# Extractant-containing microemulsions based on sodium bis-(2-ethylhexyl) phosphate and sodium dodecyl sulfate

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## Abstract

**Relevance of the work**

The use of nanostructured systems may significantly improve the development of energy- and resource-saving processes in chemical technology, including the processes of extraction and separation of substances. Using the analysis of the dynamics of publications shown in the ScienceDirect database we determined that the interest of the scientific community in the development of new methods of organic and inorganic substances extraction using self-organizing nanostructures of surfactants, such as micelles and microemulsions, has increased in recent decades. Microemulsions (MEs) are thermodynamically stable dispersions containing nanometer-sized domains with a large interfacial surface at the oil-water interface. Concentrating of extractant molecules at this interface makes microemulsions attractive for use in liquid extraction and microemulsion leaching processes. The latter is a method of extracting metals from natural and industrials solid raw materials by processing it with an extractant-containing microemulsion. It was first proposed at the Department of Nanomaterials and Nanotechnology of the Mendeleev University of Chemical Technology of Russia. Its feature is the selective extraction of the target components and their inclusion in the composition of the microemulsion already at the stage of solid phase processing, which makes it possible to combine leaching and extraction in one process. Microemulsions of sodium bis-(2-ethylhexyl) sodium phosphate (NaDEHP) containing the cation-exchange extractant bis-(2-ethylhexyl)phosphoric acid (DEHPA) can be used for the leaching process.

It is also necessary to develop other microemulsions based on surfactants widely used in industry, for example, sodium dodecyl sulfate, for the leaching of metals. These MEs must have a wide region of existence at different component

concentrations and temperatures, contain a large amount of extractant sufficient to ensure a high leaching rate and a high degree of metal recovery, as well as maintain their stability during the leaching process.

**Purpose and objectives**

**The purpose** of this work was to determine the effect of extractants on physicochemical properties of microemulsions based on sodium bis-(2-ethylhexyl) phosphate and sodium dodecyl sulfate and to demonstrate the possibility of their use for the extraction of non-ferrous metals from oxide raw materials.

To achieve this purpose, the following **objectives** were proposed:

1. To determine the effect of the extractant bis-(2-ethylhexyl)phosphoric acid (DEHPA) on physicochemical properties of microemulsions in the NaDEHP – DEHPA – decane – water system.

2. To determine the effect of extractants (DEHPA, capronic acid, a mixture of tributyl phosphate (TBP) with acetic acid) on physicochemical properties of sodium dodecyl sulfate microemulsions.

3. To determine the effect of the structure of microemulsions in the NaDEHP – DEHPA – decane – water and sodium dodecyl sulfate– butanol-1 – DEHPA – decane – water systems on the leaching of copper on a model system with copper (II) oxide.

4. To determine compositions of microemulsions for the leaching of non-ferrous metals (copper, zinc) from oxide raw materials with microemulsions in the sodium dodecyl sulfate– butanol-1 – extractant – kerosene – water system.

**Scientific novelty**

1. The multidirectional effect of DEHPA, depending on its concentration, on the following properties of microemulsion in the NaDEHP – DEHPA – decane – water system (water solubilization capacity, specific electrical conductivity, distribution of water in microemulsion droplets by types of associates, hydrodynamic diameter of microemulsion droplets) is shown.

2. Regions of existence and microemulsion droplet sizes are determined for microemulsions in the sodium dodecyl sulfate – butanol-1 – extractant – kerosene

– water system in the presence of the extractants bis-(2-ethylhexyl)phosphoric acid, caproic acid, a mixture of tributyl phosphate with acetic acid.

3. The effect of the structure of microemulsions in the NaDEHP – DEHPA – decane – water and sodium dodecyl sulfate– butanol-1 – DEHPA – decane – water systems on the leaching of copper on a model system with copper (II) oxide is determined.

4. The possibility of using extractant-containing sodium dodecyl sulfate microemulsions for the extraction of non-ferrous metals from oxide raw materials is demonstrated.

**Practical value**

1. Compositions of extractant-containing microemulsions based on NaDEHPa and sodium dodecyl sulfate for the extraction of copper and zinc ions from oxide raw materials are proposed.

2. The possibility of extracting zinc ions from industrial electroplating sludge by microemulsion in the sodium dodecyl sulfate– butanol-1 – DEHPA – kerosene – water system is shown; the recovery of zinc was 97.6% at a leaching time of 15 minutes.

**Key points for the thesis presentation**

1. The effect of the extractant bis-(2-ethylhexyl)phosphoric acid (DEHPA) on physicochemical properties of microemulsions in the NaDEHP – DEHPA – decane – water system.

3. The effect of the structure of microemulsions in the NaDEHP – DEHPA – decane – water and sodium dodecyl sulfate– butanol-1 – DEHPA – decane – water systems on the leaching of copper on a model system with copper (II) oxide.

2. The effect of extractants (DEHPA, caproic acid, a mixture of tributyl phosphate (TBP) with acetic acid) on physicochemical properties of sodium dodecyl sulfate microemulsions.

4. Compositions of microemulsions for the leaching of copper and zinc from oxide raw materials.