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METHOD FOR THE PRODUCTION OF NONIONIC SURFACTANTS USING LOCAL RAW MATERIALS

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Abstract: This article studies the effect of temperature on aqueous solutions in the production of nonionic surfactants based on local raw materials. It analyzes how an increase in temperature affects the micelle structure and stability of surfactants, as well as their interaction with water. The study highlights the role of temperature in increasing or decreasing the surface activity of surfactants, their efficiency and product quality. Proper control of the role of temperature in the production of surfactants based on local raw materials is important for obtaining high-quality and environmentally friendly products.
Keywords: local raw materials, nonionic surfactants, aqueous solution, temperature effect, micelle structure, surface activity, chemical industry, control technologies

Introduction. Surfactants are substances that occur at the interface of liquids and provide a decrease in the surface area. Nonionic surfactants, in turn, are chemical compounds that do not have an electrical charge, that is, are non-ionized. They are widely used in a number of industrial processes, including cleaning, the formation of emulsions and dispersions, as well as in the cosmetics, pharmaceuticals and food industries. Interesting research is being conducted in the field of obtaining nonionic surfactants based on domestic raw materials. The effect of temperature in aqueous solutions has a significant impact on the effectiveness and quality of surfactants. Understanding the effect of temperature on the physicochemical properties of surfactants, including their cryogenic and static properties, is one of the important factors in the production of high-quality products. Nonionic surfactants are distinguished by their unique properties. One of their main properties is the ability to emulsify compounds in aqueous solutions and reduce surface forces. These properties are especially important for substances produced on the basis of local raw materials. As local raw materials, plants and animals, as well as other natural resources, such as oils and xylenes, are widely used. In many works, for example, by K. Holmberg or A. Adamson, the effect of temperature on aqueous solutions of surfactants is determined depending on their type. The solubility of ionic surfactants increases sharply when a certain temperature (or rather, a narrow temperature range) is reached. The temperature at which the almost unlimited solubility of the surfactant begins is called the Krafft point (Tcr) by the name of the scientist who first drew attention to this phenomenon. The almost unlimited increase in solubility is associated with the micellization of surfactants, while the concentration of individual molecules of surfactants changes slightly. The phase diagram of a surfactant solution in the Krafft point region is shown in Figure 1.5.

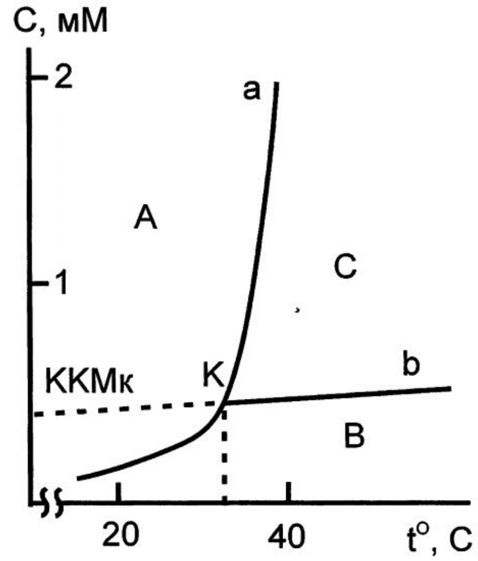
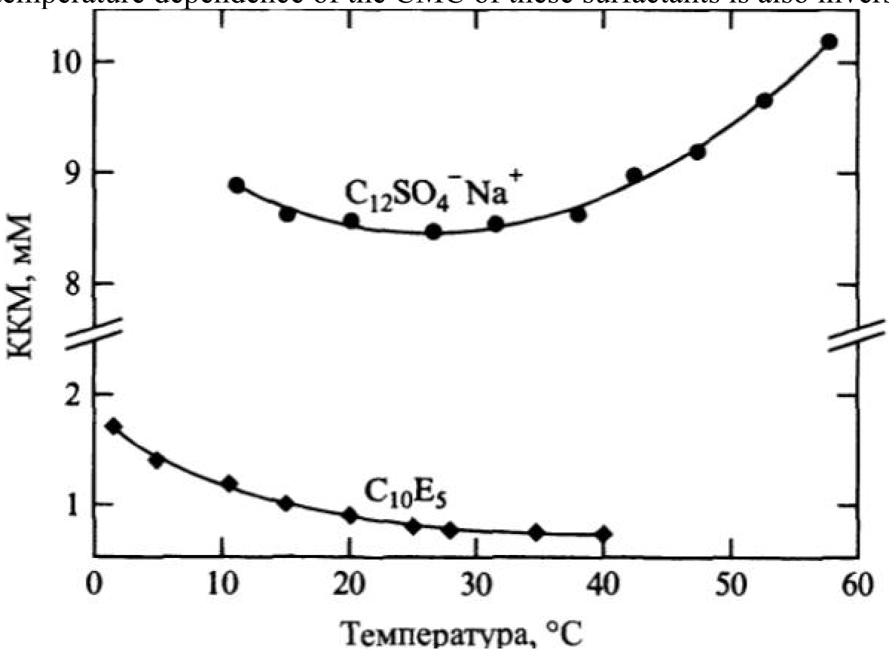


Figure 1 Phase diagram of the solution state of surfactants forming micelles. Quasicrystalline (A), true solution (B), micelles (C)

The curves in Figure 1 delimit the state of the surfactant in the quasicrystalline (A) and micellar (C) states from the region of its true solution (B), where the surfactant is in a molecularly dispersed state. The Krafft point is interpreted as the triple point at which molecules, micelles, and surfactant crystals coexist in equilibrium [2]. For most nonionic surfactants, solubility decreases with increasing temperature, and above a certain temperature, called the cloud point TP, nonionic surfactants are removed from solutions in the form of.

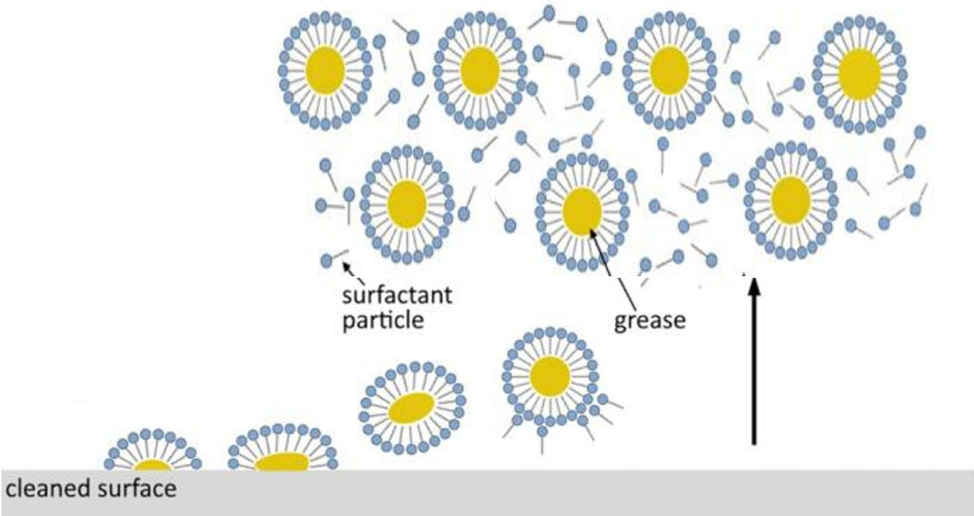
A separate macrophase due to the dehydration of their molecules. The solubility of ionic surfactants, on the contrary, increases with increasing temperature. As a result of the opposite dependence of the solubility of nonionic surfactants and ionic surfactants on temperature, the temperature dependence of the CMC of these surfactants is also inverse (Figure 2).

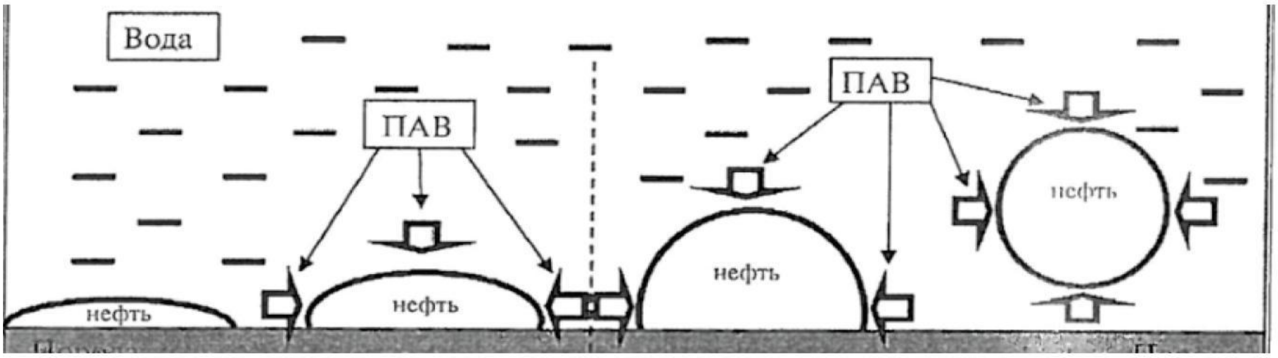


One of the most important properties of micellar systems is their solubility of various compounds. Solubilization is the ability of surfactant solutions with a concentration above the CMC to dissolve substances that are slightly or completely insoluble in a pure solvent. Micellar solubility occurs spontaneously, is accompanied by a decrease in the free energy of the system and leads to the formation of thermodynamic 18. As noted in the introduction, the principles of detergent action, first formulated by P. Rebinder in 1935 in the work "Physicochemical action of detergents" [1], have undergone almost no changes to the present day. In most studies, the washing effect of surfactants is studied on the example of washing fabrics with the aim of developing more effective synthetic detergent compositions (CMC) [1, 5]. Contaminants that are firmly retained in tissues are usually fatty products (animal fats, fatty acids, petroleum products and many other substances, including dust particles, soot, etc.). The cleaning action is defined as the ability of detergents and their solutions to remove foreign particles or contaminants adhering to various surfaces (fabric, metal, etc.) and bring them into suspension.

-Due to dispersion, dipole-dipole interactions, hydrogen, chemical and covalent, contaminant particles are retained on the surface. Covalent bonding can only be destroyed by a chemical reaction, as a result of which an adsorption layer of the surfactant is formed on the surface of the contaminant and the contaminant passes into an activated state. The adsorption layer of surfactants spreads along microcracks. Surfactants penetrate into the adhesive contact areas between the contaminant and the surface, the contaminant is released into the dispersion medium together with the hydrocarbon radical of the surfactant, the particles are crushed, the contaminant is hydrophilized, separated from the substrate and stabilized. washing solution. As a result, the contamination is retained in the volume of the washing solution and its redeposition on the washed surface is prevented. All washing processes are associated with a strong mechanical effect on contaminants, and the contribution of mechanical action can reach 60-80% of the total cleaning effect. The limiting processes in the washing effect are also the desorption of contaminants and their accumulation in micelles [3]. A lot of research is being conducted to create more effective synthetic and natural detergents [4]. In this case, the concentration of the detergent component is usually 10-15 g / l.

In many domestic and foreign works of recent decades, the detergent effect of surfactants has been studied, as well as with a view to their use in physicochemical methods to enhance oil recovery. These works mainly study the ability of existing and newly synthesized surfactants to reduce the interfacial tension of water at the interface with oil, reduce contact angles, and dissolve oil. Work is being carried out to model the processes that occur when flooding layers with surfactant solutions and combining flooding layers with surfactant solutions with other methods of increasing oil recovery (gas, biological, etc.). There is information on the results of laboratory and experimental tests using surfactant solutions. The mechanism of leaching of contaminants is considered to be primarily associated with a decrease in the Sma values and a decrease in the physical contact angle due to the penetration of surfactant particles into the space between the contaminants. particles and the substrate, which leads to a decrease in the interaction of these particles with the surface of a solid body. In this case, it is believed that thin layers of oil contaminants should gradually "wrap" into balls, which are then easily removed [1-3]. As a result, the cleaning effect of surfactant solutions is reduced to the removal of certain "microballs" of contaminants from the surface of a solid body (Fig. 1.8).





Nonionic surfactants, often in aqueous solutions, have amphiphilic properties, with one side being hydrophilic, i.e., well soluble in water, and the other side being lipophobic, close to the fatty part of liquids. Due to these properties, they work effectively in creating emulsion and dispersion systems. The effect of temperature on aqueous solutions significantly affects the physicochemical properties of surfactants. An increase in temperature can change the critical micelle concentration (CMC) of surfactants, which reduces or increases their surface activity. CMC is also one of the important parameters determining the active concentration of surfactants in solution. With increasing temperature, the kinetic energy between molecules increases, which changes their interaction with each other. As a result, the molecular structure of surfactants and their interaction with water change. Increasing temperature often changes the micelle structure and stability of the surfactant, which affects the quality and useful properties of the emulsion. The effect of temperature is especially noticeable in solution systems of nonionic surfactants at high temperatures. At high temperatures, their surface active forces can decrease or increase, which affects the efficiency of the process.

A number of works are devoted to considering the mechanism of “coagulation” of oil contaminants into spheres [5]. It is believed that this occurs due to the “shortening” of the three-phase solid-oil-water contact line, which, in turn, is associated with the penetration (diffusion) of water molecules between the oil droplet and the solid phase. In the literature, this process is called the diffusion mechanism of oil exfoliation [6] or the “twisting” mechanism of the interphase boundary. There are many experimental indications that water can spread and accumulate on the surface of glass (dioxide and silica), on which silica forms a gel layer. It was suggested that water molecules from the gel layer at the water-glass interface penetrate the oil-water interface by diffusion, at least in the immediate vicinity of the contact line. The dynamics of the formation of a water film between the oil phase and the solid have been directly observed. After the formation of such a breaking water film, even a weak shear flow is able to separate the oil droplet from the solid surface, and also found evidence that water molecules can spread in a thin layer on the solid surface by lateral diffusion. In the years, the important conditions for the separation of oil droplets from the substrate due to the instability of the shape of the oil-water boundary have been studied. Although the mechanism of oil separation has been studied by many authors, it has been concluded that important details of this process at the molecular level remain unclear.

In the work of V.I. Pochernikov, the washing process is presented as a complex, multifactorial process, depending on the nature and concentration of contaminants, the chemical composition and morphology of the washed surface, the nature and concentration of micelles. -forming surfactant (or mixture of surfactants), the presence of auxiliary components (electrolytes, complexing agents, anti-resorbants), the temperature of the washing bath, the conditions of selective wetting in three-phase contact; on the intensity and duration of the applied mechanical work, on the stability of the dispersion of contamination formed during washing and its ability to heterocoagulate on the surface of the substrate. Moreover, it is noted that many of these factors are interconnected. In the preparation of nonionic surfactants based on local raw materials, it is very important to correctly control the effect of temperature. Temperature control plays a major role in obtaining high-quality products, ensuring their long-term stability and increasing the efficiency of processing processes. It is necessary to properly analyze the temperature changes and associated chemical changes during the production process of surfactants using local resources. Local raw materialsStudies on the effect of temperature on aqueous solutions in the production of nonionic surfactants based on raw materials can lead to new achievements in the chemical industry. The effect of temperature on the micelle structure, activity level and stability of surfactants is of great importance in optimizing the production process and obtaining high-quality products. These studies also help to increase the efficiency of the production of nonionic surfactants and demonstrate the advantages of using environmentally friendly and local raw materials.

Conclusion. This study aims to study the effect of temperature on aqueous solutions in the production of nonionic surfactants based on local raw materials. The results of the study show that changes in temperature have a significant effect on the micelle structure, surface activity and their stability of surfactants. With increasing temperature, the critical micelle concentration (CMC) of surfactants can change, which can increase or decrease their effectiveness. Temperature control in the production of surfactants based on local raw materials plays an important role in improving process efficiency and product quality. At the same time, the effect of temperature on the physicochemical properties of nonionic surfactants further increases their importance in the production of environmentally friendly and sustainable products. Studies show that by controlling temperature, it is possible to improve the quality of nonionic surfactants and expand their industrial applications.

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