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ARTICLES

Effect of Transition Elements on Biochemical Oxygen Demand

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Abstract—The results of model experiments on the effect of transition elements (iron, manganese) and sulfide ions on the values of chemical (COD) and biochemical oxygen demand (BOD) are presented. It is shown that, in the presence of transition elements in water, BOD is overestimated. In the presence of 100 mg/L of iron(II) and >0.05 mg/L of sulfides in water, the BOD values exceed those of COD.

Keywords: biochemical oxygen demand, chemical oxygen demand, sewage of mining enterprises, iron, manganese, sulfides

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Wastewater of mining enterprises is a complex multicomponent system characterized by high mineralization, high metal content, and the presence of specific organic compounds used in the technological process. All these factors make the analysis of wastewater difficult.

Among of the main indicators of water quality are the values of biochemical and chemical oxygen demand (BOD and COD, respectively). The biochemical oxygen demand, as determined, characterizes the concentration of organic substances that undergo biochemical oxidation over a certain period [1]. The chemical consumption of oxygen is a quantity indicating the total concentration of reducing agents present in the water sample. The COD value is determined by the amount of chemically bound oxygen consumed for oxidation [2, 3]. Thus, these indicators give an opportunity to obtain information on the oxygen consumption necessary for the oxidation of contaminants present in the water.

It is commonly known that COD should always exceed BOD. The optimum ratio of COD and BOD for the period of full oxidation (BOD_{full}) in wastewater is 1.5–2.6 [4]. However, in the analysis of highly mineralized wastewater, the values of these indicators can be comparable, and sometimes there are cases when BOD_{full} exceeds COD. Thus, the question arises about the possible distortion of the physical meaning of the BOD_{full} value, which is associated with arbitrarily occurring reactions of chemical oxidation of contaminants, accompanied by the consumption of oxygen dissolved in water [5]. The procedure for determining BOD in natural and waste water excludes the effect of only one side reaction of oxidation, that is, the nitrification reaction [1].

The potential "consumers" of oxygen in highly mineralized wastewaters can be water-soluble salts that dissociate in an aqueous medium with the formation of transition element ions, for example, iron(II), manganese(II), and others. The concentration of such elements in the sewage waters of mining and ore-dressing enterprises can vary in a wide range and reach relatively high values [6].

In this paper, we present the results of a study of the effect of transition elements (iron, manganese) and sulfide ions, which are common components of sewage waters from mining enterprises, on the BOD.

EXPERIMENTAL

The biochemical oxygen demand was determined by the procedure [1], based on the ability of microorganisms to consume oxygen dissolved in water in the biochemical oxidation of organic substances. The essence of the method is that one part of a test water sample is mixed with n parts of diluting water; the resulting mixture is saturated with dissolved oxygen, poured into incubation flasks, and carefully sealed. The community of microorganisms develops in a bottle with the sample. The decrease in the amount of oxygen, multiplied by the degree of dilution, gives the numerical value of BOD. Diluting water is prepared from distilled water, to which various salts are previously added to create a stable buffer system. The buffer