Матеріали XXV Міжнародної науково-практичної конференції «Екологія. Людина. Суспільство» пам'яті д-ра Дмитра СТЕФАНИШИНА (12 червня 2025 р., м. Київ, Україна)

Proceedings of the XXV International Science Conference «Ecology. Human. Society» dedicated to the memory of Dr. Dmytro STEFANYSHYN (June 12 2025, Kyiv, Ukraine)

ISSN (Online) 2710-3315
https://doi.org/10.20535/EHS2710-3315.2025.329725

COMPARISON OF THE INFLUENCE OF IRON AND COPPER IONS ON WATER POLLUTION PROCESSES AT 20 ºC USING HYDRAZINE

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Abstract

The kinetics of oxygen removal processes from water using gyrazine hydrate were studied. A comparison method was used to determine a more effective reagent. It was shown that the speed and efficiency of the process increase with increasing reagent concentration. The initial oxygen concentration in water in this case depended on the temperature of the environment. The process was monitored with an oxygen meter by changing the oxygen concentration in a hermetically sealed container. At a temperature of 20°C, the oxygen binding process lasted for more than 60 minutes. With an increase in the concentration of iron (II) ions, greater efficiency was achieved than when using copper (I) ions.

Keywords: *comparison method, iron (II) sulfate, copper (I) oxide, hydrazine, corrosion, oxygen meter, electrochemical deoxidation methods.*

Today, corrosion is one of the main technical and economic problems of the energy industry, which requires constant attention, regular monitoring of the condition of equipment and the introduction of modern protection technologies. The consequences of the influence of corrosion can be the appearance of cracks and ruptures in pipelines under the influence of corrosion cracking, which is especially dangerous for high-temperature and high-pressure systems.

Deoxidation is an important area of ecological research, as it is one of the effective methods for combating metal corrosion. The use of iron and copper ions plays a significant role in studying water deoxidation processes, since their combinations in heaps at different temperatures can yield meaningful results.

Methods using redox sites consist of modified ion exchange resins that use cation exchangers modified with iron (II) and copper (I) compounds, which have reducing properties. This method is promising for industry and energy, since it does not leave toxic residues [1] and Polymer membranes - they can also be used for water deoxygenation by filtration [2].

It is worth noting that the deoxygenation process is closely linked to corrosion and redox reactions. Moreover, the reduction of oxygen levels influences the concentration of dissolved iron in water, which in turn can impact water quality and its overall ecological condition [1].

To identify the most effective method of water deoxygenation, a comparative analysis was conducted. The study was based on graphical representations and tables that clearly illustrate the

kinetics of oxygen concentration changes when using copper and iron ions at 20°C. The aim of our study was to compare the effectiveness of adding copper and iron ions at a temperature of 20 ºC and with the addition of hydrazine hydrate. to determine the efficiency of the water deoxygenation process from temperature when using hydrazine hydrate. Distilled water was used as the working medium. During the experiment, a sealed system and an oxygen meter were employed. A water bath was used to maintain a consistent temperature throughout the study.

Based on the results of the research, dependences were obtained that demonstrate the kinetics of changes in oxygen concentration over one hour. Tables 1 and 2 show the data on changes in oxygen concentration at different concentrations of hydrazine, copper(I) and iron(II) ions at 20°C.

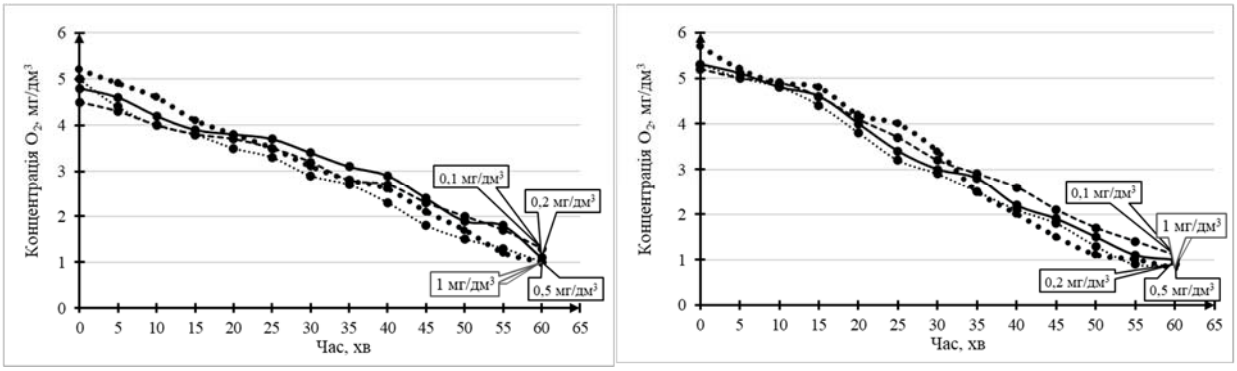
Table 1. Oxygen removal efficiency using hydrazine hydrate at 20°C and iron(II) ion concentration for 1 hour

Initial concentration O_2, mg/dm^3	**Hydrazine concentration, mg/dm^3**	**Concentration of $FeSO_4$, mg/dm^3**	**Residual concentration O_2, mg/dm^3**
4,5	10	0,1	1,3
4,8	10	0,2	1,1
5	10	0,5	1
5,2	10	1	1
5,2	20	0,1	1,1
5,3	20	0,2	1
5,3	20	0,5	0,9
5,7	20	1	0,8
6	50	0,1	0
5,2	50	0,2	0
5,6	50	0,5	0
5,4	50	1	0

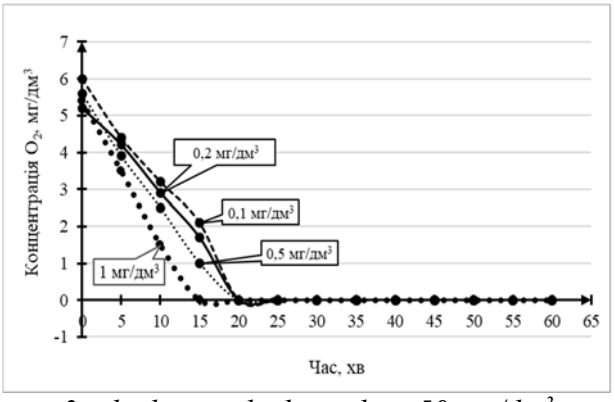
Table 2. Oxygen removal efficiency using hydrazine hydrate at 20°C and copper(I) ion concentration for 1 hour

Initial concentration O_2, mg/dm^3	**Hydrazine concentration, mg/dm^3**	**Concentration of $FeSO_4$, mg/dm^3**	**Residual concentration O_2, mg/dm^3**
5,2	10	0,1	3,2
5,2	10	0,2	3,3
5,1	10	0,5	3,1
5,3	10	1	3
4,7	20	0,1	0,7
4,9	20	0,2	0,6
5	20	0,5	1,2
5	20	1	1
5,3	50	0,1	0,3
5,1	50	0,2	0,2
5,4	50	0,5	0,1
5,2	50	1	0,1

As a graphical example, curves are presented (fig. 1 and fig. 2) showing the kinetics of changes in oxygen concentration over time at different doses of hydrazine hydrate and iron(II) and copper(I) ions at 20°C.



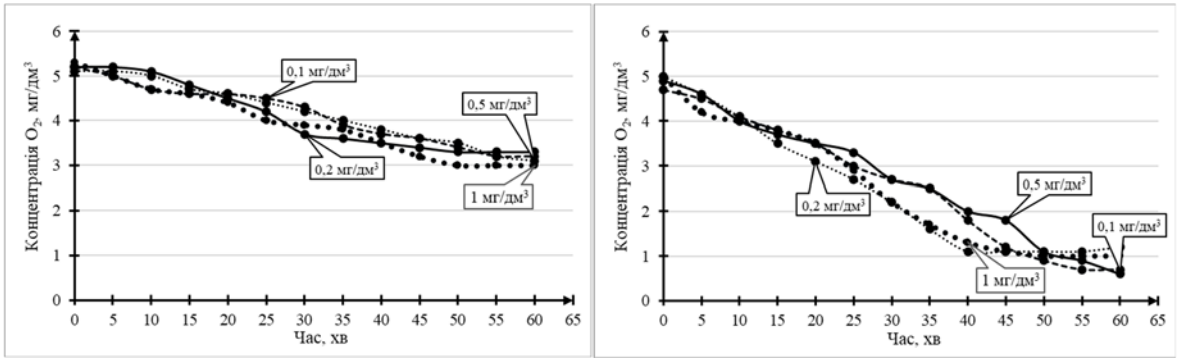
1 – hydrazine hydrate dose 10 mg/dm^3 2 – hydrazine hydrate dose 20 mg/dm^3



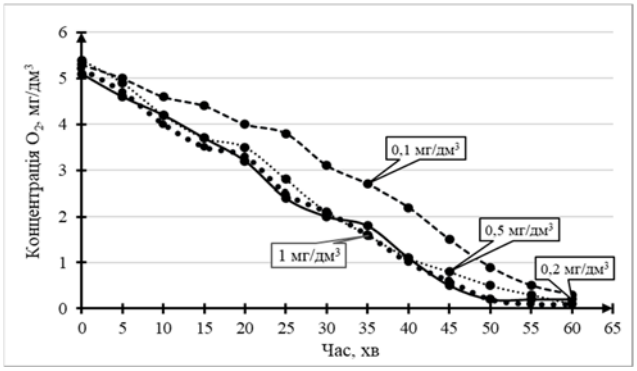
3 – hydrazine hydrate dose 50 mg/dm^3

Figure 1. *Kinetics of changes in oxygen concentration in water over time at different doses of hydrazine hydrate and iron (II) ions at 20 ºC*

At a temperature of 20°C (fig. 1), the trend shows a slight increase in the efficiency of oxygen removal, remaining at a similar level as in previous cases. However, a significant reduction in the time required to reach a 0 oxygen concentration can be observed when using a hydrazine dose of 50 mg/dm³, with the time decreasing from 40 minutes to 20–25 minutes. Additionally, at a dose of iron (II) ions ranging from 0.1 to 1 mg/dm³, this effect is also noticeable [3].



1 – hydrazine hydrate dose 10 mg/dm³ 2 – hydrazine hydrate dose 20 mg/dm³



3 – hydrazine hydrate dose 50 mg/dm³

Figure 2. *Kinetics of changes in oxygen concentration in water over time at different doses of hydrazine hydrate and copper (I) ions at 20 ºC*

As can be seen from pic. 2, a slight increase in the efficiency of deoxidation when using Cu+ ions as catalysts was achieved at maximum doses of reagents and elevated temperature conditions [4].

When comparing reagents, it can be noted that iron (II) sulfate reduces the oxygen concentration to zero faster than copper (I) oxide. This result was achieved at a dose of hydrazine hydrate of 50 mg/dm3.

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ПОРІВНЯННЯ ВПЛИВУ ІОНІВ ЗАЛІЗА І МІДІ НА ПРОЦЕСИ ЗНЕКИСНЕННЯ ВОДИ ПРИ ТЕМПЕРАТУРІ 20 ^{0}C З ВИКОРИСТАННЯМ ГІДРАЗИНУ

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Анотація.
Вивчено кінетику процесів видалення кисню із води за допомогою гіразин гідрату. Застосовано метод порівняння для визначення більше ефективного реагенту. Показано, що швидкість та ефективність процесу зростає при підвищенні концентрації реагенту. Вихідна концентрація кисню у воді в даному випадку залежала від температури середовища. Процес контролювали киснеміром по зміні концентрації кисню, що знаходились у герметично закритій ємності. При температури 20°С процес зв'язування кисню тривав понад 60 хв. При збільшенні концентрації іонів заліза (II) досягнуто більшої ефективності, ніж при використанні іонів міді (I).

Ключові слова: *метод порівняння, сульфат заліза (II), оксид міді (I), гідразин, корозія, киснемір, електрохімічні методи знекиснення.*