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ИССЛЕДОВАНИЕ СВОЙСТВ ВОДОНЕФТЯНЫХ ЭМУЛЬСИЙ ПРИ ЭКСПЛУАТАЦИИ СКВАЖИН УЭЦН

Ишалина А.Э., Такиуллина Э.И., Зиятдинова Н.А.

ФГБОУ ВО «Уфимский государственный нефтяной технический университет»

E-mail: nastya_ishalina@mail.ru , takiullina.elmira@yandex.ru

В данной работе представлен механизм образования эмульсий в погружных электроцентробежных насосах. Подробно рассмотрен процесс диспергирования и коалесценции водоняфтных эмульсий. Описаны проведенные лабораторные исследования и полученные результаты.

Ключевые слова: УЭЦН, Арланское месторождение, вязкость, разделение эмульсий, устойчивость, дисперсная среда, глобула, несмешивающаяся между собой жидкость, полидисперсные эмульсии обратного типа.

THE STUDY OF THE WATER-OIL EMULSIONS PROPERTIES WHEN OPERATING ESP WELLS

Ishalina A.E., Takullina E.I., Ziyatdinova N.A.

This paper presents the mechanism for the formation of emulsions in submersible electric centrifugal pumps. The process of dispersing and coalescence of water-in-oil emulsions is considered in detail. The laboratory researches and their results are described.

Keywords: ESP, Arlan field, viscosity, emulsion separation, stability, dispersed phase, globule, immiscible fluid, polydisperse emulsions of the inverse type.

There are no emulsions in the productive strata, they are formed only during production, namely in the place, where the phases are intensively mixed (in submersible pumps, where the pipeline section changes, in chokes during quick turns).

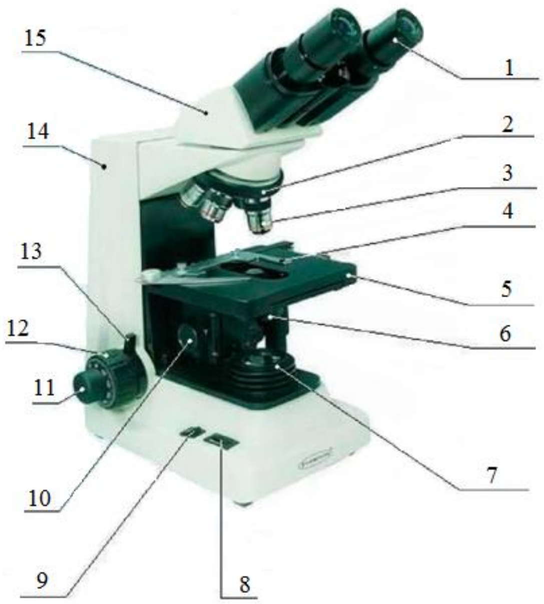
Oil emulsions, presented as a mass of the smallest water droplets dispersed in an oil medium, which is an external continuous phase, are inverse-type emulsions. Direct type emulsions are oil in water. There are also double emulsions or multiple emulsions. This type is appropriate for inverse emulsions, which contain inclusions of direct emulsions and vice versa. Usually, such emulsions are characterized by a high content of mechanical impurities [1].

Oil emulsions are polydisperse systems, i.e. systems containing particles of different sizes.

Determination of oil-water emulsions dispersion

When lifting products, dispersion and coalescence of water-in-oil emulsions occur in the wellbore, as temperature and pressure change. This also leads to changes in product properties. Significant changes occur in electric centrifugal pumps. The studies of the effects of lifting conditions on the properties of products have been conducted, as this may affect the efficiency of pumping equipment.

In our experiments we used fresh distilled water and the Arlan field's oil. We took the proportion of 50% water to 50% oil. In order to prepare the emulsion, we used a mechanical method of dispersion using a blade-paddle stirrer (at a speed of 1700 rpm). In such a way we modeled the process of mixing oil and water, which occurs in an electric centrifugal pump [2].



1-ocular; 2-revolving arrangement; 3-lens; 4-substage; 5-object table; 6-condenser; 7-illuminating lens mount; 8-lamp voltage regulator; 9-microscope toggle on / off; 10-handle for moving the condenser up and down; 11-fine focus handle; 12-coarse focus handle; 13-restraint table displacement handle; 14- tripod; 15-binocular adjustment.

Figure 1 - Microscope Labomed 2 option-1

We mixed the emulsion for 2-60 minutes. 6 experiments with different time of emulsion mixing were conducted: for 2 minutes, 5 minutes, 10 minutes, 30 minutes, 60 minutes. For each experience, a new portion of oil and water was taken. The maximum and minimum diameters of the globules were determined by using a Labomed 2 option-1 microscope (with a resolution of at least ´250); and a digital video camera 2) The DCM130E digital camera (in conjunction with an x10 lens allows to achieve resolution of ´630) [3,4].

The dispersion of the emulsion is determined by its visual observation under a microscope. For a quantitative assessment, direct measurements of the sizes of dispersed particles (globules) are necessary. The results are presented in Figure 2.

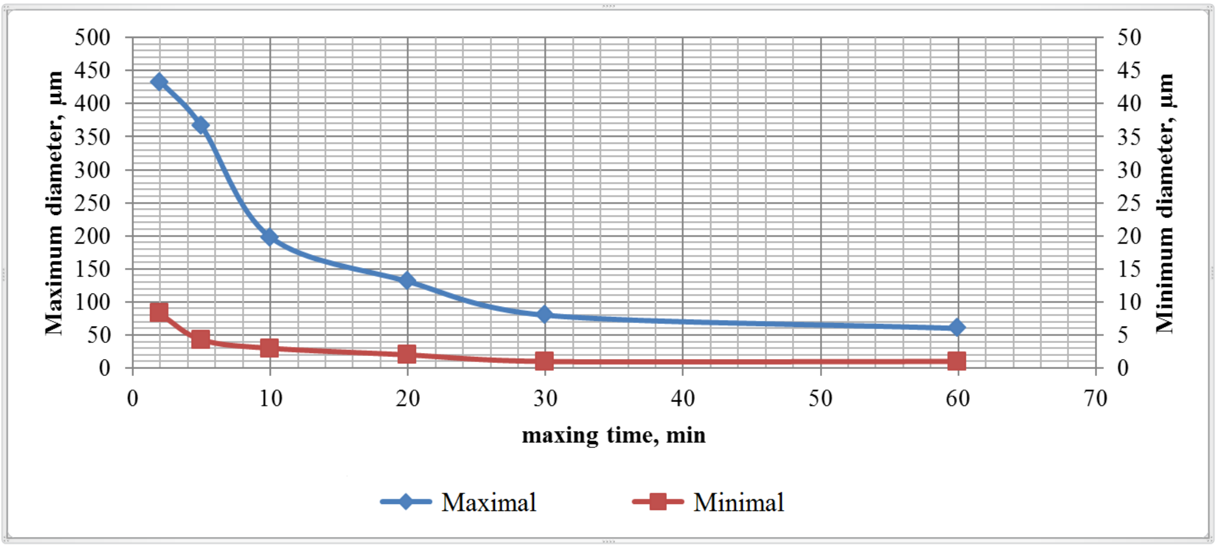
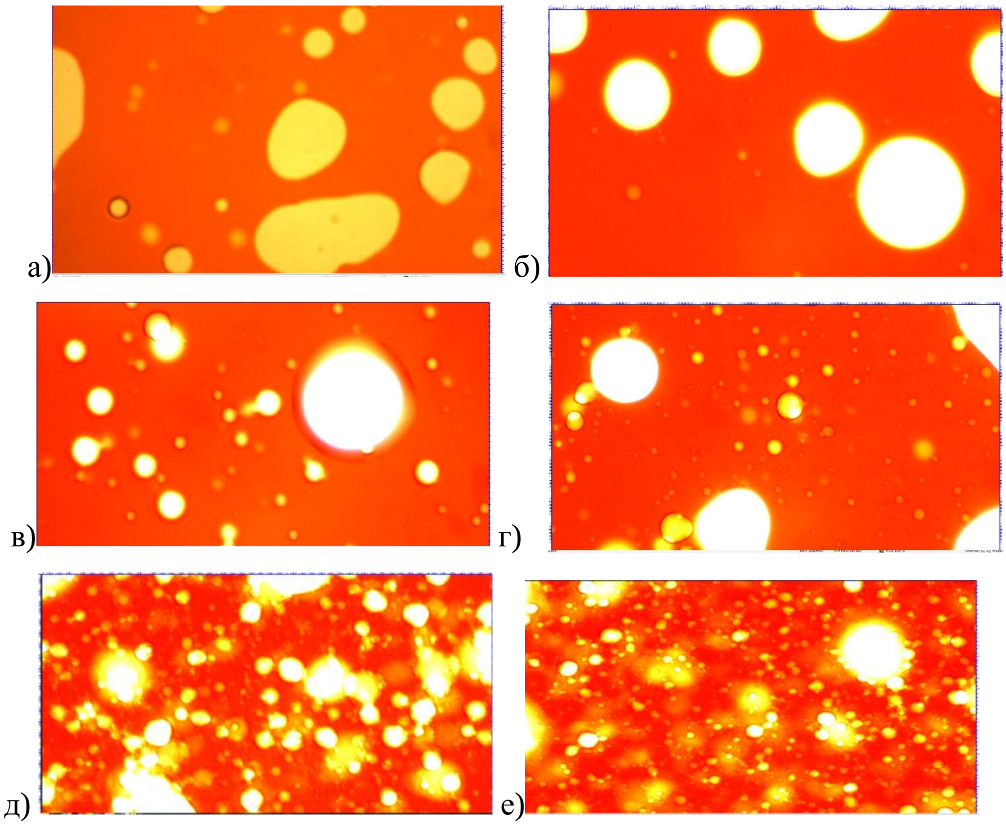


Figure 2 - The dependence of the globules diameters (maximum and minimum) from the mixing time



a) 2 minutes; b) 5 minutes; c) 10 minutes; d) 20 minutes; e) 30 minutes; e) 60 minutes

Figure 3- the pictures of oil-in-water emulsions with different mixing time taken under a microscope.

The pictures show that when the mixing time is short, the particles are larger; then more drops with a smaller diameter appear.

The highest degree of globules fragmentation was traced when the mixing time was longer than 30 minutes; this can be seen on the graph and in the pictures. Then the emulsion was being mixed for 60 minutes, while this duration provided an emulsion with the most developed interfacial area.

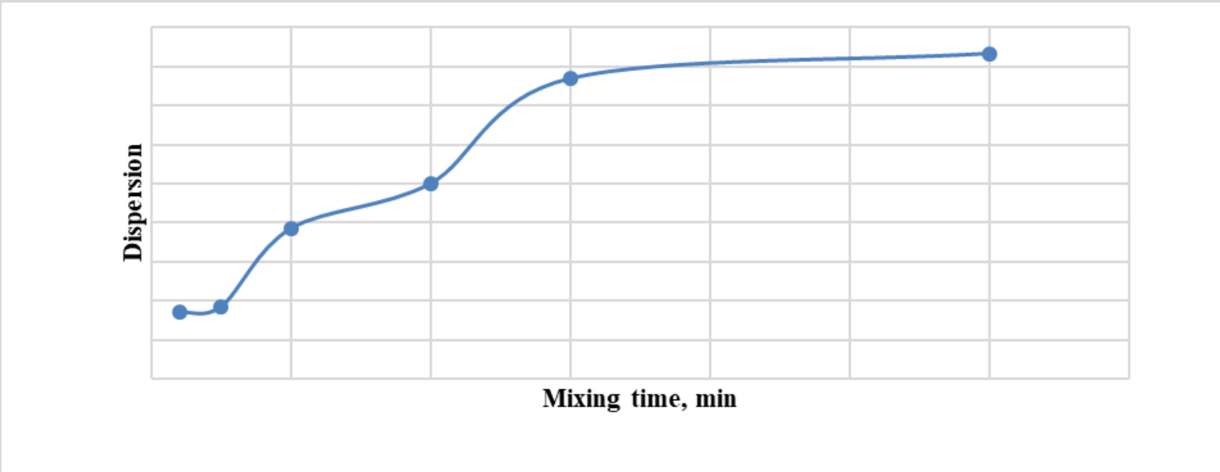


Figure 4 - Dispersion of the mixing time

If we continue to increase the intensity and time of mixing, it will not have a strong impact on the globules size.

The analysis of the results allows us to assume that for the formation of highly dispersed oil-in-water phase in the pump, one foot of the pump will be enough for the first 30 minutes of dispersion [5].

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