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Problems of Transporting "Heavy" Gas Condensates at Negative Ambient Temperatures and Ways to Solve These Problems

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Abstract

The transportation of heavy gas condensate through the pipeline system is conducted in accordance with the approved delivery plan, which provides for the operation of the system in various modes and circumstances. One of the main problems in transporting such gas condensate is the low (negative) ambient temperature.
The results of this work are presented, on the basis of which two methods of solving the problem of transporting "heavy" gas condensates in the winter conditions of the North are proposed. The first method involves the use of overpressure, which prevents the formation of structures in gas condensates at sub-zero temperatures; the second method involves the use of a solvent than which it is proposed to use "light" gas condensates.

Keywords: *Heavy gas condensate, Gas transportation, Pipeline, Negative ambient temperature, Overpressure.*

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1. INTRODUCTION

Problems associated with the transport of gas condensates (GC) at negative ambient temperatures, particularly in the winter conditions of the North where the temperature can drop to -50°C and below, have always existed [1]-[4]. These problems became particularly acute in connection with the development of gas condensate fields containing a large amount of high-melting n-paraffin; "heavy" gas condensate [5]-[8]. The temperatures of the onset of crystallization of n-paraffin of such gas condensates, i.e. their melting point (MP), are much higher than those MP of standard light gas condensate, and sometimes they can even have positive values, up to 15-20°C [9]-[11]. Pour Point (PP) of "heavy" gas condensate also occurs at positive temperatures. It is clear that it is impossible to transport "heavy" GC from the field to the plant for its processing in the winter period without additional measures.

Table 1 shows the quality indicators of two samples of gas condensate (GC-1 and GC-2) with different compositions. Sample GC-1 is a sample of "heavy" GC from a field containing higher melting point n-paraffin than sample GC-2. Sample GC-2 is a typical sample of "light" GC from the lower Cretaceous deposits.

Table 1: *Dependence of the main quality indicators of GC on their hydrocarbon composition*

Indicator	Sample GC-1	Sample GC-2
Density at 20°C, kg/m^3	778,8	697,9
MP, °C	5	–39
PP, °C	–8	–48
Fractional composition,°C:		
Gasoline	61,5	45,5
10%	93,5	80,5
50%	199,7	149,0
Petrol	300,0	300,0
Output,% vol	75,2	85,5
Residue,% vol	24,8	14,5
Hydrocarbon composition, % wt.:		
paraffins	34,1	0,89
naphthenes	15,5	20,0
aromatic hydrocarbons	15,0	33,9
Sulfur content,% wt.	0,01	0,02
Cetane number	43	45

A consequence of the differences in hydrocarbon composition of these samples is a significant difference in their MP and PP. It is clear that if sample GC-2 has problems with transport in the winter conditions of the north, sample GC-1 is completely crystallized in these conditions, so it is impossible to transport it.

The new gas-condensate fields developed in recent years generally contain "heavy" GC [12]-[14]. To solve the problems associated with transporting "heavy" GC to the processing plant, we have considered several ways to destroy the structures that form in such GC at the melting point (MP) and below.

1.The first method is to heat the condensate pipeline, through which the transport of "heavy" GC occurs.

2.The second method is the use of depressant-dispersant additives, the effect of which on the low-temperature properties of GC is probably the same as on the low-temperature properties of oils and the main types of petroleum products [15],[16].

3.The third method is the use of overpressure to destroy structures that occur at low temperatures.

4.The fourth method is the use of a diluent in the capacity of which "light" GC-2 is involved in the mixture with GC-1 in an optimal ratio.

In our opinion, the first method, which involves heating the condensate pipeline, is economically impractical because it requires significant energy costs.

The use of depressant-dispersing additives is also not considered an effective method, as it will require expensive, in-depth research related to the development of new, previously unknown high-performance additives for GC.

2. AIM OF THE WORK

The aim of this work was to investigate the influence of overpressure on the one hand and concentration of diluent on the other hand on the processes of structure formation taking place in GC at negative temperatures. In addition, it is to choose the optimal modes for the transport of heavy GC in the winter conditions of the North.

3. METHODOLOGY

3.1 Overpressure method

In order to determine the optimal value of pressure (P) at which the flow of "heavy" GC would be possible, the dependence of the structural and mechanical properties of GC, namely the structural viscosity of GC at temperatures below MP, but above PP on the value of the applied load was investigated. Based on the obtained results, the optimal value of P was determined, at which the structure is completely destroyed, ensuring the flow of GC and, consequently, its transport.

Due to the fact that at MP (+ 5 ° C) and below, down to PP (-8 ° C), the processes of structure formation occur actively in the sample of "heavy" GC-1 [17],[18], the dependence of its structural viscosity on the value of the applied load P was studied. This investigation was carried out at a temperature of -3 ° C, which is lower than its MP, but higher than PP. For comparison, similar investigations were carried out with a sample of "light" GC-2, also at a temperature lower than its MP (-39 ° C), but higher than PP, namely at a temperature of -40 ° C.

Figure 1 shows the dependence of the viscosity of the studied samples GC-1 and GC-2 on the values of P. From the obtained dependences it follows that when the P values are changed from 0 to 6100 Pa at a temperature of -3 ° C, the viscosity of the "heavy" sample GC-1 decreases steadily, until its minimum value of 2040 Pa - s at P = 4100 Pa. When the P values were further increased from 4100 Pa to 6100 Pa, the viscosity of GC-1 did not change.

A decrease in the structural viscosity of dispersed systems, which include oil-dispersed systems, such as GC, with an increase in P indicates the destruction of the structures present in them under the action of a load [19],[20].

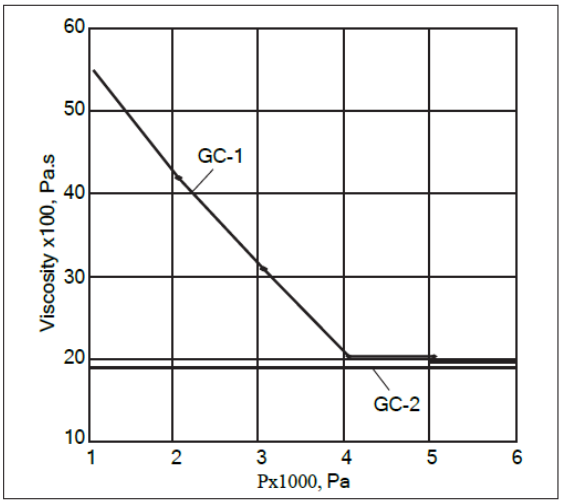

Fig.1: *Dependence of the viscosity of GC-1 and GC-2 on the value of the applied load (P)*

As the structures are destroyed, the viscosity decreases and the system acquires a flow. When the structures are completely destroyed, the dispersed system acquires a flow similar to a Newtonian fluid, as evidenced by the absence of a dependence of viscosity on pressure. Thus, the transition of the load-dependent structural viscosity to the load-independent Newtonian viscosity is direct evidence of the termination of the structure formation process and the possibility of dispersed flow.

The experimental data obtained in this work have proved that the process of active structure formation occurring in a sample of "heavy" GC-1 at temperatures below plus 5° C can be stopped by generating an overpressure in the system, more than 4000 Pa. This ensures the transport of GC-1 through condensate pipelines in the winter conditions of the North without significant problems.

As for the sample of "light" GC-2, as can be seen from Figure 1, under experimental conditions at a temperature of -40 ° C, with an increase of P from 1100 Pa to 6100 Pa, its viscosity did not change. The viscosity remained constant and equal to 1900 Pa.s , indicating the absence of complex structural formations in the range of applied loads, even at such low temperatures, which give it a flow similar to a Newtonian fluid.
Thus, it is possible to carry out the transport of GC, including "heavy", in practice at negative ambient temperatures, using excess pressure and placing only pumps as additional equipment.

However, using pressure as the only means of transporting "heavy" GC is unlikely to solve this problem for GC with high levels of PP. Thus, for example, if the ambient temperature is significantly lower than the temperature of "heavy" GC, which may even be positive depending on its composition, and such a situation is real for the north in winter, then transport of such GC will be impractical due to the impossibility of destroying the structure with pressure alone.

3.2 Dilution method

In this context, the use of a diluent has been proposed as a second method to ensure the transport of "heavy" GC at low temperatures. To this end, we studied the effect of the concentration of diluent used as a sample of "light" GC-2 on the low-temperature properties of the prepared mixtures of different compositions.

The results of the study of the dependence of MP and PP the mixtures GC-1 and GC-2 on their composition are presented in the table. 2. From the experimental data obtained, it follows that increasing the content of "heavy" GC-1 in a mixture with "light" GC-2 from 0 to 50% by weight naturally leads to an increase in the MP and PP of the mixture from -39 to -15°C and -48°C to -25°C, respectively.

Table 2: *Dependence of MP and PP of a mixture of GC-1 and GC-2 on the concentration of GC-1*

Content of GC–1, % wt.	MP, °C	PP , °C
0	–39	–48
10	–38	–48
15	–37	–47
20	–37	–47
25	–36	–46
30	–34	–44
35	–30	–40
40	–25	–35
50	–15	–25

4. CONCLUSIONS

From the obtained results it can be concluded that at negative ambient temperatures "heavy" gas condensate (GC-1) can be transported by dilution with "light" GC-2. The content of GC-1 in the mixture varying from 10 to 50 wt%. At the same time, PP of the mixtures will vary from - 48 to -25 ° C, which will ensure the transport of "heavy" GC-1 in the winter conditions of the North at ambient temperatures below -25 ° C, up to -48 ° C.

Thus, the experimental results obtained in this work show that it is possible to solve the problem of transport of "heavy" GC. In our opinion, the following methods are economically feasible, which can be recommended for the transportation of "heavy" GC:
1. the use of positive pressure,
2. the use of a diluent.

Any of the proposed methods can be applied in the climatic conditions of the North.

REFERENCES

1. Lanchakov G.A., Kucherov G.G., Zhuravlev A.N.(2003) Method of preparation of paraffin gas-condensate mixture for transport and processing. "Urengoygazprom". - M .: Nedra, 351 p.

2. Al-Obaidi SH ,Galkin AP and Patkin AA. “Prospects of High Viscosity Oil Flow Rate in Horizontal Wells”. JoPET , Vol. 5, Issue 4, pp 56-62, 2006.

3. Al-Obaidi Sudad H. and Аль Обейди Судад Х. 1996.“ Определение Глинистости Продуктивных Пластов Месторождений Нефти и Газа Восточного Багдада.” OSF Preprints. doi:10.31219/ osf.io/dmw9c.

4. Antonova E O, Bakhmat G V, Ivanov I A and Stepanov O V 1999 Heat transfer in pipeline transport of oil and gas (Nedra, St.Petersburg) 228p.

5. Al-Obaidi Sudad H. 2007. “Analysis of Hydrodynamic Methods for Enhancing Oil Recovery.” OSF Preprints. doi:10.31219/ osf.io/fvh5w.

6. AL-Obaidi Sudad H. (2009) Experimental Study of The Influence of Fluid Flow Rate on The Risk of Rock Destruction. Journal of Petroleum Engineering and Emerging Technology, Volume 9, Issue 4, pp 84-89.

7. Al-Obaidi Sudad H., Patkin AA, and Guliaeva NI. 2020. “Advance Use for the NMR Relaxometry to Investigate Reservoir Rocks.” OSFPreprints,10.31219/osf.io/ jmb9t .

8.Zhuravlev AN, Kabanova EN, Bashkatova ST et al. (2008) Problems arising in the transport of gas condensate in the Far North, and ways to solve them // Coll. Proceedings of the V International Scientific and Practical Conference "New Fuels with Additives". SPb, Academy of Applied Research, pp 218–221.

9. Al-Obaidi, Sudad H.(1998). “Areas of Effective Application of Submersible Centrifugal Pump Installations with and Without a Gas Separator.” engrXiv,10.31224/ osf.io/2c84h.

10. Al-Obaidi, Sudad H (1996). “Модификация Уравнения Арчи Для Определения Водонасыщенности Нефтяного Месторождения Восточный Багдад.” OSF Preprints,10.31219/osf.io/tqpn5.

11. AL-Obaidi SH , Glalkin AP.(2005) Dependences Of Reservoir Oil Properties On Surface Oil. Journal of Petroleum Engineering and Emerging Technology, Volume 5, Issue 9, pp 74-77.

12. Al-Obaidi Sudad H. 1996 . “Разработка Методики И Технологии Обработки Данных ГИС.” OSF Preprints. doi:10.31219/ osf.io/e68us.

13. Al-Obaidi SH , Guliaeva NI. Determination Of Flow And Volumetric Properties Of Core Samples Using Laboratory NMR Relaxometry. JoPET (2002) 20-23.

14. Smirnov VI and Al-Obaidi Sudad H (2008) Innovative methods of enhanced oil recovery. Oil Gas Res 1: e101. doi: 10.4172/2472-0518.1000e10.

15. Grishina IN (2007) Physical and chemical foundations and patterns of synthesis, production and use of additives that improve the quality of diesel fuels. - M .: Publishing house "Oil and Gas" Russian State University of Oil and Gas im. I. M. Gubkina, 230 p.

16. Al-Obaidi, Sudad H.(1996) “Разработка Методики И Технологии Обработки Данных ГИС И Керна Для Определения Подсчетных Параметров Нефтегазовых Месторождений Ирака : На Прим. Месторождения Вост. Багдад.” OSF Preprints,10.31219/osf.io/f6vka.

17. Sudad H AL-Obaidi (1999) Submersible Screw Pumps In Oil Industry. Journal of Petroleum Engineering and Emerging Technology, Volume 3, Issue 7, pp 10 -13.

18. Al-Obaidi Sudad H. 2004. “Modified Use of Microbial Technology as an Effective Enhanced Oil Recovery.” OSF Preprints, doi:10.31219/osf.io/xgthz .

19. Frolov Yu. G. (2004) Course of colloid chemistry. Surface phenomena and dispersed systems, M ,Alliance, 464p.

20. Patkin AA , AL-Obaidi SH (2001) Influence Of Temperature And Pressure Of Incoming Oil-Containing Liquid From Field Wells On The Gas Separation Process. Journal of Petroleum Engineering and Emerging Technology, Volume 3, Issue 4, pp 20-24.

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