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SURFACE-ACTIVE SUBSTANCES, THEIR TYPES, AND THEIR ROLE IN SYNTHETIC DETERGENTS

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Abstract

Surface active agent are a class of synthetic compounds. Anionic surfactants are the most aggressive substances, and their content in detergents makes up about 2–5%. These substances can cause immune system disorders in the human body, lead to allergies, and seriously damage the brain, liver, lungs, and kidneys. Phosphates, in turn, facilitate the penetration of surfactants into the human body.

What kind of harm do surfactants cause to humans and the environment? The point is that surfactants can either accumulate in large amounts in living organisms or, conversely, rapidly spread in the environment. Most importantly, surfactants reduce the surface tension of water in the environment. For example, they decrease the supply of carbon dioxide (CO_2) to water bodies.

Only some surfactants are considered relatively safe. In particular, many industrial surfactants used in everyday life, in soil, mud, and sand, can create favorable conditions for removing heavy metals and thus prevent fine particles from entering the human body. However, most surfactants are characterized by a very wide range of negative effects on the human body and water resources.

When the concentration of surfactants in water is 0.4–3.0 mg/L, a bitter taste appears, and at 0.2–2.0 mg/L the water acquires a soap or kerosene smell. The main physical and chemical property of surfactants is their ability to form foam even at a concentration of 0.3%. A foam layer formed on the water surface at 0.1–0.5 mg/dm³ prevents heat exchange between the water body and the atmosphere and reduces the transfer of oxygen from air into water by 15–20%, thereby worsening the natural self-purification process.

In our country, 95–98% of detergents used consist of anionic and nonionic surfactants. Due to their chemical composition, these substances cause significant damage to water bodies. Once surfactants enter water reservoirs, they actively interact with other substances present there (such as chlorophos, aniline, iron, butyl acrylate, carcinogenic substances, pesticides, petroleum products, and heavy metals) and enhance their toxic properties. Surfactants form stable complexes with about 6–30% of copper, 3% of lead, and 4–5% of mercury.

Even small amounts of surfactants in water can cause coagulation and sedimentation processes. During the hydrolysis of surfactants, phosphate complexes are formed in water. Synthetic detergents leave from 20 to 40% of phosphorus residues in natural waters. Surfactants may also pose epidemiological risks.

Most surfactants and their degradation products are extremely dangerous for hydrobionts: microorganisms (0.8–4.0 mg/dm³), algae (0.5–6 mg/dm³), and invertebrates (0.1–0.9 mg/dm³). The strongest negative effect is caused by alkylaryl sulfates, whose molecules contain a benzene ring.

Pollution of water bodies by surfactants depends on the amount of wastewater discharged by producing enterprises. The main difficulty in removing surfactants from water is that they actively bind with other impurities and sediments, strengthening their properties. Most synthesized surfactants, once entering water bodies, persist and accumulate there for a long time. The permissible concentration of surfactants in water is about 0.5 mg/dm³, and for nonionic surfactants 0.1 mg/dm³.

The most harmful feature of surfactants is their ability to form foam. Another specific property is that they enhance the effects of other harmful substances in the environment. Therefore, it is necessary to treat wastewater from surfactants. Many enterprises release thousands of tons of surfactants into the environment. A water surface covered with surfactants prevents oxygen from entering the water from the air, worsens self-purification processes, causes serious damage to plant and animal life, and also gives water an unpleasant odor.

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