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UDK 622.022.612.2.

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EFFECTIVE SURFACTANTS AND LUBRICANTS FOR DRILLING FLUIDS

Introduction. The role of lubricants in drilling oil and gas wells is invaluable. Lubricants reduce friction and the load on drilling equipment during drilling and extend the service life of drilling equipment. Lubricants are also used to produce lubricants. The oil and gas industry is one of the important sectors of the country's economy, which allows the production of not only food products, but also various technical and chemical substances. However, a large amount of waste is generated in this area.

The annual oil and fat production in Uzbekistan is about 350–400 thousand tons, from which about 8–12% soapstock, 3–5% gossypol tar and 25–30% cotton wool generated as waste. The production of valuable products based on the processing of these wastes, in particular, surfactants (SFM), is of great scientific and practical importance [1,2].

Surfactants also play an important role in the production of lubricants.

Surfactants ensure that lubricants form colloidal emulsions in the drilling fluid. Surfactants (SFM) are organic substances that are active at the interface between liquids or between the liquid and the gas phase. They form a structure between water and oil, or gas and liquid, and affect the physicochemical processes in these environments. The SFM molecule consists of two parts: hydrophilic (well-accepting water) and hydrophobic (water-repelling, oil-attracting) parts. Due to the presence of these two parts, they can effectively control the processes of emulsification, wetting, dispersion and adsorption [3].

There were developed new lubricants type MBR for drilling fluids based on surfactants. Drilling fluid lubricants are additives that reduce friction, torque, and drag in wellbores, preventing bit balling and improving drilling efficiency, especially in complex holes; they include oil-soluble types for oil-based muds (OBM), water-soluble/dispersible options for water-based muds (WBM) like ester-based formulations, and even biodegradable biolubricants from vegetable oils, all designed to enhance performance in high-pressure, high-temperature (HPHT) conditions.

The activity, efficiency and mechanism of action of SFM are closely related to its physicochemical properties. These include surface tension, rheological parameters (viscosity, elasticity), setting time, phase and chemical stability. These parameters determine how effectively SFM works in industrial conditions, how stable it is in phases, and how resistant it is to external factors.

The study of the physicochemical properties of surfactants not only determines their technological value, but also serves as the basis for the creation of new, resource-saving and environmentally friendly substances. Currently, SFM types obtained from oil and gas industry waste, including gossypol tar and Cotton soapstone, are in the focus of researchers' attention, as they are not only cheap raw materials, but also a useful source for the environment.

The objects of research were selected as cottonseed oil and pistachio oil industry wastes - soapstone, sodium hydroxide, sodium carbonate and other ingredients. Cottonseed oil and pistachio oil industry wastes contain high molecular weight fatty acids, glycerin, and polyphenolic compounds, and are the main raw materials for the synthesis of SFM.

Results and their analysis. Pistachio oil soapstone is an oily waste from the pistachio oil production process, consisting mainly of unsaponifiable matter, insoluble fractions, and salts of soluble fatty acids. Its composition is similar to soybean, sunflower, or cottonseed soapstone, but it also contains substances specific to pistachio oil.

Since pistachio oil soapstone has a high content of fatty acids and soaps, it is processed to obtain surfactants (SFM), emulsifiers, or biofuel fatty acid esters [4].

The following is the approximate chemical composition of pistachio oil soapstone. The physical and chemical properties of pistachio oil soapstone are given in Table 2.

Table 2 – Physical and chemical properties of pistachio oil soapstone

№	Name of indicators	Value	Comments
1	Density (at 20 °C) g/cm³	0.91 – 0.93	Typical for fatty substances
2	Viscosity (at 40 °C) mm²/s	60 – 90	High due to fatty acids
3	Acid number mg KOH/g	60 – 120	High content of free fatty acids
4	Saponification value mg KOH/g	170 – 195	Depends on the amount of triglycerides
5	5Iodine value g I/100 g	80 – 95	High in double-bonded acids
6	Moisture content, %	5 – 10	Depends on the degree of purification
7	Peroxide value mmol O/kg	5 – 15	Oxidation degree indicator
8	Color (Gardner scale)	10 – 15	Brown or black
9	pH(10% aqueous suspension)	8 – 10	Alkaline due to soaps Typical composition of pistachio oil environment
10	Main composition of fatty acids:	Olein (≈50%) Linoleic (≈25%) Palmitic (≈10%) Stearic ≈5%)	

Pistachio oil soapstone is a biologically valuable waste product with a high content of fatty acids and soaps. By processing it, bioemulsifiers, surfactants (SFM) and environmentally friendly techno-reagents can be prepared.

The main physicochemical parameters of SFM include the following:

1. Surface tension is a physical phenomenon associated with the interaction force between molecules on the surface of the SFM. That is, the surface of the liquid differs from the molecules inside it, and some of its molecules are in contact with air or other media. Reducing the surface tension indicates the effectiveness of the SFM.

2. Rheological properties are of particular importance - the viscosity and layering ability of the substance. The flow of SFM in a liquid depends on its concentration, temperature and molecular composition. SFM with high viscosity maintain emulsions stable, while those with low viscosity disperse quickly.

3. Drying time and stability are the long-term properties of SFM under the influence of air and temperature, which is the time it takes for the emulsion, suspension or coating substance based on it to transition from a

liquid to a solid state. Drying time and stability depend on the composition, concentration, temperature and humidity of the SFM. Stability is the ability of the SFM to maintain its physical and chemical properties over time.

4. Phase emulsion support ability is the ability of the substance based on it to maintain the oil and water phases for a long time without separation. Oil droplets in a liquid are dispersed in water, or water droplets in oil. The function of the SFM is to stabilize the dispersion and prevent phase separation. This layer softens the attractive forces between oil and water molecules, as a result of which the emulsion becomes stable. It is located on the hydrophilic and hydrophobic parts of the molecules.

5. Chemical stability is the ability to maintain its properties despite changes in pH, temperature, and ionic concentration. The functional molecules of SFM (hydrophobic and hydrophilic groups) are sensitive to chemical effects. Stable SFM does not lose its effectiveness under different conditions. In acidic or basic environments, the strength of the SFM particle and molecules can change. Stable SFM can maintain an emulsion under different pH conditions. Ions such as sodium, potassium, and calcium can cause SFM particles to aggregate and reduce their activity. Stable SFM is not damaged by ionic effects and maintains the emulsion.

Table 3 – Physical and chemical parameters of SFM obtained from pistachio oil

Parameters	Results
Water content, %	5–10
Surface tension, N/m	35–40
Emulsion stability, %	95–98
Hydrogen value (pH)	7-8
Foaming ability, ml	250–300

Determination of the foaming ability of surfactants (SFM) is an important indicator in assessing their technological and functional properties.

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