water and alkaline solution(NaOH) supplied from the reservoir in the system.One part of processed associated gas flows from the top to the detector H2S, and then is returned back in the process. The chemical processes taking place in desulfurization based on the method «Sulfurex» are presented below.The process of hydrogen sulfide removal (H2S) is carried out using gas scrubbing with alkaline solution (NaOH). Hydrogen sulfide is absorbed by the circulating cleaning liquid. This process is called chemical adsorption. Chemical adsorption of hydrogen sulfide and carbon dioxide using caustic alkali (NaOH) takes place in accordance with the reactions presented below. It results in obtaining sodium bisulfate (NaHS) and mineral alkali (Na2CO3):

$$H_2S+NaOH \rightarrow NaHS+H_2O \quad (1)$$

$$CO_2+2NaOH \rightarrow Na_2CO_3+H_2O \quad (2)$$

Sodium sulfide (Na2S) and sodium hydrocarbonate (NaHCO3) are formed through the interaction according to the following equations:

$$H_2S+2NaOH \rightarrow Na_2S+2H_2S \quad (3)$$

$$CO_2+NaOH \rightarrow Na_2CO_3 \quad (4)$$

Sodium carbonate formed as a result of the previous reaction interacts with hydrogen sulfide resulting in obtaining sodium hydrosulfite and sodium carbonate:

$$Na_2CO_3+H_2S \rightarrow NaHS+NaCO_3 \quad (5)$$

Thus, sodium hydrocarbonate is obtained as a result of interaction of sodium carbonate and carbon dioxide in the presence of water molecules:

$$CO_2+Na_2CO_3+H_2O \rightarrow 2NaHCO_3 \quad (6)$$

The chemical reactions (1) and (5) are the most important ones for the process of desulfurization where the chemical compound of hydrogen sulfide takes place. The chemical process directly depends on gas concentration, system pressure and temperature.

After being desulfurized gas gets into the block-module installation for associated gas treatment. Firstly, the gas gets into the fine-dispersed filter.

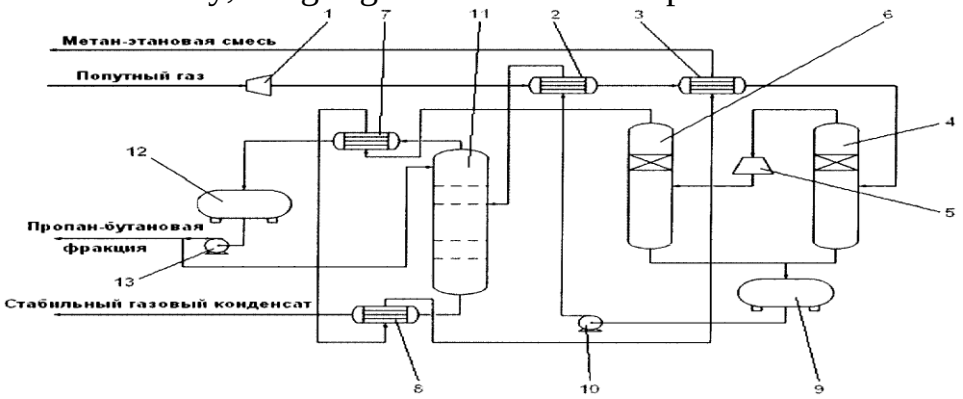

Fig. 3– block-module installation

Then, it is delivered to the installation for associated gas processing to obtain the required condition of the gas piston installation (GPI). The installation is equipped with temperature sensors and gas pressure regulators which take the gas readings in the inlet of the installation

According to the scheme of the installation the associated gas at temperature -10 +30˚C and pressure 0,2-0,6 MPa gets into screw compressor 1.The associated gas flows through recuperative heat exchangers 2 and 3 at temperature 100-130˚C and presure 3-3,5 MPa, where it is cooled by gas condensate and methane- ethane mixture. After that, the associated gas gets into the first stage of separation in small size separator 4. Separated associated gas gets from the top of the separator 4 into the expansion turbine and at temperature minus 16-20˚C and pressure till 1,4 MPa Further, it arrives at the second stage of separation in separator 6. Separators 4 and 6 have similar construction. Dry gas is used as fuel and gets into gas main pipe line being heated in advance in recuperative heat exchangers 7, 8, 3. The liquid phase of gas condensate gets from seperators 4 and 6 into the surge tank 9 and is pumped into rectification column 11. This condensate is heated till + 125˚C before getting into recuperative heat exchanger 2.

Stable gas condensate is stored or pumped into the main oil stream. Heat recovery of stable gas takes place in heat exchanger 8, where dry gas is used as a coolant. Propane- butane fraction gets into reflux condenser 7 at temperature 50˚C where it is condensed by dry gas and at temperature 20-40˚C and then gets into the refluxed reservoir 12. Part of propane-butane mixture from the refluxed reservoir is pumped into the top part of the column 11 as a mean of irrigation.

Conclusion

Unlike the existing analogues the specified method allows obtaining three products, which quality characteristics enable to use various technological processes without further gas processing.

Dry gas obtained from the considered treatment has high methane number defining its antiknock value. The latter is the most important gas characteristic. Thus, the obtained dry gas can be successfully used to produce electrical energy which can be then utilized as fuel for gas piston power plants.

The obtained propane butane fraction can be used as fuel in transport as well as for commercial and industrial needs, e.g. stable gas condensate can be used in oil extraction as a gasoline additive.

Therefore, gas prepared for GPI as fuel in accordance with the proposed technological scheme meets all requirements for different types of gas fuel.

The method offered in this article completes the most challenging environmental issue by reducing flared gas volumes up to complete avoidance of flaring. [1]

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PEST ANALYSIS OF SMART METERING MARKET IN RUSSIA

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INTRODUCTION

In order to describe a current smart meter market in Russia the PEST analysis will be used. PEST is an acronym for political, economic, social, and technological – external factors that commonly affect business activities and performance. Created by