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(E-mail: edigemus@mail.ru)***Analysis of the effectiveness of dispersant for oil spills**

The acceptability and effectiveness in some situations, the practical application of dispersants for oil spill at sea is now well recognized and recorded in official documents in many countries and international organizations. To evaluate the quality offered to control the oil spills dispersants in our laboratory studies were conducted using the recommended techniques. Studies have been conducted on the impact of the proposed dispersant Kashagan oil in sea water of the Caspian Sea. On the basis of research has been done evaluating the effectiveness of dispersants at 5 °C, 25 °C and is given recommendation for their use.

Key words: crude oil, topped oil, oil spill, emulsification, dispersants, salinity, viscosity, density.

Oil and petroleum products are a significant reasons of environmental pollution, particularly water of oceans and seas [1]. Contact with petroleum hydrocarbons in the marine environment has a negative impact on almost all of its components, including fisheries, phyto- and zooplankton, algae, benthos, marine mammals and birds [2, 3].

One of the most important means for the elimination of accident consequences are dispersants which are designed to dissipate (emulsification) floating oil slicks in a large volume of water in the form of crushed oil droplets. When this is achieved by lowering the concentration of oil in the vicinity of the spill, enhanced biodegradation processes of pollution of the marine environment is restored interaction with the atmosphere, reduced fire hazard spill, preventing the possibility of contamination of the coastal strip, emersion of «chocolate mousse» [4, 5].

In connection with the prospects of oil production in the Kazakhstan sector of the Caspian Sea (KSCS), the question arises about analysis opportunities and the efficient use of different dispersants for oil spills [6].

The purpose of this study was to evaluate the effectiveness of a number of dispersants towards the Kashagan oil using artificial sea water of different salinity at different ambient temperatures. In the experiments were used Kashagan oil, artificial seawater (salinity 0, 6, 12, 18, 35 ‰), dispersants of various manufacturers: Corexit EU 9500, Dasic Slickgone, Inipol IP- 90, Inipol IPF, FLD-1, FLD-2, Bioversal HC (Table 1).

Table 1

Several dispersants accepted for use in oil spills

Dispersant	Approved for use in the following countries:
Corexit EU 9500	France (for use at sea), UK, USA
Inipol IP-90	France (for use at sea)
Inipol IPF	France (for use in freshwater)
Dasic Slickgone NS	France (for use at sea), the UK, Cyprus, Norway
Bioversal HC	Italy, Spain

Oil spills on water natural weathering processes occur light petroleum oil fractions, so test the effect of dispersants in the model is carried out under reduced crude.

Topped oil fraction was obtained at atmospheric pressure by ST RK ISO 3405–2008. Crude and topped oil tested for viscosity and density to determine the suitability of dispersants at the temperature 5–25 °C. Kinematic viscosity of crude and topped oil measured capillary viscometer IWF-2. Density was determined by areometers.

Kinematic viscosity of Kashagan oil — 11,6 mm²/s², density — 0,846 g/cm³.

Topped oil at 250 °C oil is too high in viscosity and is not suitable for further work. Oil topped in a temperature range up to 220 °C at ambient temperature of 5 °C solidifies and becomes uncomfortable for the study. Thus, the test proved to be suitable oil, topped at 200 °C (Table 2).

Conducted to determine the effectiveness of dispersants according to the procedure adopted in the UK as the standard for analysis of dispersants, WSL 448 LR [7].

Kinematic viscosity and density of reduced crude

№	Distillation temperature, °C	Measurement temperature, °C	Density, g/cm ³	Viscosity, mm ² /s ²
1	200	20	0,862	12,1
2	220	20	0,870	16
3	250	20	1,014	559,9
4	200	5	0,870	15,4
5	220	5	0,880	Not measured

Efficiency index dispersant defined as the mass fraction of the oil were tested, which is dispersed as fine droplets in the aqueous phase at the test conditions.

The concentration of oil in water was measured by an extraction-photometric method: oil dispersed in the aqueous phase was extracted with chloroform, and then the optical density of the oil chloroform solutions at 580 nm. For operation was used the spectrophotometer UV-1800, a light absorbing layer length — 10 mm. Oil concentration was determined using the calibration curve — dependence of the optical absorption of the oil concentration of the solution in chloroform (Fig. 1).

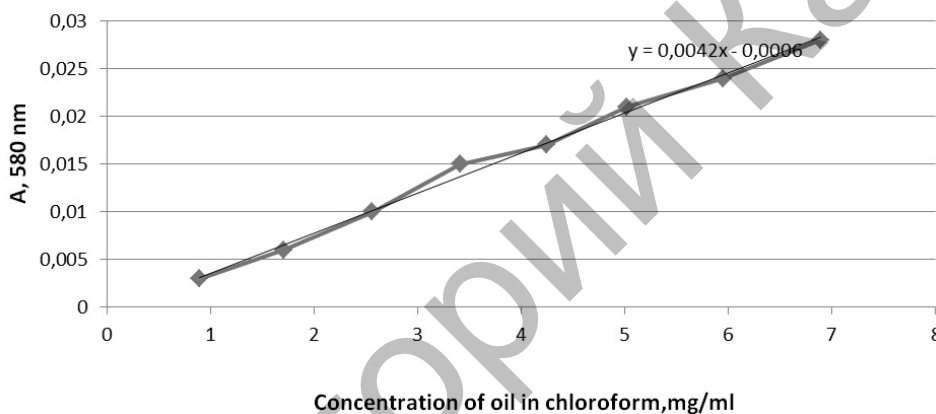


Figure 1. Calibration graph of optical density the concentration of the oil in chloroform (oil, topped at 200 °C)

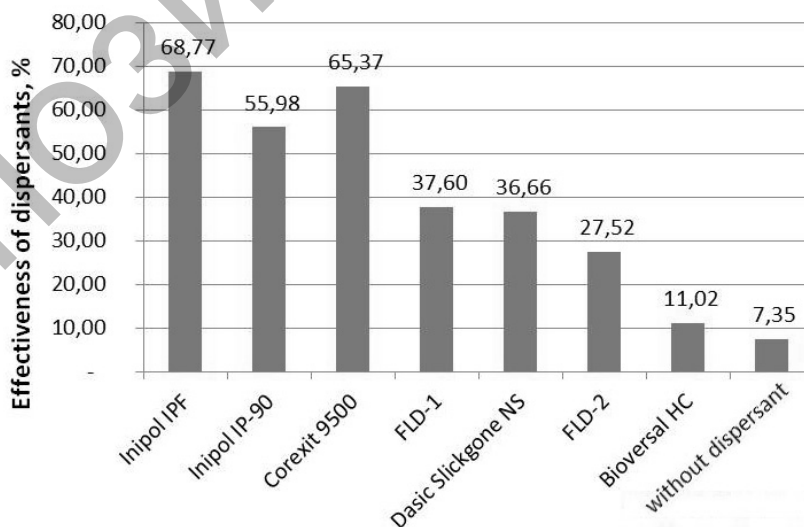


Figure 2. Effectiveness of dispersants at 25 °C, salinity 16 %

Thus, for selected conditions, in particular at a temperature of 25 °C and salinity 16 % dispersant is most effective mark Inipol IPF, followed dispersants Corexit 9500, Inipol IP-90. FLD-1, Dasic Slickgone

NS, FLD-2 and Bioversal HC dispersants are weakly dispersing agents for the Kashagan oil under these conditions (Fig. 2).

Effectiveness of dispersants is strongly dependent on the ambient temperature (Fig. 3, 4).

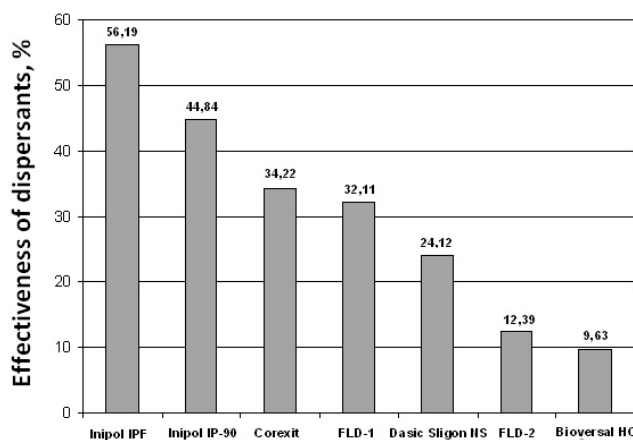


Figure 3. Effectiveness of dispersants at 5 °C

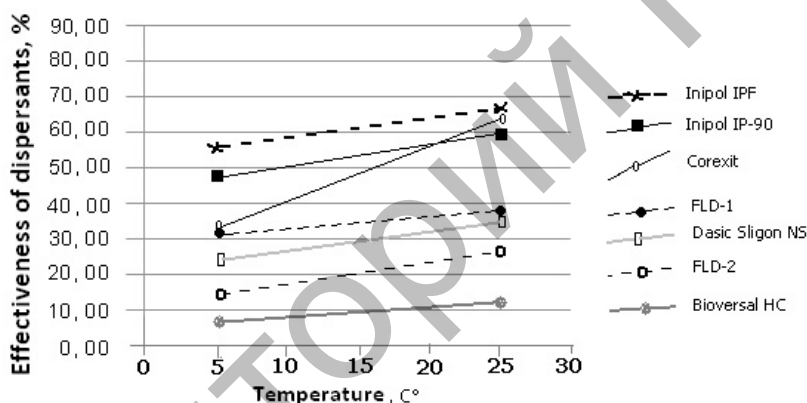


Figure 4. Dependence of the efficiency of dispersants by temperature

The effectiveness of dispersants increases with increasing temperature, while the differences in the efficiency of dispersants are stored — the most effective dispersant Inipol IPF, hereinafter — Inipol IP-90, FLD-1, and least effective dispersants — FLD-2, Bioversal HC.

Dispersants are manufactured primarily for use in ocean waters with an average salinity of 35 ‰. Salinity of the Caspian Sea below the ocean, especially in the KSCS which varies in the range 6–16 ‰. Therefore, we conducted research on the effectiveness of dispersants for different values of salinity in the range of 0–35 ‰ (Table 3).

Table 3

Comparison of the dispersants effectiveness at different salinities (25 °C)

Salinity, ‰	Dispersants					
	Inipol IPF	Inipol IP90	Corexit9500	Bioversal HC	Dasic Slickgone NS	Without dispersant
0	18,23	17,31	18,92	5,34	9,94	3,87
6	38,49	33,88	44,93	10,86	18,23	8,7
12	60,58	42,17	51,38	20,07	30,20	6,28
16 (sea water, Aktau)	68,77	48,85	65,37	11,02	36,66	7,35
35	55,06	41,25	95,57	9,02	86,36	3,87

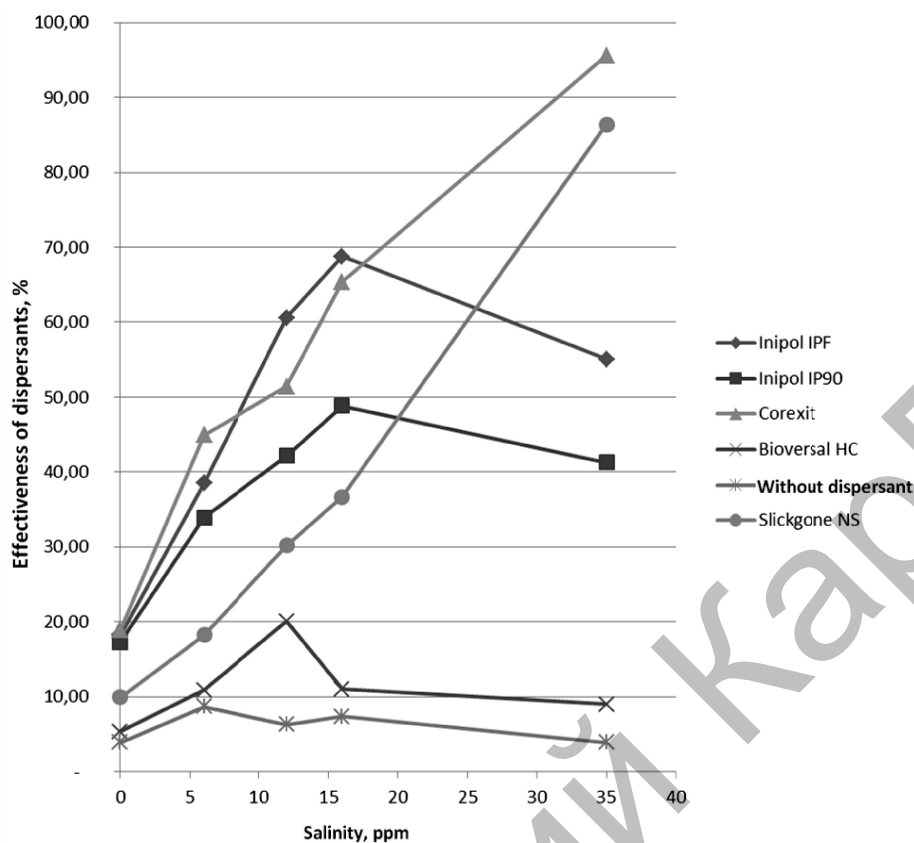


Figure 5. The dependence of the efficiency of dispersants depending on the salinity of the water

As can be seen, salinity of water influences different to the effectiveness of dispersants. Most effective in saltwater ocean with corresponding 35 ‰ are Corexit 9500 and Dasic Slickgone NS. However, their effectiveness at a salinity of the Caspian Sea (from 6 to 16 ‰) is significantly reduced, while Corexit 9500 is one of the preferred dispersants and Dasic Slickgone NS sharply reduces its effectiveness with 86,36 to 36,66 %.

The most effective at salinity of the Caspian Sea (from 6 to 16 ‰) can be considered Inipol IPF and Corexit 9500. Inipol IP-90 is less effective than the above Inipol IPF and Corexit 9500. Dasic Slickgone NS, Bioversal HC and FLD-1, FLD-2 for the Caspian Sea are unacceptable due to low efficiency values (Fig. 5).

Conclusions

1. Effectiveness of dispersants.

At a temperature of 25 °C and 16 ‰ salinity is the most effective dispersant brand Inipol IPF, whose efficiency is 77,84 %, followed by dispersing Inipol IP-90 — 55,10 % and FLD-1 — 45,01 %. Dispersants FLD-2 — 27,03 % and Bioversal HC — 20,77 % are weakly dispersing agents for the Kashagan oil under these conditions. It should be noted that in the absence of dispersants, natural conditions give 14,62 % of the dispersion at 25 °C.

Thus, in the case of Kashagan oil spills possible to use dispersants discussed the following reagents: Inipol IPF, Corexit 9500 and Inipol IP-90.

2. Temperature influence.

The effectiveness of dispersants decreases with decreasing temperature. However, the sequence number of reagents for dispersing activity is fully preserved. So, at 5 °C the best dispersant properties against Kashagan oil dispersant showed brand Inipol IPF, whose efficiency is 56,19 % and dispersant Inipol IP-90 — 44,84 %. Dispersants FLD-1 — 32,11 % and FLD-2 — 12,39 % are weakly dispersing agents for the Kashagan oil under these conditions. Dispersant Bioversal HC 9,63 % with efficiency at a temperature of 5 °C practically no effect, as dispersing natural conditions at this temperature give 8,60 % of the dispersion.

3. Effect of salinity.

Reducing salinity of the water in tests reduces the efficiency of dispersants. Most effective in saltwater corresponding to ocean water with 35 ‰ are Corexit 9500 and Dasic Slickgone NS, with salt water from 6 to 16 ‰ the most effective are Inipol IPF and Corexit 9500.

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Мұнай төгілгендегі қолданылатын диспергенттер тиімділігінің сараптамасы

Қазіргі кезде теңіздегі мұнай төгілу салдарын жою үшін бірқатар жағдайда диспергенттерді іс жүзінде қолдану көптеген елдерде және халықаралық ұйымдарда кең көлемде танылған және ресми құжаттарда бекітілген. Мұнай төгілу салдарымен күресу үшін ұсынылып отырған диспергенттердің сапасын бағалау барысында біздің зертханада кеңес етілген әдістемелердің көмегімен зерттеулер жүргізілді. Аталмыш диспергенттердің Каспий теңізінің суында Қашаған мұнай кен орнының мұнайына әсері анықталған. Жүргізілген зерттеулер нәтижесінде 5 °С, 25 °С температураларда диспергенттерді қолдану тиімділігін бағалау жүргізілді және оларды қолдану бойынша кеңестер берілді.

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Анализ эффективности диспергентов для применения при разливах нефти

Приемлемость и эффективность в ряде ситуаций практического применения диспергентов для ликвидации нефтяных разливов в море в настоящее время общепризнаны и зафиксированы в официальных документах во многих странах и международных организациях. Для оценки качества предлагаемых для борьбы с разливами нефти диспергентов нашей лабораторией проводились исследования с помощью рекомендованных методик. Были проведены исследования влияния предлагаемых диспергентов на нефть Кашаганского месторождения в морской воде Каспийского моря. На основании проведенных исследований была сделана оценка эффективности диспергентов при температурах 5 °С, 20 °С и дана рекомендация по их применению.

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