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Results of Industrial Tests and Implementation of the Nanodemulsifier “IKHLAS” -1 in Cleaning Oil from Water And Water From Oil at the Field of “Phystech II”.

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ABSTRACT. The article presents results of industrial tests and implementation of the nanodemulsifier “IKHLAS”-1 in cleaning oil from water and water from oil in the conditions of primary preparation of oil at the field of “Phystech II”. A general formula for calculating the specific consumption of demulsifiers for all deposits and for all demulsifiers has been proposed.

KEYWORDS: nanodemulsifier "IKHLAS" -1, oilfield nanotechnology, cleaning oil from water and water from oil, JS “Phystech II”.

I. INTRODUCTION

Grounds for conducting the experimental industrial tests (EIT):

The grounds for conducting the PGI were: The results of laboratory tests (bottl-tests) on the selection of a new demulsifier, carried out by the specialists of TOO "IOS KZ" (10.27.2016-05.12.2016) and the corresponding "Technical Report", presented in JSC “Phystech II”.

Information on the patentability of the demulsifier “IKHLAS”-1:

The novelty of the demulsifier “IKHLAS” -1 was defended by the employees of “IOS Kz”, "MMG" RK and with the Azerbaijan State University of Oil and Industry by the innovative patent No. 30960 of the Republic of Kazakhstan (registered in the State Register of Inventions of the Republic of Kazakhstan dated 02.19.2016) [7].

Information on the implementation of nanodemulsifier “IKHLAS”-1 in other fields:

Currently nanodemulsifier “IKHLAS”-1 successfully implemented in four oil fields of the Republic of Kazakhstan.

II. LITERATURE SURVEY

At a late stage of field exploitation, the production of oil wells, consisting of oil, gas, produced water and mechanical impurities (MP), is a four-phase multicomponent system [1]. These components in production wells are capable of forming water-oil or reverse emulsions, oil-water or direct emulsions, multiple or medium emulsions, water-oil suspensions, oil-water suspensions (hereinafter referred to as such systems in brief we call oil colloids), which were and are the subjects of basic research of classical and modern colloid chemistry and are also of great practical importance for the primary preparation of oil [2-5].

The persistence of water-oil emulsions is imparted by the formation on the surface of droplets of the dispersed phase by the adsorption-solvate layers of natural emulsifiers, which include naphthenic acids and their salts, low molecular weight and high molecular resins, asphaltenes, solid mineral and organic substances. The main physical properties that

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determine the stability of oil emulsions include: density, viscosity, dispersion of water droplets and mechanical impurities of inorganic and organic origin [6], which are more characteristic of the JS “Phystech II” oil field. The stability of polydisperse water-oil emulsions, in addition to the above physical parameters, is determined also by the concentration of micro-, nano-emulsions, i.e. structuring of systems occurs, resulting in increased viscosity and durability of oil-water emulsions, and thus there are some difficulties in the primary preparation of oil. It is known that the existing demulsifiers are mainly used for the destruction of oil-water (inverse) emulsions, and other types of oil colloids, depending on the nature of the oil, can create certain problems during the primary preparation of oil. For example, direct emulsions determine the degree of contamination of produced water with oil, which is utilized for a reservoir pressure maintenance (RPM) system at the oil field. Multiple emulsions in primary preparation of oil (PPO) technology are potential sources of the formation of hard destructible water-oil emulsions (HDWOE), hard destructible water-oil suspensions (HDWOS), viscous-elastic systems (VES) and of trap oil sludge (TOS). These systems pose a potential threat to the environment. For example, in practice PPO at shop for primary preparation of oil (SPPO) Zhetybaimunaygaz of JSC Mangistaumunaigas, JV Tenge LLP and the Arystanovskoye field of Ken-Sary LLP are formed by HDWOE, HDWOS. For the first time, we found that, at the SPPO of JSC Ozenmunaygaz except the HDWOE and HDWOS, are also being formed the VES, with deteriorated rheological properties that can create very serious complications during the PPO. With of the experiences conducted experimental-industrial tests (EIT) and implementations at the fields of MMG JSC (“Zhetybaymunaygaz”), LLP “Tenge Oil and Gas” and “Arystanovskoye” LLP “Ken-Sary” unambiguously established that, not happening formation of HDWOE and HDWOS after applying the nanodemulsifier “IKHLAS”-1 [3]. Similar results were also obtained by laboratory testing of oil emulsions of the “Uzen” field of “OMG” JSC, with the result that “IKHLAS”-1 was recommended for carrying out EIT. We found for the first time that LNSH, which is formed in a water reservoir at the CSPP of the “Karazhanbasmunai” JSC, enters as an emulsifier, and the basic demulsifier does not cope with the requirements of regulations, as a result of which is violated the technological regime of the preparation of crude oil, as well as the mode of timely delivery of commercial oil of oil. In addition, issues of wastewater disposal to RPM in the development and operation of oil fields is also of great interest in oil production practice, since wastewater for injection into the reservoir must meet certain regulatory requirements for the design of development oil field. One of the noted requirements is the regulatory limit (not more than 50 mg/l) on the oil content in the composition of oilfield wastewater for RPM. Based on the above mentioned problems of the APU, the representatives of the new generation of highly efficient demulsifiers (or the so-called nano demulsifiers), in our opinion, should have the following properties:

- to form a nanostructure with extremely high surface activity relative to interphase processes occurring in systems of oil colloids;
- highly effective demulsifiers and desuspensors (the term “desuspensor” was first used by us) for oil-water and oil-water emulsions and in general for all types of oil colloids.

In this regard, the development and implementation of the most highly efficient demulsifiers is an urgent task of modern oilfield nanotechnology for many fields, including for the “Phystech II” JSC field.

III. EXPERIMENTAL RESULTS AND DISCUSSION

On the complex of installations (such as horizontal settlers) of preliminary primary oil preparation (CPPOP) of the “Phystech II” field on the period 12.04.17-17.04.17 were held experimental industrial tests (EIT) of the demulsifier IKHLAS -1 developed together by specialists and scientists of “International Oil Services Kazakhstan” LLP, “Mangistaumunaygas” JSC and the Azerbaijan State University of Oil and Industry [7]. Before of the EIT, the specific consumption of the base demulsifier was 220 g/t, at oil heating temperatures of up to 65-75 °C by the method of circulation through furnaces. The following factual the specific consumptions of “IKHLAS”-1 at 60–70°C (oil temperature at the end of circulation) were tested during the EIT: 221.1 g/t; 181.8 g/t; 142.6 g/t; 93.0 g/t.. The duration of each test averaged 1 day. Settling averaged 45-60 minutes. The residual water results were 0.2-0.5%, which are consistent with the results of JV “Arman” LLP. During the EIT, experiments were performed at the Dean-Stark facility after 2–3 hours of sedimentation. The residual water content was 0.05-0.19%. Consequently, the dehydration of oil or

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the process of demulsification under the conditions of OPI of the demulsifier “IKHLAS”-1 on the field of “Phystech II” is almost completely completed, then only sludge in the tanks of JV “Arman” LLP is required.

To calculate the specific consumption (S_c) of demulsifiers in the oilfields, by us proposed a generalized empirical formula:

$$S_c = (\Delta H_i \cdot 1000 \cdot \rho \cdot K \cdot 24) / (m_{dp} \cdot \Delta \tau_i) \quad (1)$$

where:

1000 is the transition from kg to g;

S_c is the specific consumption of the demulsifier, g / t;

ΔH_i is the changes in the calibration level of the demulsifier on the dosing unit block, for a certain period of time $\Delta \tau_i$ (hours), cm;

ρ is the density of the demulsifier, g / cm³;

K is the equivalent of the demulsifier volume (l) per 1 cm;

24 is the hours per day;

m_{dp} is the daily production, t;

$\Delta \tau_i$ is the time interval, which corresponds to ΔH_i , hours

Taking into account the values of some constant values ($\rho = 0.93$ g/sm³; $K = 4l$; $m_d = 180$ tons) of formula (1), a simpler formula was obtained for the emergency calculation of the specific consumption of the nanodemulsifier “IKHLAS”-1 for the “Phystech II” deposit:

$$S_c = (496 \cdot \Delta H_i) / \Delta \tau_i \quad (2)$$

The specific consumption of the demulsifier was also determined by the traditional oilfield method. As follows from the table, the results of both methods are 100% identical. Estimation by the field-method is usually carried out within a day (24 hours), and according to the IOS Kz-ASUOI formula (2), the S_c values can be determined at $\Delta \tau \geq 2$ hours, and much faster than by the field method. Practical accuracy of the data according to the formula (2) was confirmed also by an experienced process engineer of “Phystech II”.

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Table: Comparative data on the specific consumption of the demulsifier, depending on the duration of the dosage and changes in the level of the demulsifier in the dosing block

date	duration of dosing ($\Delta\tau_i$), h	the change in the level of the demulsifier in the dosing unit (ΔH_i), sm	determination of specific consumption, g/t		error, %
			by oil-field technique	according to the formula IOS Kz-ASUOI	
12.04.17	4	1.8	-	223.2	-
	6	2.7	-	223.2	-
	8	3.6	-	223.2	-
	12	5.3	-	219.0	-
	24	10.7	221.1	221.1	0
13.04.17	6	2.2	-	181.8	-
	12	4.4	-	181.8	-
	24	8.8	181.8	181.8	0
14.04.17	6	1.7		140.5	-
	12	3.4		140.5	-
	24	6.9	142.6	142.6	0
15.04.17	6	1.1		90.9	-
	12	2.2		90.9	-
	24	4.5	93.0	93.0	0

The residual water in the oil samples after settling (30-60 min) was determined on a VSN-L instrument (laboratory crude oil moisture meter) in the Method-1 mode (sample humidity is up to 60%). When sampling, was immediately determined the temperature of the oil . Photographs of some measurements on the VSN-L are presented in Fig. 1 and 2. The dependences of residual water concentrations (C_{rw} , %) on oil temperature and on settling time after thermochemical preparation at the “Phystech II” JSC field are identical (Fig.3 and 4). Sharp kinks on the $C_{rw} = f(T)$ curve are observed at 54 ° C and 58 ° C (Fig. 3). Therefore, in order to satisfy the water standard (not more than 0.5%) for the thermochemical preparation of oil at the CPPOP of the “Phystech II” JSC, the oil temperature at the settling must be at least 56 °C. The kinks along the curve of the dependence of $C_{rw} = f(\tau)$ correspond to $\tau = 40$ minutes and $\tau = 50$ minutes (Fig. 4). Therefore, for normal preliminary preparation of oil, the sludge time after thermochemical processing of oil must be at least 40 minutes.

IV. CONCLUSIONS

Based on the results of the EIT, certain technological and economic benefits were established (a twofold reduction in the specific consumption of the demulsifier and a decrease in the preparation temperature by 5 °C) the advantages of the “IKHLAS”-1 nanodemulsifier compared with base demulsifier SNPCH-4315D. Therefore, “IKHLAS” -1 was recommended (with an optimal dosage of ~ 100 g / t) for introduction at the “Phystech II” field. Currently, nanodemulsifier “IKHLAS”-1 is being successfully introduced at the “Phystech II” with a dosage of ~ 100 g/t.

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Figure.1. The result of measuring the concentration of residual water after thermochemical treatment of the oil-water emulsion using the nanodemulsifier “IKHLAS” -1 (at a dosage of 90.9 g/t).

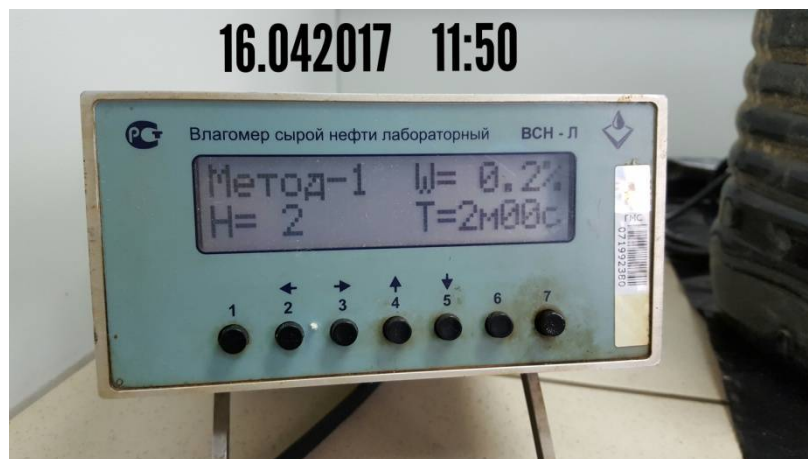


Figure.2. The result of measuring the concentration of residual water after thermochemical treatment of the oil-water emulsion using the nanodemulsifier “IKHLAS” -1 (at a dosage of 99.2 g/t).

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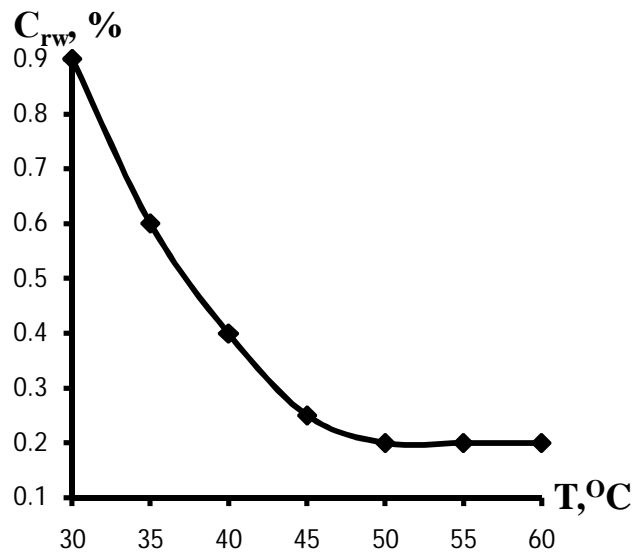


Figure.3. Dependence of residual water in oil on oil temperature (with Sc = 93-221 g / t; e = 30-60 minutes).

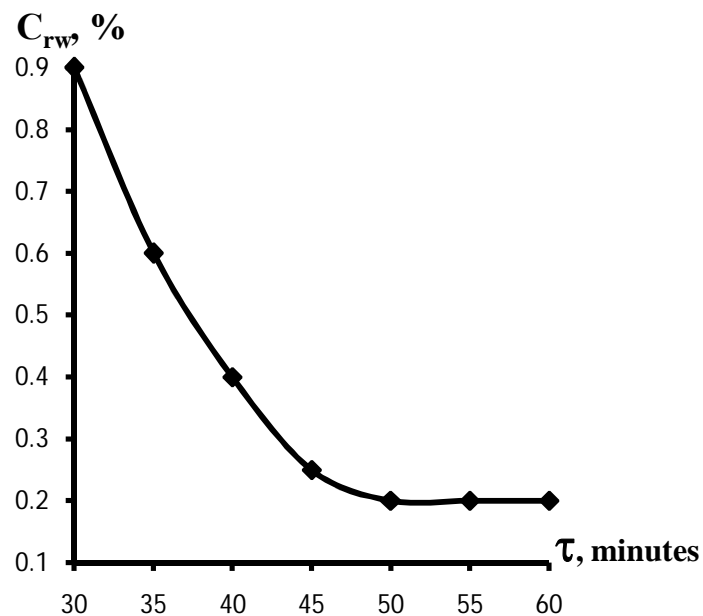


Figure.4. Dependence of residual water in oil on sludge time (with Sc = 93-221 g/t; T = 56-66 °C).

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