СЕКЦИЯ «ИНЖЕНЕРНОЕ ДЕЛО, ГОРНОЕ ДЕЛО, РОБОТОТЕХНИКА, ТРАНСПОРТНЫЕ КОММУНИКАЦИИ, ЭКОЛОГИЯ»

УДК 330.1

DISSOLUTION TEST OF ATMOSPHERIC OXYGEN AND OZONE IN THE SOLUTION AT THE ACTIVE AND PASSIVE MODES OF THEIR DILUTION

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The process of dissolution of ozone and oxygen in liquids is the subject of numerous studies. Oxygen is the most abundant element in earth's crust. In the atmosphere, it is about 23 %, consisting of water – about 89 %, in the human body – about 65 %, sand is contained 53 % of the oxygen, in the clay – 56 %, etc. Free oxygen is contained almost exclusively in the atmosphere, with the estimated amount of at 1.2 * 1015 t. With all the enormity of this value does not exceed 0.0001 total oxygen content in the crust [7].

Ozone is one of the strongest oxidizing agents, which is very attractive for its being used for various purposes. Extremely valuable feature is its ecological purity – the ability to decompose oxygen. It does not increase the volume and weight of the treated environment, furthermore the salt-forming elements are not made, which is extremely important for today.

Studies of solubility, oxygen reactivity (O_2) and ozone (O_3) in acidic and neutral media are of greatest interest to find conditions under which the chemical activity of these substances is increased and this enables their use in the mining industry. The report shows the results of solubility studies and dissolution kinetics of oxygen and ozone in liquids at room temperature for 24 ºC (± 1 ºC) [1].

The solubility of atmospheric oxygen and ozone in the water (neutral) and the acidic solution (acidic, pH – 5 g/l). The experiment was conducted in two environments. The solvent with typically water (H_2O) was made in a neutral environment. The solution with dilute sulfuric acid at a concentration of 5 g/l served as acidic medium to our experience.

The experiment was conducted as follows. Ozone was prepared by passing the oxygen through a barrier discharge ozonizer. Volume of ozone and oxygen diluted in diluents was measured with a manometer and in all experiments was 10.0 g/m3. The coefficients of solubility of ozone and oxygen at a temperature of 24 ºC (±1 ºC) were measured during the transmission of ozone-oxygen mixture in a bubbling reactor.

Reactor for dissolving the oxidizing agent is a glass cylinder soldered into the bottom of a sintered glass filter through which our samples were received. Before starting the experiment, the reactor is poured into 200 ml of solution [2].

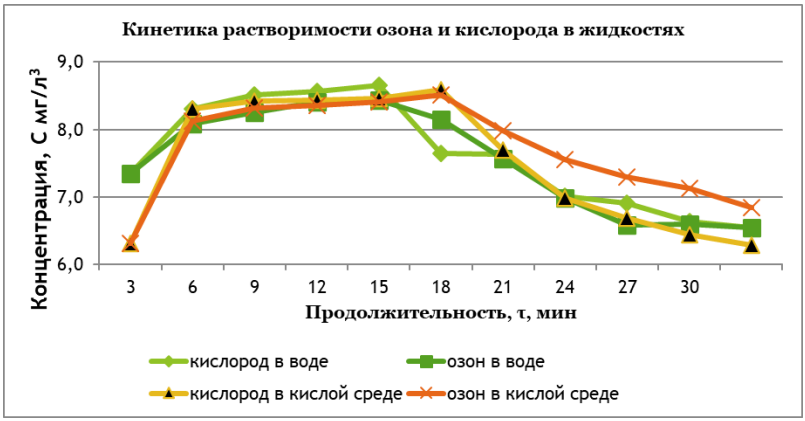
Duration of the experiment (τ) was 30 minutes, experience was tested in two stages. In the first half of the experiment the liquid active oxygen diluted air, and ozone. In the second half the process has stopped and the solution, dissolved oxygen (C, mg/m^3), together with redox reaction potential (Eh, mV) (see. pic. 1, 3). was measured every 3 minutes in the saturated state during the experiment medium temperature (t, ºC).

It is known that the rate of oxygen dissolution is inversely proportional to the degree of liquid saturation of oxygen or directly proportional to the unsaturation (deficit). This applies, of course, only to the surface of contact of water with oxygen (diffusion layer). In order to achieve that the dissolution rate refers to the entire mass of water, it is necessary to make intensive mixing. It is known that the alkaline, neutral and slightly acidic aqueous solutions and oxidizing ozone dissolution occurs in a radical chain reaction, which is the initiation stage of their interaction with hydroxide anion [3].

According to known facts, kinetics of ozone decomposition in aqueous solutions were studied at pH ≥ 2, and the smallest value of the constant solubility of ozone in this range was approximately 0.02 min –1. In this case, the acidity of the medium is very low. The concentration of hydroxyl anion is negligible, and the mentioned mechanism of ozone decomposition may not take place.

Время протекания, τ, мин	Температура среды, t, град ^{0}C		Окислительно-восстановительный потенциал, Eh, mV		Концентрация кислорода, C, мг/л	
	кислород	*озон*	*кислород*	*озон*	*кислород*	*озон*
Исходная среда	23,4	23,4	446	446	7,4	7,4
3	22,9	23,6	237	530	8,3	8,1
6	22,5	22,9	241	527	8,5	8,3
9	22,1	22,2	215	509	8,6	8,4
12	21,6	21,9	230	575	8,7	8,4
15	21,4	21,6	222	549	7,7	8,2
18	21,5	21,6	208	295	7,6	7,6
21	21,7	21,8	197	267	7,0	7,0
24	21,8	22	214	255	6,9	6,6
27	22,1	22,3	197	251	6,6	6,6
30	23,4	22,3	205	257	6,5	6,5
Среднеарифметические (при разбавлении)	**22**	**23**	**265**	**523**	**8,2**	**8,1**
Среднеарифметические (после разбавления)	**22**	**22**	**204**	**265**	**6,9**	**6,9**
Среднеарифметические (за общее время)	***22***	***22***	***237***	***406***	***7,6***	***7,5***

Pic. 1. – Solubility of oxygen and ozone in water



Pic. 2. – The kinetics of dissolution of oxidants in two environments

Increased ozone dissolution is constant with increasing acid concentration due to the existence of a mechanism for the decomposition of ozone, which is implemented only in highly acidic environments.

From the summary tables it can be seen that in the same conditions, equilibrium solubility of ozone and oxygen is almost identical. Despite

their allotropic, the values of oxidation-reduction potential (ORP) of ozone to oxygen above should be noted [4].

Thus, the results of the work suggest that acidic media occurs in specific acid catalysis reactions involving ozone. Solubility of ozone is increased with increasing acid concentration due to the existence of a mechanism for the decomposition of ozone, which is implemented only in highly acidic environments.

As a result, defined solubility of ozone and oxygen with the above set values, the mechanism of which has a chain nature in two environments tested (see pic. 1–2). Also, there is equilibrium solubilities of both oxidizers, which proves the absence of variation in the choice between atmospheric oxygen and ozone [5].

Время протекания, τ, мин	Температура среды, t, град ^{0}C		Окислительно-восстановительный потенциал, Eh, mV		Концентрация кислорода, C, мг/л	
	кислород	*озон*	*кислород*	*озон*	*кислород*	*озон*
Исходная среда	24,1	24,1	485	485	6,3	6,3
3	23,3	23,7	505	836	8,3	8,1
6	22,5	22,8	525	824	8,4	8,3
9	21,8	22,2	520	817	8,4	8,4
12	21,4	21,9	535	843	8,5	8,4
15	21,1	21,5	515	847	8,6	8,5
18	21,1	21,5	540	755	7,7	8,0
21	21,5	21,8	522	718	7,0	7,6
24	21,8	22,7	533	710	6,7	7,3
27	22,1	22,7	536	690	6,4	7,1
30	22,3	23,4	560	689	6,3	6,8
Среднеарифметические (при разбавлении)	**22**	**23**	**514**	**775**	**8,1**	**8,0**
Среднеарифметические (после разбавления)	**22**	**22**	**538**	**712**	**6,8**	**7,4**
Среднеарифметические (за общее время)	***22***	***23***	***525***	***747***	***7,5***	***7,7***

Pic. 3. – Solubility of oxygen and ozone in an acidic solution

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