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ХИМИЯ ҒЫЛЫМДАРЫ ИНСТИТУТЫ»  
АКЦИОНЕРЛІК ҚОҒАМЫ

# ҚАЗАҚСТАННЫҢ ХИМИЯ ЖУРНАЛЫ

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## ХИМИЧЕСКИЙ ЖУРНАЛ КАЗАХСТАНА

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**PHYSICO-CHEMICAL PROPERTIES  
OF COMPOSITIONS BASED  
ON A TECHNICAL OIMASH SALT USED  
AS WELL JAMMING**

**Abstract.** The physico-chemical properties of the technical salt of the Oimash deposit have been studied. The results showed that the salt has no alkaline-earth metals, is not soluble or compactable, and when dissolved is compatible with seawater and wastewater. The characteristics of new 5 dry compositions based on the Oimash field technical salt, used for the preparation of jamming liquids, the physico-chemical characteristics of which meet the requirements for said compositions, have been developed and studied. The dry mixtures and seawater are used to produce well jamming liquids with high physico-chemical characteristics that are suitable for well jamming operations.

**Keywords:** muffling fluid, composites, dry mixture, technical salt of Oimashdeposit.

**Introduction.** At present, in the group of water-based jamming liquids, the main role belongs to aqueous solutions of mineral salts or pure brine that do not contain a solid phase. When they are used, the irreversible presence of pores by particulate particles is often excluded from the complex of causes causing a reduction in the permeability of the productive formation [1].

The jamming liquids (JL) shall be such that pressure is placed on the bottom as to exceed the plastics pressure. The solution to this problem is possible with the aid of various mixtures of silting formations, which generate a pressure higher than the formation pressure at the well bottom. Water formulations with additives for thickening or mineral salts are usually used and are prepared based on this.

Water-based jamming liquids are the most technological, non-toxic and environmentally friendly. At the present stage of development of oil fields (domestic and foreign), there is wide use of JL, which are reservoir and technical waters, as well as aqueous solutions of mineral salts or mixtures thereof [2].

The high technological efficiency of water-based jamming liquids can be achieved by using high-quality reagents that fully meet the technical requirements. In the work aimed at assessing the quality of the studied reagents used for preparation of muffling fluid, the basic physical-chemical parameters of the main reagent – technical salt of the deposit «Oimash» are defined.

The technical salt of the deposit «Oimash» is a crystalline bulk mineral, most of which contains sodium chloride (96-97%), the rest of which is various impurities.

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## EXPERIMENTAL PART

The technical salt (TS) of the Oimash field was used for the experiment. All dry compositions of the muffling fluid are prepared on the basis of 25 gram of technical salt of Oimash with additives of reagents improving the quality of the muffling fluid. Such reagents were used: 0.01-0.05 g phosphate salt (PS), 0.1-0.2 g Trilon B (TB), 0.1-0.4 g formalin, 0.01-0.03 g solution of PAA, PAS – 0.1-0.04 g solution.

For the formation of the first composite dry composition, 25 g of the technical salt of Oimash and reagent of PS is taken: TB: Formalin: PAA: PAS at a ratio of 0.5:0.1:0.1:0.01:0.1 g, in a reduced form (250:5:1:1:0.1:1:1). For the second formulation 25 g OimashTS and the added reagents PS:TB:Formalin:PAA:PAS at a ratio of 0.1:0.2:0.1:0.01:0.1 g are taken, in abbreviated form (250: 1:2:1:0.1:1). For the third composition: 25g Oimash TS and PS: TB: Formalin: PAA: PAS at a ratio of 0.1:0.1:0.4:0.01:0.1, in abbreviated form (250:1:1:4:0.1:1). For the fourth composite 25 g Oimash TS and reagents in ratios (250: 1:1:1:0.03:1). For the fifth formulation: 25 g TS and reagents above the ratios given (250:1:1:1:0.1:4).

*The determination of the traceability of salt* ensures the acquisition of high-quality information on the propensity of the commercial form of salt for tracking, the formation of lumps and lumps in the packaging during storage. The cylinder with the packed salt with a closed cork was placed in the oven with a temperature of 35°C for 2 hours. The cylinder was then cooled to room temperature, after which it was placed with salt in a cryostat with a temperature minus 10°C for 2 hours. Then the salt cylinder was cooled to room temperature for 2 hours. At the end of the cooling process, the cylinder contents were poured onto the tray and the presence of lumps and agglomerates was recorded [3].

The main problem when jamming wells is the selection of a liquid with the required *density* [4]. The choice of formulations of the main suppressant liquids in the form of salt-based solutions is based on the attainment of brine density and stability. The density of the solutions was determined by an areometer.

*Determination of the consumption rate of the studied salt.* Data on the determination of the consumption rate of the studied salts provide quantitative information on the mass consumption of salts needed to achieve the maximum density of jamming solutions and process fluids under fishing conditions.

Mass fraction of ions of alkaline earth metals. Mass fraction of ions of alkaline earth metals, in terms of calcium ions in salts used for the preparation of killing solutions and repair and technological fluids. This is necessary to predict the occurrence of the risk of salt deposition (calcite, dolomite, barite, etc.) and take preventive measures to minimize it [4].

## RESULTS AND DISCUSSION

According to above methods, the mass fraction of moisture in the Oimash deposit salt and its traceability have been found[3]. The density, mass fraction of the ions of the alkaline-earth metals and compatibility with the formation water of Uzen deposit are further determined [4]. The results are shown in table 1.

Table 1 – Physico-chemical properties of the Oimash deposit technical salt

Name of indicator	Technical salt of the Oimash deposit	
	sea	waste
type of water	sea	waste
Humidity, %	1,01	1,01
mass fraction insoluble substances, %	0,45	0,54
mass fraction of alkaline earth substances, %	isabsent	isabsent
salt consumption for saturation, kg / t	247,0	245,0
density of saturated solution at 20 °C, kg/m <sup>3</sup>	1190	1163
caking	notpronetocaking	notpronetocaking

The results of the salt studied, used for the preparation of salt compositions, showed that the sample has a humidity of 1.01%, the size of granules is less than 1 cm, which indicates that it is «non-caking tendency», the mass ratio of insoluble substances is 0.45% in seawater and 0,54% in sewage. The salt dissolved in marine and sewage water has no alkaline-earth metals and shows compatibility with both types of water, as during dissolution a mildly cloudy white solution is formed.

Thus, the salt in the Oimash deposit can be used to prepare jamming liquids.

The main characteristics of the prepared dry formulations based on the Oimash technical salt are further studied.

The requirements [7] for dry formulations used for the preparation of well jamming fluid shall include the quality of the original materials such as; *their crystal mass* (partial clustering is allowed), *the colour change* from white to grey, *saturation density* - not less than 0.7 tn/m<sup>3</sup>, *solubility in sea (technical) water* - not less than 98.5%, *mass ratio of soluble substances in water* not more than 1.5%, *mass proportion of moisture* - not more than 5%, *corrosion rate of steel* in solution - not more than 0.12 mm/year.

The following are the characteristics of the new five dry compositions we have developed, which will be used for drilling fluids. The basis of the dry mixtures is the technical salt of the Oimash deposit and contains a complete set of necessary and sufficient additives of chemical products (table 2).

The saturation density, mass fraction of insoluble substances in water, mass fraction of moisture of dry compositions slightly increases compared to the initial technical salt of the Oimash deposit as can be seen from the data of Table 2. For example, in the developed dry compositions, the density of the saturated compositions increases by 0.13-0.22 tn/m<sup>3</sup> compared to the technical salt and meets the requirements of [7] at least 0.7 tn/m<sup>3</sup>. The mass ratio of insoluble substances when dissolved in water increases slightly, but does not exceed 1.5% and meets the requirements for dry mixtures. The mass proportion of moisture in the formulations developed is less than in the Oimash technical salt and also meets the requirements (not more than 5%).

Table 2 – Main characteristics of dry compositions

Samples	Saturated density, tn/m <sup>3</sup>	Mass of insoluble substances in water, %	Moisture-massratio, %	Solubility in seawater, %	Solubility in sewage, %
Technical salt of the Oimash deposit	0,7	0.015	1,01	98,22	95,97
1 composition (250:5:1:1:0,1:1)	0,92	0.318	4,26	98,56	92,66
2 composition (250: :2:1:0,1:1)	0,89	0.318	5,05	98,05	93,59
3 composition (250:1:1:4:0,1:1)	0,83	2,1	5,02	97,89	91,7
4 composition (250: 1:1:1:03:1)	0,83	1,57	4,38	97,64	92,76
5 composition (250:1:1:1:0,1:4)	0,91	1,66	0,07	97,96	93,01

The solubility of the developed dry compositions depending on the types of water was investigated. From the data given in table 2 it can be seen that all dry mixtures are readily soluble in both types of water. It should be noted that the solubility of all dry compositions in seawater is 98%, while in waste water their solubility decreases slightly and ranges from 91.7 to 95.97%. Judging by the data obtained, all dry compositions of the mixtures meet the requirements [7] for dry composite compositions used to prepare the well jamming liquids.

Table 3 – Main characteristics of ready-made compositions of - jamming liquids (in seawater)

Samples	Solution density – from 1,01 till 1,18 g/cm <sup>3</sup>	The amount of suspended solids, kg/dm <sup>3</sup>	Corrosion activity – no more than 0.1 mm/year	Aggressiveness of solutions
Technical salt	1,177	0,78	0,180	slightly aggressive (0,01-0,1 mm/year).
1 composition (250:5:1:1:0,1:1)	1,133	0,902	0,019	slightly aggressive (0,01-0,1 mm/year).
2 composition (250: :2:1:0,1:1)	1,150	1,108	0,055	slightly aggressive (0,01-0,1 mm/year).
3 composition (250:1:1:4:0,1:1)	1,160	1,423	0,056	slightly aggressive (0,01-0,1 mm/year).
4 composition (250: 1:1:1:03:1)	1,157	1,384	0,046	slightly aggressive (0,01-0,1 mm/year).
5 composition (250:1:1:1:0,1:4)	1,152	1,384	0,046	slightly aggressive (0,01-0,1 mm/year).

The results of the study of main characteristics of prepared solutions – jamming liquids based on dry compositions, in seawater by density, by the amount of suspended solids and corrosive activity have shown in table 3. The results obtained showed that the density of all ready-made fluids lies in the range from 1.13 up to 1.177 g/cm<sup>3</sup> and meets the requirements [7] from 1.01 to 1.18 g/cm<sup>3</sup>.

The amount of suspended solids during the dissolution of the investigated compositions is high in comparison with the technical salt of the Oimash deposit, this is due to an increase in the viscosity of the solutions. It is known that if the corrosion rate lies in the range of 0.01-0.1 mm/year, then the medium is characterized by a slightly aggressive one. In terms of the degree of aggressiveness, the corrosive environment of the developed compositions of jamming liquids is no more than 0.1 mm/year and meets the requirements for them.

Thus, the developed composite compositions based on the technical salt of the Oimash deposit can be used for the preparation of effective jamming liquids.

#### REFERENCES

- [1] Ryabokon S. A. Technological liquids for completion and repair of wells. Second edition. Krasnodar, 2009. 337 p.
- [2] Petrov N. A. Improving the quality of completion of wells with polymict oil collectors: textbook. manual / USNTU. Ufa, 2010. 68 p.
- [3] GOST 13685-84. Table salt. Test method.
- [4] TU 2159-002-17635211-2014.
- [5] PND F 14.1:2.110-97. Quantitative chemical analysis of water. Method of measurement of suspended solids and total impurity content in samples of natural and treated wastewater using the gravimetric method-5s.
- [6] OST 39-099-79. Corrosion inhibitor. Method for evaluating the effectiveness of protective action of corrosion inhibitors in oilfield wastewater. Moscow, 1980. 19 p.
- [7] Rules for conducting repair work in wells. RD 153-39-023-97 (approved by the Ministry of fuel and energy of the Russian Federation 18.08.97).

#### Резюме

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#### ФИЗИКО-ХИМИЧЕСКИЕ СВОЙСТВА КОМПОЗИЦИЙ НА ОСНОВЕ ТЕХНИЧЕСКОЙ СОЛИ ОЙМАША, ПРИМЕНЯЕМЫХ В КАЧЕСТВЕ ГЛУШЕНИЯ СКВАЖИН

В статье изучены физико-химические характеристики технической соли Оймаша и композиционные составы на их основе.

Исследование показало, что техническая соль имеет влажность 1,01%, размер гранул менее 1 см, что указывают на её «не склонность к слеживанию», массовая доля нерастворимых веществ составляет 0,45% в морской воде и 0,54 % в сточной воде. Соль не имеет щелочно-земельных металлов и показывает совместимость с обоими типами воды. А в сухих композиционных составах насыпная плотность возрастает по сравнению с технической солью на 0,13-0,22 тн/м<sup>3</sup>, массовая доля

нерастворимых веществ при растворении в воде несколько увеличивается, но составляет не более 1,5% в воде, Массовая доля влаги у разработанных составов меньше, чем у оймашской технической соли, и также соответствует предъявляемым требованиям (не более 5%). Растворимость всех сухих составов в морской воде составляет 98 %, а в сточной воде несколько уменьшается и колеблется от 91,7 до 95,97 %. Полученные результаты по основным характеристикам приготовленных на воде растворов показали, что плотность всех готовых жидкостей лежит в пределах от 1,13 до 1,177 г/см<sup>3</sup> и соответствует требованиям [7] от 1,01 до 1,18 г/см<sup>3</sup>.

**Ключевые слова:** жидкость глушения, композиционные составы, сухая смесь, техническая соль месторождения Оймаш, физико-химические свойства.

### Резюме

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### ҰҢҒЫМАЛАРДЫ СӨНДІРГІШ РЕТІНДЕ ҚОЛДАНЫЛАТЫН ОЙМАШ ТЕХНИКАЛЫҚ ТҰЗЫ НЕГІЗІНДЕГІ КОМПОЗИЦИЯЛАРДЫҢ ФИЗИКА-ХИМИЯЛЫҚ ҚАСИЕТТЕРІ

Жұмыста Оймаш кен орны техникалық тұзының және оның негізінде жасалған композициялық құрамдардың физика-химиялық қасиеттері зерттелді. Нәтижелер тұзда сілтілі-жер металдары жоқ екенін, жабысқақтық қасиеттері де жоқ және кесектелмейтінін көрсетті. Бұл тұз ерігенде теңіз және ағызынды сумен үйлесімділік көрсетті. Сол себепті Оймаш кен орнының техникалық тұзының негізінде жаңа 5 құрғақ композициялық құрамдар әзірленді және олардың сипаттамалары зерттелді. Осы құрамдардың физикалық-химиялық сипаттамалары зерттелініп, ол сипаттамалар құрғақ қоспаларға қойылатын талаптарға сәйкес келедіні көрсетілді. Құрғақ қоспалар мен теңіз суы негізінде жоғары физикалық-химиялық көрсеткіштері бар ұңғымаларды сөндіру сұйықтықтары алынды, олар ұңғымаларды сөндіру жұмыстарына жарамды.

**Түйін сөздер:** сөндіру сұйықтығы, композициялық құрамдар, құрғақ қоспа, Оймаш кен орнының техникалық тұзы, физика-химиялық қасиеттері.