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**Extraction of iron, aluminum and chromium compounds from wastewater in  
the presence of alkaline earth metal ions**

**Abstract**

**Relevance of the research topic**

The composition and degree of wastewater pollution is very diverse and depends on the production process and the conditions of water use in various operations of the technological process. The main pollutants of the wastewater of most industrial enterprises are metal ions, which are toxic pollutants, the control of which is mandatory.

Scientific and practical studies have shown that the use of the electroflotation process in technological schemes makes it possible to effectively purify wastewater not only from metal ions, but also from organic impurities to regulatory indicators. The formation of the dispersed phase is an important stage that ensures the efficiency of the entire process. Often in practice, compounds of alkaline earth metals are used as precipitating reagents, which have a lower cost compared to alkali metal hydroxides.  $\text{Ba}^{2+}$  ions are used to remove  $\text{SO}_4^{2-}$ ,  $\text{CrO}_4^{4-}$  anions from electroplating wastewater. Significant concentrations of  $\text{Ca}^{2+}$  may be present in the source water as hardness salts. These ions remain in solutions and can influence the processes of flotation and sedimentation of the dispersed phase. There are a large number of methods for removing alkali-earth metal ions from aqueous solutions (ion exchange, reagent method, dialysis, etc.), the choice of which is determined by their content in the technological solution and technical and economic considerations. The use of additional methods contributes to an increase in the cost of water treatment costs, therefore, the study of the process of purification of aqueous solutions from heavy and non-ferrous metal ions in the presence of  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$  by the electroflotation method, as well as aimed at improving its efficiency, is an urgent scientific task.

**Purpose of the work:** development of technological solutions for wastewater treatment from poorly soluble compounds of iron (III), aluminum (III) and chromium (III) in the presence of alkaline earth metal ions by a combined method including electroflotation and filtration.

Within the framework of achieving the goal of the dissertation work, the following **tasks** were set and solved:

1. Investigation of the effect of background salts on the efficiency of the electroflotation process of extraction of poorly soluble compounds of iron (III), aluminum (III) and chromium (III) in the presence of alkaline earth metal ions.

2. Determination of the effect of organic additives (surfactants, flocculants) on the efficiency of the electroflotation process of extraction of poorly soluble compounds of iron (III), aluminum (III) and chromium (III) in the presence of alkaline earth metal ions.

3. Investigation of the effect of the concentration of alkaline earth metal ions on the efficiency of extraction of poorly soluble iron (III) compounds in the presence of surfactants of various nature.

4. Identification of the dependences of the charge of the surface of the dispersed phase on the ionic composition of the aqueous phase and their effect on the process of extraction of the dispersed phase.

5. Selection of process parameters to increase the efficiency of electroflotation and filtration extraction of iron, chromium and aluminum hydroxides from wastewater in the presence of alkaline earth metal ions.

### **Scientific novelty of the work**

New data have been obtained on the electroflotation extraction of poorly soluble compounds of Me(III) (Me – Cr, Al, Fe) from aqueous solutions in the presence of alkaline earth metal ions, depending on the nature of the background salt and organic additives:

- it was found that the nature of the background salt (NaCl, Na<sub>2</sub>SO<sub>4</sub>) does not significantly affect the process of electroflotation extraction of poorly soluble compounds of iron (III), aluminum (III) and chromium (III);

- it was found that the presence of Mg<sup>2+</sup>, Ca<sup>2+</sup>, Ba<sup>2+</sup> ions in the solution reduces the degree of electroflotation extraction of the dispersed phase of trivalent metals, regardless of the composition of the solution due to the adsorption of alkaline earth metal ions on the surface of freshly formed hydroxides, the effect of reducing the extraction efficiency is directly proportional to the concentration of alkaline earth metal ion in the solution in the range of 0.25-1 g/l;

- it is shown that the introduction of anionic surfactants and flocculants into the system increases the degree of extraction of the dispersed phase, regardless of the nature and ionic composition of the solution.

### **Theoretical and practical significance of the work**

Technological parameters for the efficient extraction of iron, chromium and aluminum hydroxides from wastewater in the presence of alkaline earth metal ions by combined electroflotation filtration method are proposed. Regardless of the ionic composition of the aqueous solution, it is recommended to extract the dispersed phase during electroflotation at pH 7 using an anionic surfactant or anionic flocculant at a concentration of 5 mg/l to increase the purification efficiency.