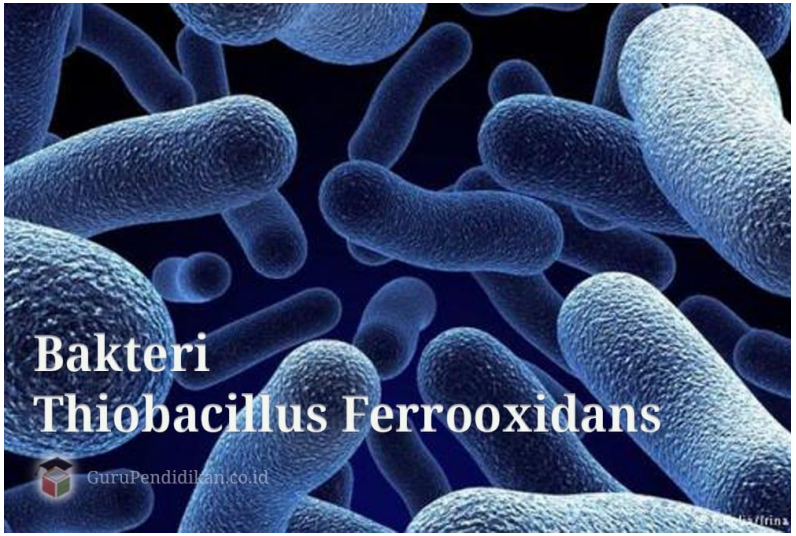
Ministry of Education and Science of the Russian Federation Federal State Autonomous Educational Institution of Higher Education
SEVASTOPOL STATE UNIVERSITY
Institute of Nuclear Energy and Industry
Department of Radioecology and Environmental Safety

Microbiological destruction of metals under the influence of bacteria (Thiobacillus ferrooxidans)



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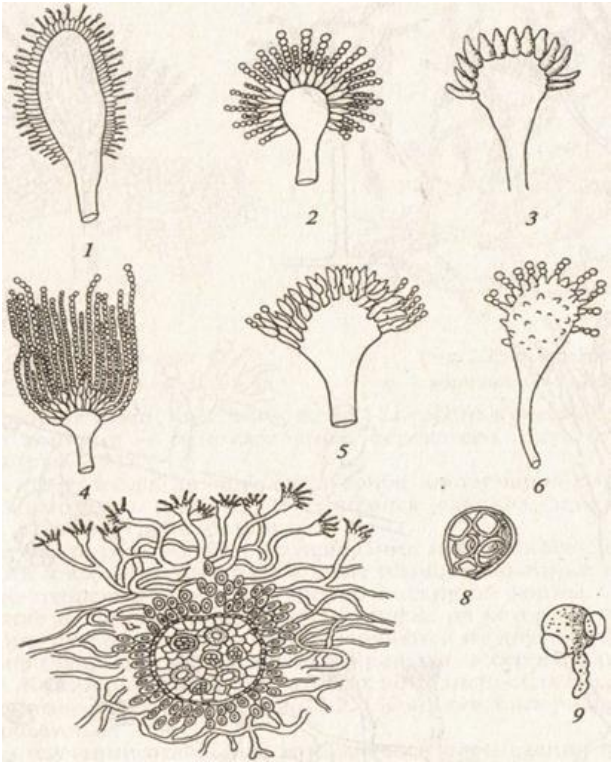
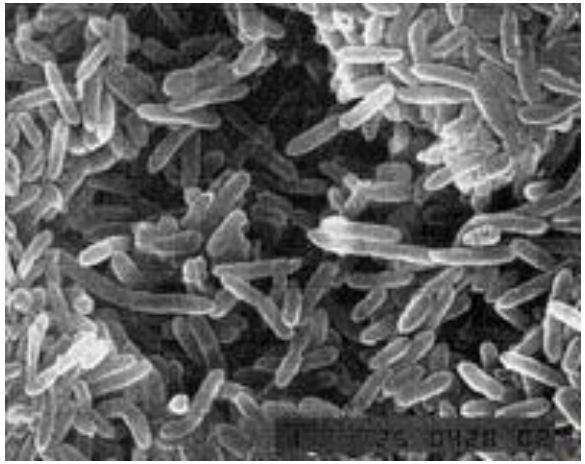
Microbiological corrosion of metals and alloys, therefore, the study of the corrosion resistance of metallic materials under the influence of microorganisms is an urgent problem.

Corrosion-aggressive action is possessed by:
-mycelial fungi
-iron bacteria
-thionic bacteria
-sulfate reducing bacteria

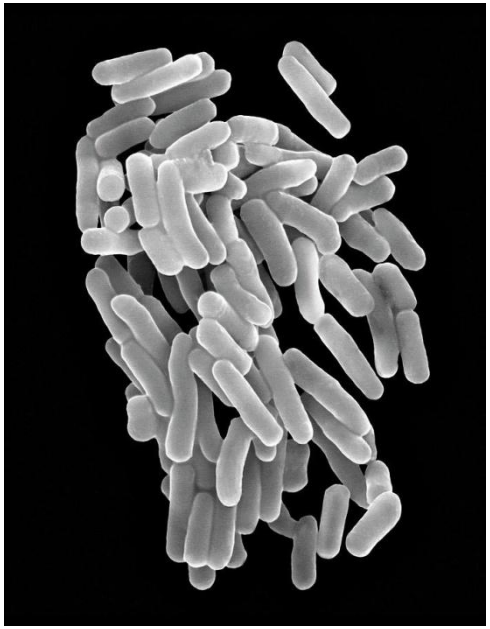


Able to exist both in aerobic and anaerobic conditions.



Biological corrosion of metals is often associated with the activity of thionic bacteria, which are common in natural and waste waters, in soils.
Representatives of thionic bacteria are terii of the genus Thiobacillus.

Bacteria Thiobacillus ferrooxidans are chemoautotrophs, the only source of energy for their life is the oxidation of ferrous iron, sulfides of various metals and elemental sulfur.
This energy is spent on the absorption of carbon dioxide released from the atmosphere or from ore. The resulting carbon goes to build the bacterial cell tissue.


Microbiological leaching method

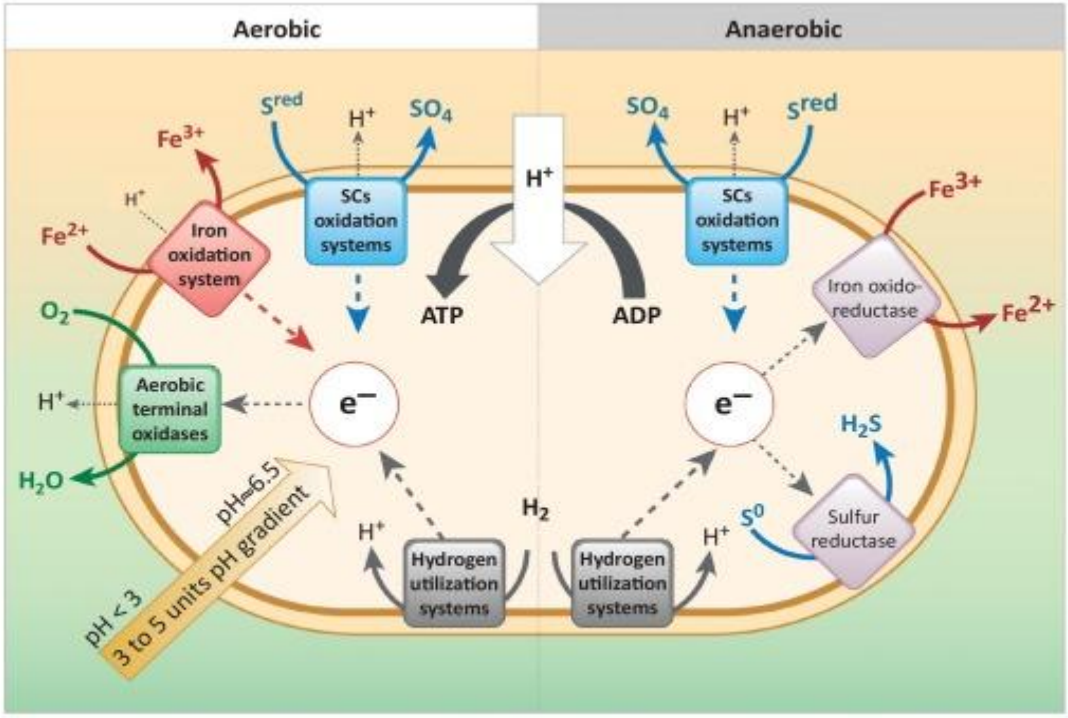
1. Bacterial oxidation, adsorption of microorganisms on the surface of the alloy

$$Fe2 + - \bar{e} \text{ bacteria} \rightarrow Fe3 +$$
$$Ni + 2Fe^{3+} \rightarrow 2Fe^{2+} + Ni^{2+}$$

2. The destruction of the crystal lattice of the alloy.

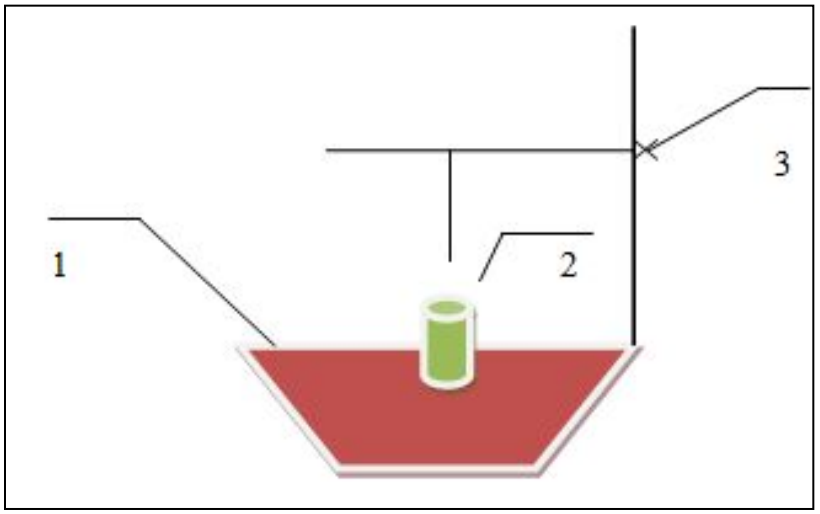
3.Transport into the cell elements and their intracellular oxidation

The optimum temperature for the development of thionic bacteria is 25–35 ° C, and the pH is from 2 to 4.



Biological leaching of components from alloys was carried out in an experimental setup, which is a biological reactor with continuous air supply.

Experimental setup
1. Bioreactor
2.Sample steel-60
3. Tripod



The principle of operation of the experimental setup:
1. The solid carbide scrap is loaded into the bioreactor.
2. Pour dispersant liquid.
3. Supply continuously air.

As the investigated material used steel-60X.
Alloy sample: Diameter 10.6mm, Fe - about 97%, C - 0.57-0.65%

The sample was coated with biologically resistant paint. To study the effectiveness of biocorrosion in a certain place of the presented sample, the paint layer was violated for direct interaction with the bacterial solution.

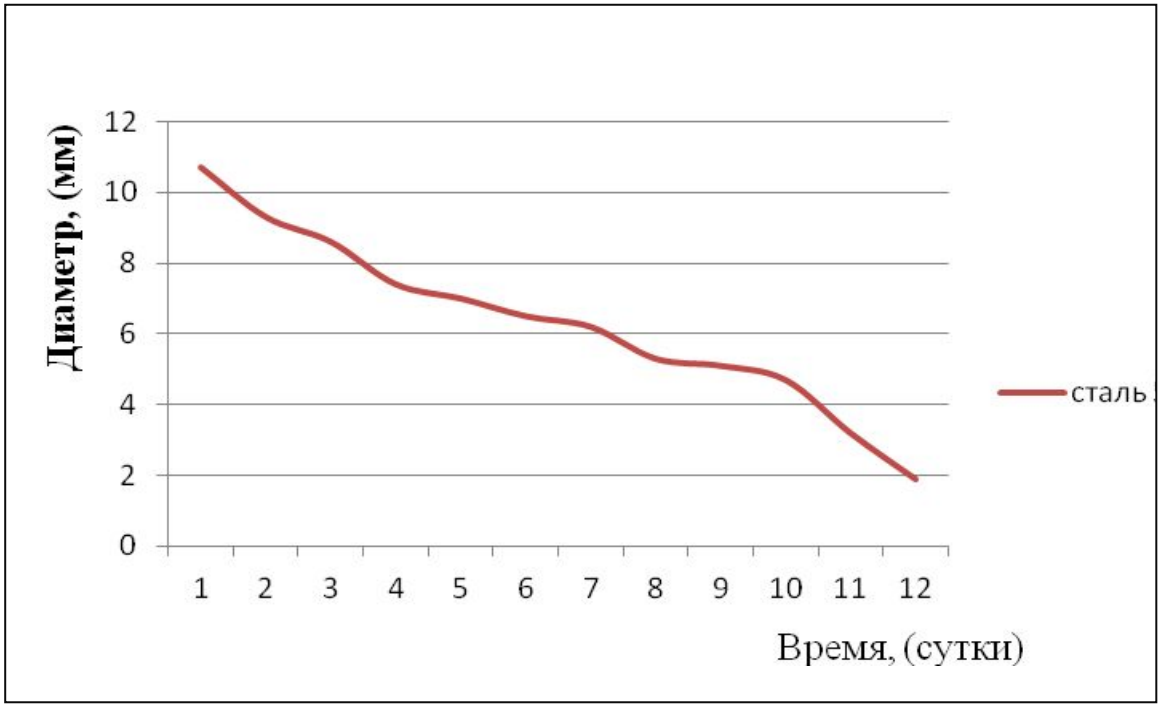
Evaluation of the corrosion efficiency of the steel-60X alloy was carried out for 12 days by measuring the decrease in the diameter of the sample.

The average measurement results are presented in table 1.

time (day)	Diameter
1	10.6
2	9.3
3	8.6
4	7.5
5	7.1
6	6.6
7	6.4
8	5.3
9	5.1
10	5.0
11	3.2
12	1.3

During the experiment, it was revealed that steel-60X is subject to biocorrosion, this is explained by a high iron content of 97%, however, the presence of additives that increase the strength and corrosion resistance of steel reduce the risk of brittle fracture.

The data obtained allow us to conclude that the use of thionic bacteria T. Ferrooxidans for the processing of waste steel products. According to the results of the work, it was revealed that the steel-60X sample underwent a process of microbiological destruction within 12 days, the diameter of the sample decreased: St-60X from 10.6 to 1.3 mm. The effectiveness of the destruction is due to the chemical composition of the steel.



Findings.
Traditional methods of metal processing are distinguished by energy intensity, large production areas, as well as, often, environmental problems.

Using the method of microbiological destruction is effective in the destruction of metals using the bacteria Thiobacillus ferrooxidans.

The leaching process is due to: selective recovery of chemical elements from multicomponent compounds by dissolving them.

It was experimentally proved that a steel-60 sample exposed to a dispersed solution for 12 days changed its diameter from 10.6 to 1.3 mm, which indicates the effectiveness of the biodegradation method.


Thank you for attention