## THERMODYNAMIC FORECAST OF THE INTERACTION OF MICROORGANISMS WITH NICKEL

**Kliara O[1], Havryliuk O[2], Hovorukha V[2], Tashyrev O[2].**
[1]National Technical University of Ukraine "Igor Sikorsky Kiev Polytechnic Institute",
Department of Ecology and Technology of Plant Polymers
[2]D.K. Zabolotny Institute of Microbiology and Virology of the NAS of Ukraine,
Department of extremophilic microorganism's biology
*e-mail: kliara.aleksandra@gmail.com*

The treatment of artificial metal containing rivers - products of mining enterprises, is a global problem. None of the existing technologies ensures the proper level of cleaning of artificial metal-containing rivers. It is obvious that in order to solve this problem, it is necessary to search for new methodological solutions.

We used the thermodynamic prediction method to theoretically substantiate the extraction of metals from aqueous solutions using the example of soluble Ni compounds. Pourbaix diagrams of the stability of Ni compounds in the coordinates "pH-Eh" were used for prediction.

Hence, it follows that the reactions of $Ni^{3+}$ reduction to $Ni^{2+}$ ions are inaccessible to microorganisms, since the potential of this reaction is above the upper limit of water stability. The reduction reaction of $Ni^{2+}$ to metallic Ni is also impossible, since its potential is below the limit of water stability. Let us consider examples of using forecasting to achieve the desired effect: at pH≥9 take place the soluble $Ni^{2+}$ transformation into insoluble $Ni(OH)_2$. It follows that to remove $Ni^{2+}$ ions from the solution, it is necessary to increase the pH with the help of certain microbial metabolic pathways. This is possible through microbial denitrification and ammonification. Finally, in the zone of thermodynamic stability of water, there is insoluble nickel sulfide NiS, which is stable in a wide range of pH values. Obvious that precipitation with biogenic hydrogen sulfide provides a more reliable environmental effect in comparison with the formation of $Ni(OH)_2$. Contrariwise, the transformation of insoluble $Ni(OH)_2$ to soluble $Ni^{2+}$ is achieved by decrease of the pH of the medium due to anaerobic hydrolysis of plant polymers and the accumulation of organic acids.

Thus, the thermodynamic forecast made it possible to determine the necessary conditions and pathways of microbial metabolism for both the mobilization and immobilization of metals. The most effective metabolic pathway for removing nickel from wastewater is biogenic sulfidogenesis.