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Research Article

Influence Of Temperature And Pressure Of Incoming Oil-Containing Liquid From Field Wells On The Gas Separation Process

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Abstract In terms of oilfield terminologies, separators are used to separate oil, gas, and water and to remove material such as entrained solid impurities from the crude oil produced from the wells. Optimization of separation process represents a challenging operation that can be achieved by improve the separation performance .This article is devoted to the analysis of changes in the process of separation of oil-containing liquid coming from field wells. It investigate the first stage of separation at the installation of preliminary water discharge and oil treatment, when the temperature and pressure of the liquid of the incoming medium change. It was observed that with an increase in temperature and a decrease in pressure, the process of gas separation increases.

1. Introduction

At the design, construction and operation stages, separators are used to improve the oil treatment process. Moreover the separators improve the gas extraction system (first stage of separation) for own needs and transferring gas to the end user as a whole, as well as reduce the amount of gas utilization (flaring) after the end stage of separation [1 , 2 , 3].

In recent years, more and more attention has been paid both domestically and globally to measures to promote the reduction of air pollution from the combustion of associated petroleum gas in flaring plants, to reduce the loss of light hydrocarbon fractions during flaring [4 , 5 , 6]. For this purpose, in order to assess and analyse changes in temperature and pressure on the process of separating gas from oil, the oil treatment unit (OUT) with the oil-containing liquid supplied to it from oil wells was analysed.

2. Methodology

Calculations of the process of separation of associated petroleum gas with the arrival of an oil-containing liquid at various temperatures and pressures were performed. The calculation was carried out by determining the equilibrium constants ķ between the gas and oil phases [7 , 8]. It has been calculated for each component (hydrocarbon) of oil according to the De-Priester chart, followed by solving systems of equations, the distribution of hydrocarbons between gas and liquid (Table 1, Table 2).

Table 1: The results of calculating the process of gas separation from oil at the first separation stage at a temperature of 7.5 ° C and a pressure of 0.55 MPa.

Component	Temperature,ºC	Pressure, MPa	Ki, Distribution coefficient of the components	Mass fraction of the original component	Zi, mole fraction of the components present in this oil	L, molar fraction of all components in the liquid phase	V, the molar fraction of all components in the gas phase	Xi, the molar fraction of the component in the liquid phase.	Yi, the molar fraction of the component in the gas phase
Methane	7,5	0,55	25,00	0,013	0,12	0,852	0,148	0,0263	0,6578
Ethane	7,5	0,55	3,980	0,017	0,080			0,0558	0,2220
Propane	7,5	0,55	1,100	0,027	0,087			0,0855	0,0941
Isobutane	7,5	0,55	0,420	0,005	0,014			0,0149	0,0062
n-butane	7,5	0,55	0,290	0,017	0,042			0,0466	0,0135
Isopentane	7,5	0,55	0,100	0,011	0,022			0,0256	0,0026
n-pentane	7,5	0,55	0,080	0,012	0,024			0,0277	0,0022
n-hexane	7,5	0,55	0,024	0,024	0,040			0,0464	0,0011
n-heptane	7,5	0,55	0,008	0,03	0,043			0,0506	0,0004
n- decane and higher	7,5	0,55	0,0001	0,844	0,529			0,6206	0,0001
				1,000	1,000			1,0000	1,0000

Table 2 : Calculation results of gas separation from oil at the first separation stage at various pressure and temperature parameters.

No.	Temperature,ºC	Pressure, MPa	Gas factor, $м^3/м^3$	Amount of gas separation from oil at the first separation stage , m3 / day
1	7,5	0,55	17,2	8219,4
2	15,9	0,55	18,9	9058,8
3	25	0,55	21,1	10063
4	7,5	0,3	23,8	11371
5	15,9	0,2	31,7	15140

An increase in the temperature of the oil-containing liquid in the system from 7.5 ° C to 15.9 ° C increases the gas output, according to calculations, by 10.2%, with an increase in temperature to 25 ° C, the gas output increases by 22.4%.At a constant temperature and a decrease in pressure in the system from 0.55 MPa to 0.3 MPa, gas separation increases by 38.3%, with an increase in temperature to 15.9 ° C and a decrease in pressure to 0.2 MPa, gas separation increases to 84.2 % (Fig. 1).

It should be noted that an increase in temperature leads to an increase in the gas output during the separation process, but the proportion of heavy components in the gas increases [9 , 10, 11]. This is explained by the fact that an increase in temperature causes an increase in the saturated vapour pressures of the components of the gas-oil mixture, which leads, in accordance with the Raoult-Dalton law, to an increase in the phase equilibrium constants and the fraction of the component in the gas.

An increase in temperature and a decrease in pressure at the head of the oil treatment unit can be achieved in various ways. To increase the temperature of the incoming oily liquid, the supply of drained slop oil from commercial tanks and hot sludge tanks is often used, where the drained oily liquid and water have a high temperature after heating.

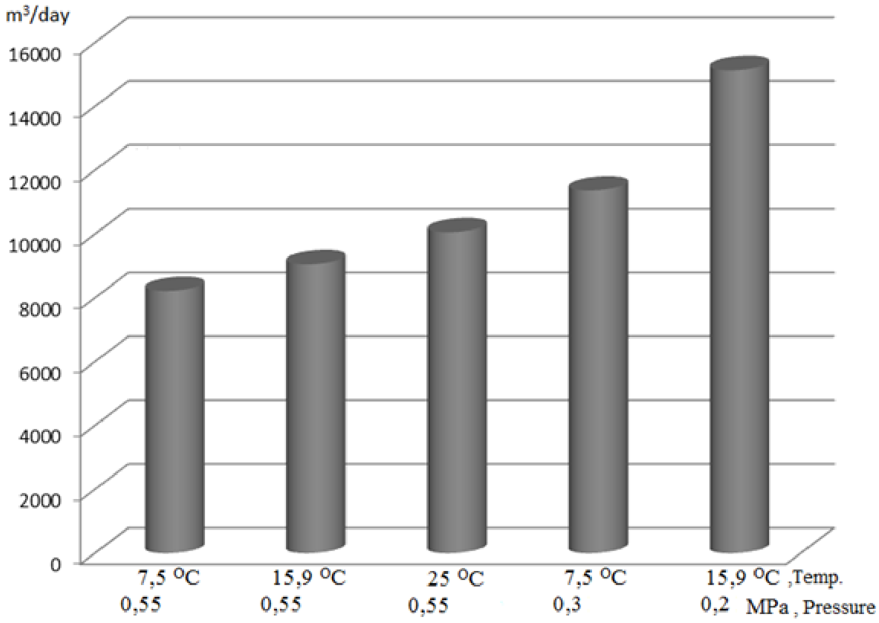

Figure 1: Dependence of the increase in the process of separation of gas from oil with changes in temperature and pressure

For example, when mixing an incoming oily liquid with a water cut of 70% and a temperature of 7.5 ° C in a volume of 85 m3 / h with an oily liquid drained from commercial tanks and hot sludge sumps with a water cut of 90% and a temperature of 35 ° C in a volume of 32 m3 / h, the percentage of gas separation increases by 10.2%.

To reduce the pressure on the separators of the first stage of separation, it is necessary to use equipment and pipelines with the appropriate capacity. It is well-known that, deposits may form over the years, which in turn worsen the permeability in pipelines and apparatuses, resulting in an increase in pressure in the system [12, 13 , 14].

It is necessary to perform timely revision of equipment and pipelines and assess the dynamics of pressure changes in the oil and gas treatment system over time, as well as to increase the production capacity (increase in liquid production from field wells) to increase the throughput capacity of equipment, pipelines, and apparatuses.

For example, when the pressure in the system decreases from 0.55 MPa by only 0.15 MPa at a temperature of 7.5 ° C, the percentage of gas release from oil increases by 19%.

3. Conclusions

The performed computational analysis allows us to assert that with an increase in temperature and a decrease in pressure, the process of gas separation increases. However, it should be noted that with a decrease in pressure, the fraction of separation of components such as methane, ethane, propane is significantly higher than with an increase in temperature, where proportion of heavy components increases.

Also, when the temperature increases and the pressure decreases in the incoming production fluid, the process of destruction of the armor shells of the emulsion improves, which has a beneficial effect on the process of cold settling and increases the proportion of water separation in subsequent settling tanks.

The quality of oil treatment directly affects the quality of oil transportation through pipelines, the condition of pipelines and equipment over time. The depth of gas separation from oil is also important when pumping oil. If the gas content in oil exceeds 3% by volume, it cannot be pumped by centrifugal pumping units through the pipeline, to avoid failure of the pump itself.

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