# EVALUATION OF TECHNOLOGICAL EFFICIENCY OF TWO-STAGE GAS DRYING DURING FALLING PRODUCTION

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**Introduction**

Most of the gas fields are currently in the period of declining production [3]. The produced natural gas has a reduced pressure and increased moisture content relative to the initial (design) values. The quality problem of the transported gas, due to its increased humidity, remains unresolved and escalates. It becomes clear that not only gas quality control is necessary, but also full-fledged monitoring of gas preparation processes. Process parameters can be controlled not only by direct methods with the help of instruments, but also by a comprehensive examination, calculations and analyzes for the subsequent elimination of problematic issues in technology.

The purpose of this study is to evaluate the technological efficiency of two-stage gas dehydration in the fields during the period of falling production.

The essence of the process of absorption drying of natural gas is to remove water from the produced fluid due to its contact with the absorbent [1]. In the process of absorption drying, the absorbent is saturated with water. After that, it is regenerated in the process of desorption of water from a saturated absorbent to a certain extent and the circulation is fed back into the absorption process. In this process, glycols — diethylene glycol and triethylene glycol — are used as absorbent.

One of the solutions to increase the efficiency of the absorption technology for the preparation of natural gas is to modernize the technology and monitor the properties of the exhaust stream of dried gas and identify the dependence of its properties on the operation of the equipment. But the problem is that the properties of this product are affected by many parameters (pressure, temperature, flow rate, type of absorbent, etc.). Therefore, in this situation, it is proposed to apply a two-stage absorption technology for gas dehydration with an analysis of the same and parameters. And the most high-quality comparative analysis of the existing and modernized gas treatment technologies is possible as a result of technological modeling implemented in the special UniSim Design R460 software package.

**Experimental research**

The UniSim Design R460 software package simulated a flow chart of an existing gas dehydration installation for field M with an additional second stage of an absorption column with an additional stage of recirculation of a saturated absorbent, shown in Figure 1. In the modeling scheme, the composition, pressure, temperature, and flow rate of all material flows were used (gas, absorbent, etc.) similar to the parameters of the existing gas dehydration field installation [2]. The initial component composition for modeling in the UniSim Design R460 software package is presented in Table 1.

Initial data for modeling:

- The consumption of natural gas in both cases is 289 thousand $m^3$ / h (6,95 million $m^3$ / day);
- Mass concentration of absorbent (diethylene glycol) in regenerated 98,0% and in saturated solutions 51,5% for the current and proposed technology 98,0% and 46,6%;
- The dew point on the water of the dried gas with the current and proposed technologies minus 21 ° C;
- The gas-glycol contact temperature with the current technology is 10,8 ° C and with the proposed 12,2 ° C;
- Winter season, compressor operation period.

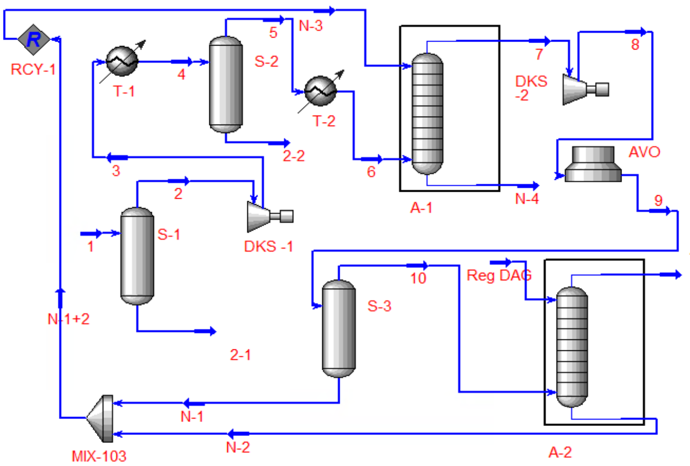


***Fig. 1 - Simulated scheme of a two-stage gas dehydration (winter season): S-1–liquid cork trap; S-2,3–primary separators; DKS-1,2–booster compressor station; T-1.2–refrigerator, A-1.2–absorption column, AVO air cooler***

***Table 1***

***Component composition of reservoir Cenomanian gas***

| $CH_4$ | $C_2H_6$ | $C_3H_8$ | $iC_4H_{10}$ | $nC_4H_{10}$ | $C_{5+}$ | $N_2$ | $CO_2$ | $H_2O$ |
|---|---|---|---|---|---|---|---|---|
| 92,90 | 1,15 | 0,67 | 0,26 | 0,26 | 0,04 | 1,77 | 0,10 | 2,85 |

The study was conducted on the basis of the current gas dehydration unit. For the study, was took the actual gas compositions, input parameters, the type and composition of the absorbent in the M field. The adequacy of the model was assessed by comparing the density of commercial gas obtained from the simulation and the density of commercial gas from a real gas dehydration unit. As follows from table 2, the relative error is 0,07%.

***Table 2***

***Comparison of densities of real commercial gas and calculated by the UniSim Design R460 program***

| Material flow | Property | Value | | Relative error, % |
|---|---|---|---|---|
| | | Experiment | Calculation | |
| Dry gas | Density, kg / $m^3$ | 0,696 | 0,697 | 0,07 |

***The following research results are included in the evaluation of technological efficiency:***

- The effect of pressure and temperature on the performance of an existing and modernized installation for absorption drying of natural gas with glycols is presented in Figure 2.

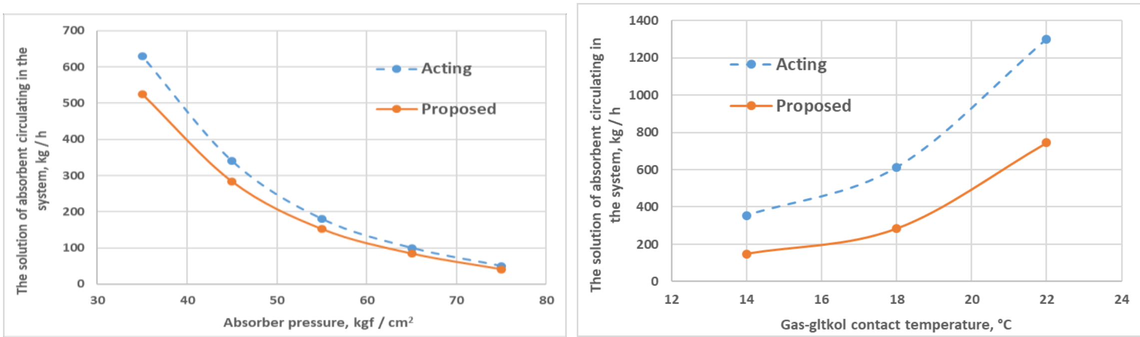


***Fig. 2 - The effect of pressure and temperature on the flow rate of the absorbent of the existing and proposed installation of absorption drying of natural gas with glycols***

- The influence of the type of absorbent at a concentration of 98% depending on the contact temperature on the dew point of the water of the existing and modernized installation of absorption drying of natural gas is presented in Figure 3.

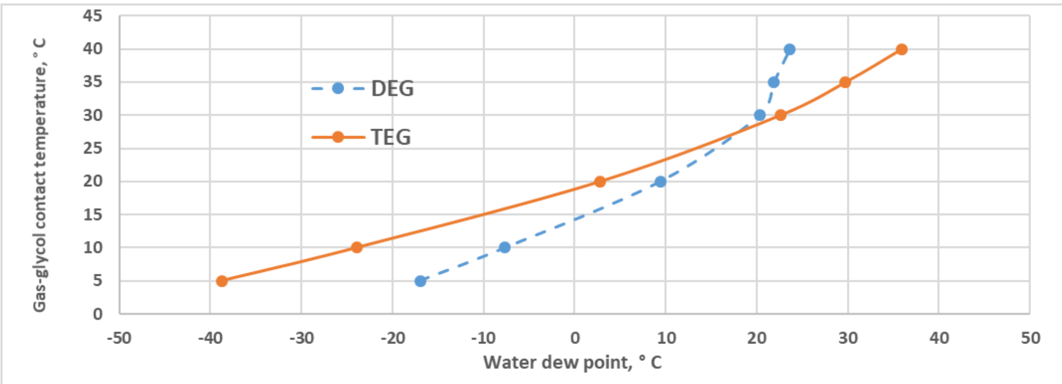


***Fig. 3 - Influence of the type of absorbent on the contact temperature on reaching the dew point in water***

**Conclusion.** In the course of the study, the influence of factors on the efficiency of drying natural gas showed:

- With increasing pressure, the flow rate of the absorbent solution supplied to the system decreases. At a pressure of 7,5 MPa, the proposed technology required an absorbent of 9,9 kg / h less than for the current technology.
- With an increase in the gas-glycol contact temperature, the flow rate of the absorbent solution supplied to the system increases significantly. At temperatures above 23 ° C, the study did not make sense, since the consumption of absorbent was greatly increased. At a temperature of 22 ° C, an absorbent was required for the existing technology 1300 kg / h, and for the proposed technology 774 kg / h, which is 526 kg / h less than for the existing technology.
- At the same mass concentration of 98% and a gas-glycol contact temperature of 5 ° C, the required dew point is much easier to achieve with triethylene glycol, since the dew point temperature is minus 46,9 ° C, and in the current minus 38,7 ° C.

## References


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