# PREDICTION OF THE PROCESS OF CORROSION FORMATION OF STEEL DEGASATION PIPELINES

LEONID SHYRIN, ROSTYSLAV YEHORCHENKO

Dnipro University of Technology

This article examines the results of modeling and research of the corrosion process of underground degassing pipelines in the COMSOL Multiphysics software showed that the high level of corrosion processes of the gas pipeline is the result of the interaction of the metal, which plays the role of an electrode, with groundwater, which plays the role of an electrolyte, while the determining factors of corrosion of the process is the electrical conductivity of the soil and deformation processes in the pipelines.

*Keywords:* degassing, underground vacuum gas line, methane-air mixture, monitoring, capacity, vacuum pumping station

**Introduction**. An urgent task in the field of ensuring safe operating conditions of a mine degassing gas pipeline is to predict the durability of the system and the formation of corrosion in its links [1]. Mine degassing gas pipelines are in contact with aggressive fluids and have a short service life due to critical corrosion wear of the steel links of the gas pipeline.

Groundwater that enters mining operations and the produced space of mines is contaminated with organic and mineral particles of varying degrees of dispersion, soluble mineral salts (including salts of heavy metals), various types of bacteria, in some cases acquires an acidic reaction (pH < 6), and upon contact with moving and rotating mechanisms are contaminated with oil products and provoke corrosion of gas pipelines [2].

It should be noted that two electrochemical reactions take place on the walls of the steel gas pipeline, namely the oxidation of steel for the anodic reaction and the release of hydrogen for the cathodic reaction. This is due to aggressive mine waters, which are highly acidic.

It is known that the high level of corrosion processes of steel pipelines is the result of the interaction of the metal, which acts as an electrode, with groundwater, which acts as an electrolyte, and the determining factor of the corrosion process is the electrical conductivity of the soil (Fig. 1).

Fig. 1. Formation of pitting corrosion of steel links of the gas pipeline

Electrochemical corrosion often has a local character, that is, with it, corrosion spots and deep caverns appear on the pipeline, which can turn into fistulas in the pipe wall

Such corrosion is much more dangerous than continuous corrosion and the probability of its formation from the moment of time $P_o(t)$ is calculated by the expression:

$$P_0(t) = P_0(\tau \geq t) \tag{1}$$

$$P_0(t+dt) = P_0(t)P_0(dt) = P_0(t)(1-\lambda dt) \tag{2}$$

According to expressions (1, 2), we get that the change in $P_o(t)$ depends on the probability of formation of a single pitting λ, according to recommendations [9]:

$$\frac{dP_0}{dt} = \lambda P_0(t) \tag{3}$$

Solving equation (5), we get:

$$P_0(t) = \exp(-\lambda t) \tag{4}$$

where $P_o(t)$ is the dependence of the probability of pitting formation on time;

$t$ is the time since the initialization of the model;

$\lambda$ is the probability of formation of single pitting.

The average time of the moment of the beginning of pitting formation τ is defined as:

$$\tau = \frac{\int_0^\infty t\exp(-\lambda t)dt}{\int_0^\infty \exp(-\lambda t)dt} = \frac{1}{\lambda} \tag{5}$$

The obtained values were used as a base of initial data with the introduction of relevant equations into the model, on the basis of which models of the formation of corrosion of the degassing gas pipeline were built at different points in time: the beginning of the corrosion process, its development and the end of the process.

1. *Shirin L.N., and Yegorchenko R.R.* Improvement of methods of maintenance and renovation of mine degassing pipelines //Institute of Superhard Materials named after V. M. Bakulya of the National Academy of Sciences of Ukraine. – 2022.– 25 – P. 65 – 74 p.
2. *Maglyovana T.V., Zavyalova O.L. and Kostenko V.K.* Increasing the efficiency of mine water treatment using guanidine flocculants // News of the Donetsk Mining Institute. – 2017. – 1, №40. – p. 176–182.