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DEPRESSOR ADDITIVE FOR OIL PUMPING

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Abstract: *The purpose of the research was to study rheological properties of Azerbaijani oils from the Sangachali and Muradkhanli fields. In order to improve rheological properties of the oil produced from the Muradkhanli and Sangachali fields, a Russian-made depressant СНПХ -2005 additive was used. To determine the optimal concentration of the СНПХ-2005 and confirm its positive effect on oil and oil products, control samples were prepared with this additive in oil M-8 and the oil from the above fields with the calculation of 0.5 kg/t, 0.8 kg/t and 1.0 kg/t. In parallel, similar samples were prepared with the depressant АзНИИ. The pour points of the samples were investigated at -5^{0}C, -10^{0}C and -20^{0}C on the rotational viscometer REOTECT-2. It found that the sample with the СНПХ -2005 additive (at the concentration of 0.8%) in the M-8 oil has a lower pour point (minus 40°C) as compared to a similar sample with the depressant АзНИИ (-32°C). The sample with the depressant СНПХ-2005 (at the concentration of 0.8%) and oil reveals the best rheological properties (minus 38°C versus -30°C). As a result of the studies carried out, it was determined that the introduction of the depressant СНПХ-2005 improves rheological parameters of the oil from the above fields, and thereby makes it possible to refuse additional heating in low temperature areas when pumping oil through the oil pipeline.*

Keywords*: rheological properties, Azerbaijan oils from the Sangachali and Muradkhanli fields, depressant СНПХ -2005, depressant АзНИИ.*
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Introduction

A significant proportion of the world's deposits are deposits of paraffinic oils. About half of them are highly paraffinic and ultra-high paraffinic oils, the production of which is becoming more and more important [1, 2].

Paraffin deposits reduce the useful section of the tubing and significantly complicate the oil pumping, increase power consumption, and result in increased wear and tear of equipment [3]. In order to eliminate such drawbacks, special additives are introduced into the oil, providing them with necessary rheological properties.

Highly paraffinic oils are rheologically complex fluids with a heterogeneous composition prone to structure formation with decreasing temperature [4].

For the transportation of highly paraffinic oils, depressants are often used to impede the formation of a single crystal structure of paraffin during oil cooling. The introduction of a depressant, even in small amounts, improves oil properties such as dynamic viscosity and shear stress. At the same time, the pour point decreases, the effective viscosity decreases, and thus, the rheological properties of oil are improved.

Results and discussion

The purpose of the research was to study rheological properties of Azerbaijani oils from the Sangachali and Muradkhanli fields.

As is known from the literature, the oil from the Sangachali area is paraffinic (7.5–8.0% paraffin), highly resinous (20–22% sulfuric acid

resins), low-sulfur (0.18–0.20% sulfur) and contains 46.0% of fractions boiling away at temperatures up to 350^0C [5]. The oil from the Muradkhanli area is also paraffinic (46.91% asphaltenes, 39.09% paraffin, 14.0% resin).

To improve the rheological properties of the oil produced from the Sangachali and Muradkhanli fields, a Russian-made CHПX-2005 depressant [6] additive was used. The depressant CHПX-2005 is a reagent of complex action and is designed to reduce the viscosity of solidification of highly paraffinic and/or high-viscosity oils during their production and transportation. The reagent prevents the formation of paraffin deposits on the surface of oilfield equipment, reduces the operating and starting pressure of pipes and increases their overhaul period.

The depressant CHПX-2005 dissolves in oil, does not contain organ chlorine compounds, and has high efficiency at relatively low temperatures [7].

Main characteristics of the depressor CHПX-2005:

Density at 20°C, kg/m^3	820-920;
Mass fraction of the active base, %	10-15;
Pour point, ^{0}C	from -2 to +7.

To determine the optimal concentration of the CHПX-2005 and confirm its positive effect on oil and oil products, control samples were prepared with this additive in oil M-8 and oil from the above fields with the calculation of 0.5 kg/t, 0.8 kg/t and 1.0 kg/t (Table 1). In parallel, similar samples were prepared with the depressant AзHИИ. The depressant AзHИИ is a dialkyl derivative of naphthalene [8]. The pour points of the samples were investigated at minus 5^0C, 10^0C and 20^0C temperatures ГOCT-20287-91 [9] and the dynamic viscosity at the rotation viscometer REOTECT-2.

Table 1. Pour point depending on the depressant concentration

Samples	Pour point °C, depending on the depressant concentration, %		
	0.5	0.8	1.0
1. M-8 + depressant CHПX-2005	-33	-40	-40
2. M-8 + depressant AзHИИ	-29	-32	-36
3. Oil (Sangachali) + depressant CHПX-2005	-30	-38	-37
4. Oil (Sangachali) + depressant AзHИИ	-27	-30	-34

It found that the sample with the CHПX -2005 additive (at the concentration of 0.8%) in the M-8 oil has a lower pour point (- 40°C) as compared to a similar sample with the depressant AзHИИ (-32°C). The sample with the depressant CHПX-2005 (at the concentration of 0.8%) and oil also shows the best rheological properties (-38°C versus -30°C).

The positive effect of the depressant CHПX -2005 can be explained as being due to the fact that in the process of catalytic cracking of oil, the hydrocarbon groups contained in the reflux enter into long-term interaction with the depressant to form persistent hydrocarbon groups which makes it possible to obtain sufficiently low pour points of oil and oil products.

As a result of the studies carried out, it was determined that the introduction of the depressant CHПX-2005 improves the rheological parameters of the oil of the above fields, and thereby makes it possible to refuse additional heating in low temperature areas when pumping oil through the oil pipeline.

To study the effect of oil samples on the dynamic viscosity, 0.8 kg / t and 1.0 kg/t of CHПX-2005 additive were added to the Muradkhanli and Sangachal oils. Measurements were at -5°C for commodities and 0.8 kg/t additive oils; at -10°C and -20°C, and at -5°C for commodities and oils with an additive of 1.0 g/t. The results are presented in Tables 2 and 3 and shown in Figure 1 and Figure 2.

Table 2. Changes in dynamic viscosity of Muradkhanli oil at different temperatures with/without additives CHПX-2005 0.8 kg/t and 1.0 kg/t

Speed stages	Dynamic viscosity of oil without additives and with 0.8 kg/t additive CHПX-2005, cP									Dynamic viscosity of oil without additives and with 1.0 kg/t additive CHПX-2005, sP		
	- 20 °C			- 10°C			- 5°C			- 5°C		
	Commercial oil	Oil with addition of additive	Viscosity reduction rate, %	Commercial oil	Oil with the addition of the additive	Viscosity reduction rate, %	Commercial oil	Oil with addition of additive	Viscosity reduction rate, %	Commercial oil	Oil with addition of additive	Viscosity reduction rate, %
la	657.3	563.4	14.3	939.0	751.2	20	1126.8	1408.5	0.04	1126.8	1038	7.9
2a	397	332	16.4	626.1	469.6	25.0	678.3	626.1	7.7	678.3	533	21.4
3a	247	195	21.1	397.5	288.0	27.5	406.9	469.5	7.7	406.9	336	17.4
4a	128	88	31.25	243.6	156.6	23.4	261.0	278.4	20.0	261.0	197	24.5
5a	80	62	22.5	135.6	83.5	23.7	177.3	166.9	35.3	177.3	116	34.6
6a	49	33	32.7	81.2	52.2	23.4	104.3	98.5	33.3	104.3	58	44.4
7a	27.8	13	53.2	48.7	34.8	25.9	69.5	69.6	40.0	69.5	38.3	44.9
8a	15.4	13.5	12.3	30.9	19.3	24.6	44.4	40.6	34.8	44.4	25.1	43.5
9a	13.9	8.2	41.0	19.7	11.6	20.8	31.3	25.5	37.1	31.3	17.4	44.4
10a	7.7	4.5	41.6	12.2	7.1	21.3	18.7	16.1	27.8	18.7	11.6	38.0
11a	5.8	3.1	46.6	7.7	5.8	11.7	10.8	10.8	21.3	10.8	6.4	41.0
12a	4.1	2.4	41.5	5.4	3.2	11.1	7.1	7.09	23.9	7.1	4.2	40.8
Dynamic viscosity values, sP	136.1	109.8	-	212.3	156.8	-	244.7	210.0	-	244.7	198.4	-
Average rate of viscosity decline,%			19.3			26.1			14.2			18.9

Table 3. Change in dynamic viscosity of Sangachali oil at the different temperatures without additives and with additive СНПХ-2005 0.8 kg/t and 1.0 kg/t

Speed stages	Dynamic viscosity of oil without additives and with 0.8 kg/t additive СНПХ-2005, cP									Dynamic viscosity of oil without the additives and with 1.0 kg/t additive СНПХ-2005, sP		
	- 20 °C			- 10°C			- 5°C			- 5°C		
	Commercial oil	Oil with the addition of the additive	Viscosity reduction rate, %	Commercial oil	Oil with addition of additive	Viscosity reduction rate, %	Commercial oil	Oil with addition of additive	Viscosity reduction rate, %	Commercial oil	Oil with addition of additive	Viscosity reduction rate, %
1a	657.3	525.8	20.0	751.2	559.0	36.7	1126.8	1126.8	0	1126.8	1154.8	2.5
2a	401.8	313.1	22.1	469.6	353.4	16.7	626.1	678.3	8.3	626.1	652.2	4.2
3a	219.1	156.5	28.6	288.0	260.2	11.9	375.6	406,9	8.3	375.6	391.3	4.2
4a	144.4	99.2	31.3	156.6	194.9	24.5	208.8	261.0	25	208.8	226.2	8.3
5a	73.02	46.9	35.8	83.5	120.0	43.7	114.8	177.3	54.4	114.8	156.5	26.6
6a	40.6	26.1	35.7	52.2	75.4	44.4	69.6	104.3	49.9	69.6	92.7	33.2
7a	27.8	24.3	12.6	34.8	48.7	39.9	41.7	69.5	66.7	41.7	46.9	12.5
8a	13.5	9.7	28.1	19.3	30.9	60.1	28.97	44.4	53.3	28.97	25.1	13.4
9a	6.96	7.0	-0.6	11,6	19.7	69.8	19.7	31.3	58.9	19.7	17.4	11.6
10a	3.9	3.9	0	7.1	11.6	63.4	13.5	18.7	38.5	13.5	11.0	18.5
11a	2.3	2.7	-17.4	5.8	7.1	22.4	8.5	10.8	27.1	8.5	7.3	14.1
12a	1.3	1.5	-15.4	3.2	4.7	46.9	5.4	7.1	31.5	5.4	4.9	9.6
Dynamic viscosity values, sP	132.7	101.4		156.9	140.1		201.3	178.0		201.3	232.28	
Average rate of viscosity decline,%			23.6			10.7			11.6			14.04

Table 1 shows the dynamic viscosity of Muradkhanli oil at different temperatures at minus 20°C, -10°C and -5°C, respectively, without the addition of 0.8 kg/t of CHПХ-2005 additive. As can be seen from the Table, the average viscosity reduction at minus 20°C is 19.3%, at - 20°C it is 26.1%, and at -5°C it is 14.2%. This indicates that at low temperatures, the effect of an excess oil flow decreases at all speeds; an increase in the rate of viscosity reduction at a temperature of -5°C is observed when the amount of added additive is increased to 1.0 kg/t (18.9;%).

The changes in the dynamic viscosity of Muradkhanli oil at temperatures of -5^{0}C, -10^{0}C, -20^{0}C without additives and with the addition of depressant CHПХ-2005 in the amount of 0.8 kg/t and 1.0 kg/t are reflected in Fig. 1 as well.

When comparing the results of samples of 0.8 kg/t and 1.0 kg/t of Sangachal oil additive at -5°C, it becomes clear that the average decrease in the viscosity of Sangachali oil reduces due to the increase in the amount of additive (Table 3). That is, the viscosity of high-paraffin oil depends on the amount of additive added to it, and the additive affects the structural changes that occur in this oil at low temperatures. This qualitative change is more evident in Fig. 2.

Thus, summarizing the research results it was dete6rmined that the addition of CHПХ-2005 additive to the high-viscosity oils from the Muradkhanli and Sangachali fields of Azerbaijan under study significantly reduces the dynamic viscosity of these oils.

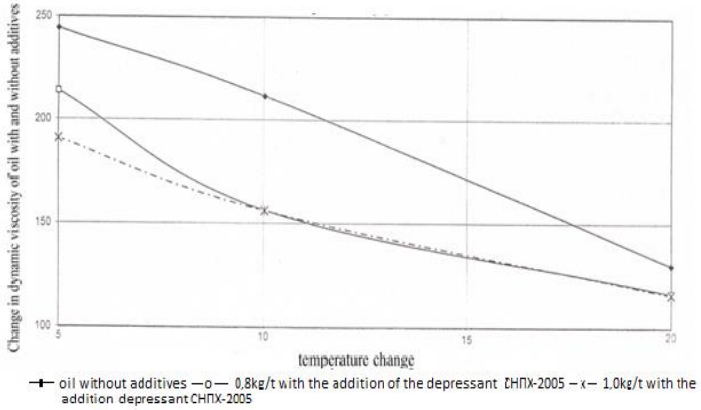

Fig. 1. Changes in the dynamic viscosity of Muradkhanli oil at the temperature of -5, -10 and -20^{0}C without additives and with the addition of the depressant CHПХ-2005 in an amount of 0.8 kg/t and 1.0 kg/t

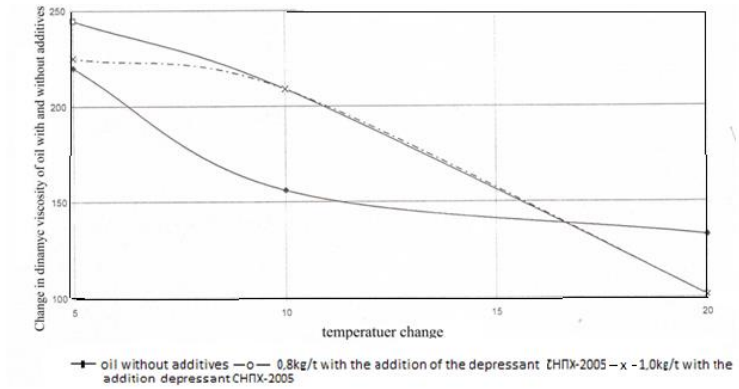

Fig. 2. Changes in dynamic viscosity of Sangachali oil at the temperature of -5, -10 and -20^{0}C without additives and with the addition of the CHXП-2005 depressant in the amount of 0.8 kg/t and 1.0 kg/t

Conclusion

As a result of the studies performed, it was determined that the introduction of the CHПX-2005 depressant improves the rheological parameters of oil from the Muradkhanli and Sangachali fields to thereby make it possible to refuse additional heating in low temperature areas when pumping oil through the oil pipeline.

Addition of CHПX-2005 additive to the high-viscosity oils of Azerbaijan reduces the dynamic viscosity of these oils.

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NEFTİN NƏQL EDİLMƏSİ ÜÇÜN DEPRESSATOR

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Tədqiqatın məqsədi Səngəçal və Muradxanlı yataqlarından cıxarılan Azərbaycan neftinin reoloji xassələrini öyrənməkdir. Səngəçəl və Muradxanlı yataqlarından çıxarılan neftin reoloji xassələrini yaxşılaşdırmaq üçün Rusiya istehsalı olan CHПX-2005 depressor aşqarından istifadə edilmişdir. CHПX-2005-in optimal qarılığını təyin etmək və onun neft və neft məhsullarına müsbət təsirini təsdiq etmək üçün bu aşqar ilə M-8 yağında və göstərilən yataqlardan cıxarılan neftlərdən 0.5 kq/t., 0.8 kq/t və 1.0 kq/t hesabı ilə sınaq nümunələri hazırlanmışdır. Paralel olaraq AзНИИ depressatoru ilə də anoloji nümunələr hazırlanmışdır. Nümunələrin donma temperaturu mənfi 5^0C, mənfi 10^0C və mənfi 20^0C temperaturlarda PEOTECT-2 fırlanan viskozimetrində tədqiq edilmişdir. M-8 yağında CHПX-2005 aşqarı olan nümunənin (0.8% qatılıqda) AзНИИ depressatoru ilə anoloji nümunəyə (mənfi 32°C) nisbətən daha aşağı donma temperaturuna (mənfi 40°C) malik olduğu aşkar edilmişdir. CHПX-2005 depresssatoru yağda (0.8% qatılıqda) həmçinin yaxşı reoloji xassələr göstərir (mənfi 38°C ilə mənfi 30°C temperaturlarda). Aparılan araşdırmalar nəticəsində məlum

oldu ki, СНПХ-2005 depressatorunun tətbiqi göstərilən yataqların neftinin reoloji parametrlərini yaxşılaşdırır və bununla da aşağı temperaturlu zonalarda nefti nəql edərkən neft kəmərinin əlavə qızdırmasına ehtiyac qalmır.
Açar sözlər: reoloji xassələr, Səngəçəl və Muradxanlı yataqlarından Azərbaycan nefti, СНПХ-2005 depressantı, АзНИИ depressantı

ДЕПРЕССОРНАЯ ПРИСАДКА ДЛЯ ПЕРЕКАЧКИ НЕФТИ

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Целью исследования было изучение реологических свойств азербайджанских нефтей месторождений Сангачал и Мурадханлы. Для улучшения реологических свойств нефти месторождений Сангачал и Мурадханлы использовалась депрессорная присадка СНПХ-2005 российского производства. Для определения оптимальной концентрации СНПХ-2005 и подтверждения его положительного воздействия на нефть и нефтепродукты были приготовлены контрольные пробы с этой присадкой в масле М-8 и нефти указанных месторождений из расчета 0.5 кг/т, 0.8 кг/т и 1.0 кг/т. Параллельно готовили аналогичные образцы с депрессантом АзНИИ. Температуру застывания образцов исследовали при -5^0C, -10^0C и -20^0C на ротационном вискозиметре РЕОТЕСТ-2. Установлено, что образец с добавкой СНПХ-2005 (при концентрации 0.8%) в масле М-8 имеет более низкую температуру застывания (-40°C) по сравнению с аналогичным образцом с депрессором АзНИИ (-32°C). Образец с депрессантом СНПХ-2005 (в концентрации 0.8%) и маслом также показывает лучшие реологические свойства (-38°C против -30°C). В результате проведенных исследований установлено, что введение депрессора СНПХ-2005 улучшает реологические параметры нефти указанных месторождений и тем самым позволяет отказаться от дополнительного нагрева в низкотемпературных зонах при перекачке нефти через нефтепровод.
Ключевые слова: реологические свойства, азербайджанская нефть месторождений Сангачал и Мурадханлы, депрессант СНПХ -2005, депрессант АзНИИ.