STUDY AND ANALYSIS OF THE PROCESS OF PHYSICAL ABSORPTION DRYING OF NATURAL GASES

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Abstract: Abstract: This article presents various physical absorption drying processes for natural gases: the dew point is the temperature at a certain pressure at which water vapor is saturated, and methods of drying by cooling are also presented. When the gas is cooled at constant pressure, excess moisture condenses, and accordingly its dew point decreases, and absorption drying is carried out - selective (selective) absorption of water vapor by liquid dust-absorbing materials using various glycols as absorbents. The article presents the basis for absorption (achievement) and technological schemes for gas drying.

Keywords: Physical absorption, relative humidity, gas drying, gas hydrate, selectivity, dew point,, drying by cooling, absorbents, DEG, TEG, EG, Absolute humidity of gas.

Аннотация: В статье рассмотрены различные физические абсорбционные процессы осушки природных газов: точка росы – температура при определённом давлении, при которой водяной пар достигает насыщения, а также способы осушки охлаждением. При охлаждении газа при постоянном давлении происходит конденсация избыточной влаги, и соответственно понижается его точка росы, и осуществляется абсорбционная осушка – селективное (избирательное) поглощение водяных паров жидкими пылепоглощающими материалами с использованием в качестве абсорбентов различных гликолей. В статье представлены основы абсорбционной осушки (достижения) и технологические схемы осушки газа.

Ключевые слова: Физическая абсорбция, относительная влажность, осушка газа, газовый гидрат, селективность, точка росы, осушка охлаждением, абсорбенты, ДЭГ, ТЭГ, ЭГ, Абсолютная влажность газа.

Annotatsiya: Ushbu maqolada tabiiy gazlar turli xil fizik absorbion qurutish jarayonlari keltirilib o‘tilgan: shuningdek shudring nuqtasi-suv bug‘ining to‘yinganligiga erishadigan ma’lum bosimdagi harorati, sovutish orqali quritish usullari keltirib o'tilgan Gaz doimiy bosimda sovutilganda, ortiqcha namlik kondensatsiyalanadi va shunga mos ravishda uning shudring nuqtasining kamayishi va absorbsion quritish bunday quritishdi- absorbent sifatida turli xil

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glikollar ishlatiladigan suyuq changni yutish moddalar tomonidan suv bug‘ining sellektiv (tanlab) yutilishiga (erishiga) asoslanishi va gazni qurutishning texnologik sxemalari maqolada keltirilgan.

Kalit so‘zlar: Fizik absorbsiya, nisbiy namlik, gazni quritish, gazgidrati, selliktivlik, shudring nuqtasi,, sovutish orqali quritish, absorbentlar, DEG, TEG, EG, Gazning mutloq namligi.

Introduction

Currently, many gas and gas condensate fields have entered a phase of declining production, which complicates gas preparation in fields, especially in terms of ensuring the quality of natural gas. In order to comply with regulatory requirements for the quality of natural gas supplied to main gas pipelines, it is necessary to improve the calculation, technological and measurement methods for studying the efficiency of gas drying technological equipment. To clarify the thermodynamic methods for calculating the moisture content and dew point temperature for aqueous phases (liquid water, ice and gas hydrate), additional experimental studies of the phase equilibrium in the “natural gas - water - hydrate” system are required. Therefore, the development and improvement of methods for determining the technological parameters of natural gas drying devices is a topical research topic. [2].

The presence of moisture in hydrocarbon gases is characterized by several parameters.

Moisture capacity (humidity) of a gas– the amount of water vapor in a saturated state at a given temperature and pressure (g/m^3).

Absolute humidity of the gas - This is the actual amount of water vapor (in g/m^3 of gas).

Relative humidity - It is the ratio of the mass of water vapor actually present in a gas mixture to the saturated mass, that is, the ratio of absolute humidity to the moisture content of the vapor that could be contained in a given volume at the same pressure and temperature. Relative humidity is also expressed as the ratio of the partial pressure of water vapor in a gas to the saturated vapor pressure at the same temperature.

Gas drying - This is the process of removing moisture from it, i.e. a decrease in absolute and relative humidity. Usually, the depth of drying (the amount of residual moisture) is regulated by the dew point.

Dew point - This is the temperature at a given pressure at which water vapor is saturated, that is, it is the highest temperature at which moisture droplets can condense in a given pressure and gas composition. The deeper the drying, the lower

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the dew point, which usually depends on the subsequent gas direction, from -20 to -70°C.

Dew point depression (loss) is called - The difference between the dew point of wet and dry gas is understood. The degree of gas drying (dew point depression) is determined by the location where the gas is to be delivered to the consumer or for further processing.

The presence of moisture in gas is undesirable (and sometimes dangerous) for its transportation process, since moisture can precipitate in pure form or in the form of hydrates with hydrocarbons, which causes various corrosion problems in the operation of transport equipment systems. If the moisture in the gas is to be further processed at low temperatures, its dew point should be below the processing temperature of the process gas. Moisture can also poison some of the catalysts used in further processing of the gas. The degree of drying of the gas (dew point) is determined depending on where the gas is to be sent - to the consumer or for further processing. If the gas is shipped to a consumer, the dew point of the dried gas is selected so that the dew point of the gas is several degrees below the minimum temperature at which it is possible to cool the gas during transportation, depending on the humidity. To prevent moisture condensation and liquid blockages in the pipeline, if the gas is to be sent for further processing, such as separation by low-temperature condensation or rectification, the dew point of the dried gas is determined based on the expected operating temperature of the subsequent processing steps.

Natural gas drying methods: Gas drying can be carried out using various methods: direct cooling, absorption, adsorption, or a combination of these methods.

Freeze drying: When a gas is cooled at constant pressure, excess moisture condenses and its dew point decreases accordingly. This is the basis for drying the gas by cooling, the lower limit of gas cooling being limited by the conditions for the formation of hydrates.

This method is not essential for gas drying and is usually used as an element in combination with other methods (to remove the main amount of moisture in advance).

In the absorption drying of hydrocarbon gases, the absorption process is of two types, depending on the interaction between the absorbent and the absorbent. Physical absorption and chemical absorption,

In physical absorption, no chemical reaction is observed during the absorption of a gas. In this case, an equilibrium of pressures of a large or small value occurs above the solution between the component and the adsorbent, that is, the partial pressure in the gas phase continues until it exceeds the equilibrium

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pressure above the solution. In this case, a countercurrent is applied to completely remove the components from the gas, and complete separation is achieved by driving the adsorbents that do not contain the component to be removed into the absorber.

Absorption drying, such as DEG and TEG drying, is based on the selective absorption of water vapor by liquid dust-absorbing substances used as sorbets. Partial dehydration of the gas occurs in a number of processes for its purification from sulfur compounds (for example, in the purification of gas from sulfur compounds with glycol solutions). Initially, ethylene glycol and glycerin were used as dust absorbers, later they switched to less volatile compounds - diethylene glycol and triethylene glycol.

RESULT: Diethylene glycol (DEG) and triethylene glycol (TEG) are mainly used for absorption drying. To a lesser extent, ethylene glycol (EG) is used as a hydrate inhibitor for injection drying in heat exchangers. A number of di- and triethylene glycol derivatives or by-products obtained during their processing (ethyl carbinol, tetraethylene glycol, propylene glycol, etc.), although they have high hygroscopicity, are widely used.

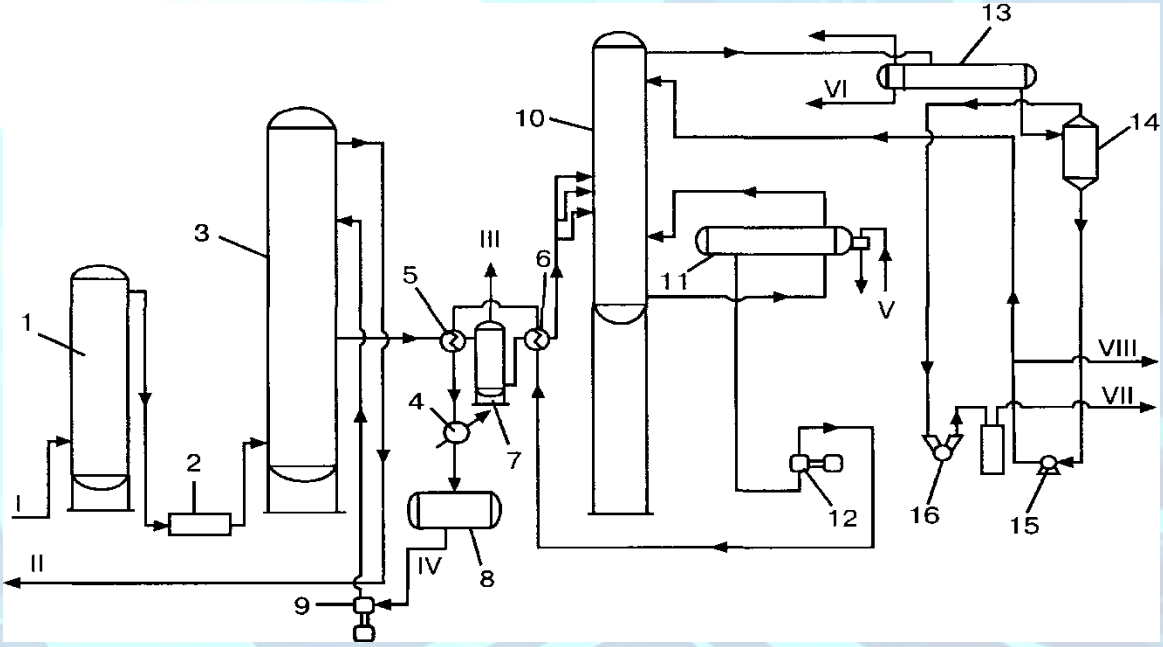


Figure 1. Technological scheme of industrial gas dehydration equipment:

1 - dust collector; 2 - measuring point; 3 - absorber; 4 - freezer; 5, 6 - first and second sections of heat exchangers in the same way; 7 - air meter; 8 - intermediate power DEG; 9, 12 and 15 - pumps; 10 - desorber; 11 - boiler; 13 - condenser; 14 - condensate tank; 16 - vacuum pump RMK-3. Flows: I - raw gas from the condenser; II - dry gas; III - flue gases; IV - recovered DEG; V - water vapor; VI - cooling water; VII - vapor release into the atmosphere; VIII - condensate discharge into the sewer.

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At each stage, the drying process occurs in the cone of the crack, mainly where glycol droplets are formed, and ends in the volume of the apparatus and the separator. For glycol filtration, filters are available that ensure the removal of suspensions with particles larger than 5 microns, since they lead to mechanical mixing and foaming of the solution.

If the process of drying gas with glycol is carried out at low temperatures, then a 70-85% solution of monoethylene glycol is used, and the glycol is injected into the heat exchanger. This version of the gas drying scheme is used today in many gas processing plants for dust removal.

Glycol injection gas drying plant consists of three main units: glycol injection, three-phase separator and glycol recovery unit. Drying efficiency depends on the gas/glycol contact area, i.e. the degree of atomization of the dryer. Special sprayers are used for fine atomization of glycol. As the gas moves through the pipes, the liquid droplets become larger, facilitating the separation of dry gas from the saturated desiccant as well as from condensed hydrocarbons. Water desorption is carried out in the glycol regenerator. A schematic diagram of the industrial plant is shown in Fig. The compressed raw gas passes through a water cooler 1, a water separator 2, a glycol injection unit 3 and a heat exchanger 4. The gas then enters the propane cooler 5 and then the three-phase separator 6.

The dried gas and hydrocarbon condensate from the three-phase separator are sent for further processing, i.e. regeneration of saturated glycol. After passing through the aeration unit 7, the glycol saturated with water enters the 8th stage, is placed in the upper part of the column 9. It cools and partially condenses the water vapor in the column, which provides irrigation of the column. Then the saturated glycol enters the lower part of the purification column through a heat exchanger. The removed water vapor is discharged into the atmosphere, and the regenerated glycol enters the heat exchanger through a level regulator and then flows through the water cooler 1 to the tank 11.

The regenerated glycol from the tank is pumped through a filter by pump 12 and sent to the injection block.

Each of the gas drying schemes has its own advantages and disadvantages. The method of injection with simultaneous cooling of the gas allows to significantly lower the dew point, to dry the gas and the resulting gas condensate at the same time, and to use glycols with a concentration of 70-80% as a desiccant. The disadvantages of the glycol injection drying method are the high losses of the dryer with gas condensate. Drying by gas absorption minimizes glycol loss, but requires high glycol recovery (up to 95-99%).

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SELECTION: Various drying processes have been developed for the drying of gases. For example, cooling drying, in which water is collected in the form of droplets when the gas is cooled. Absorption drying mainly uses diethylene glycol (DEG) and triethylene glycol (TEG). In rare cases, ethylene glycol (EG) has been used as a hydrate inhibitor for injection drying in heat exchangers, and technological solutions have been developed for drying gases.

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