CORROSION OF METALS AND METHODS OF PROTECTION

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ABSTRACT

Today, metals are the most important structural material and work in different conditions (air, water, underground). When working with metals, there are many substances that break them down. In such cutting, metals can be partially or completely eroded, i.e. corroded. Waste metals due to corrosion amount to several million tons per year. The article describes the corrosion process, its harmful aspects and methods of protection.

Keywords: Metal corrosion, erosion, tread protection and electrical protection.

INTRODUCTION, LITERATURE REVIEW AND DISCUSSION

It is known that most metals occur in nature as part of chemical compounds, and this is their most stable state. In metallurgical processes, metals are separated from these compounds, which destroy the stable state of the metals, but the metals restore their stable state when favorable conditions are met, that is, they combine with oxygen and other elements. This is the process of corrosion.

Corrosion of metals is the destruction of metals by chemical or electrochemical interactions with the environment. It consists of 3 stages: the arrival of the reactants at the phase boundary - the reaction zone; reaction; deviation of the reaction product from the reaction zone. Each of these stages, in turn, consists of elementary stages. Corrosion of metals is divided into chemical and electrochemical types. Chemical metal corrosion consists of the oxidation of metals and the reduction of the oxidizing component. Such corrosion occurs in aggressive non-conducting environments. Electrochemical Corrosion of metals is the decomposition of metals in an electrolyte solution in a conductive liquid medium. In this case, the metal particles are dissolved in the electrolyte solution. Corrosion of metals is divided into the following types according to the nature of erosion: flat, local, inter-crystallite and corrosion cracks. As a result of corrosion, 1-1.5% of all metals collected and used by humans are lost every year. Some measures are taken to protect metals from corrosion[1] (copper, alloying elements: chromium, nickel, etc. are added).

Pipes, pipe fittings, pumps, tanks, railway cisterns and other metal structures, metal equipment, structures and other items used in the oil and gas industry are mainly made of carbon and low-alloy steels. During use, these metal devices corrode with the external environment (electrolytes, atmospheric air, etc.) as a result of chemical and electrochemical processes, forming oxides and hydroxides. Accordingly, corrosion of metals means that they slowly decompose as a result of chemical or electrochemical processes that interact with the external environment. In general, the word corrosion (term) is derived from the Latin word "corrosio", which means rust, decay and decay of metal. The conditions that cause corrosion of metals are

[1] N. R. Yusupbekov, O. S. Nurmukhamedov, Z. G. Zokirov. Basic processes and devices of chemical technology. - O .: «Sharq», 2003.

called corrosive or aggressive environments. Metals can also erode as a result of mechanical processes (grinding, friction). However, this is erosive erosion and does not mean corrosion of metals. The combination of corrosion and erosion is called fretting corrosion. Electrochemical corrosion is common in many technological processes in the chemical industry, mainly due to the use of electrolyte solutions. The damage to the national economy from the corrosion of metals is due to the fact that the tools, equipment and technological devices used in various sectors of the economy are mainly made of metals. Depending on the type and conditions of the technological processes performed, the mass of one of them is several hundred tons. For example, a typical steel tank used in an oil and gas supply system can weigh up to 500 tons. During operation, the internal and external surfaces are exposed to corrosive environments (oil, gas streams containing moisture, salts, H2S, SO2) and corrode. Corrosion damage can lead to rapid equipment failure. They cost a lot of money and metal to repair or upgrade.

In general, corrosion of metals causes great damage to the economy. We can see this in the information below.

1. According to the literature, one-sixth of the steel alloys produced during the year are used to replace corroded metal structures, equipment, and their parts. If we look at this figure worldwide, it is several million tons. It turns out that the steel alloys produced by several smelters during the year are wasted.

2. By the end of the twentieth century, mankind has melted more than 35 billion tons of steel alloys. Today, there are 14 billion of them in the world, and the rest is released into the biosphere in the form of corrosion products. Corrosion damage is the sum of two costs: direct and indirect costs. If we look at these costs in the oil and gas pipeline system, the direct costs include the cost of the metal of the pipeline, the cost of building the pipeline and its ancillary equipment. Indirect costs include the repair of accidents caused by corrosion in pipelines, the monetary costs of non-operation of the enterprises using them, the cost of metals and money spent on the elimination of accidents, as well as spilled or released into the atmosphere, pollution of environmental components. 'includes the values of the negative consequences that occur as a result of the acquisition.

Corrosion of metals continues unabated and causes great damage. It is estimated that the direct losses of iron due to corrosion are about 10% of the liquefied iron per year. As a result of corrosion, metal products lose their valuable technical properties. Therefore, methods of protecting metals and alloys from corrosion are of great importance. They are extremely diverse. Here are some of them:

Protective surface coatings of metals. They can be made of metal (coating with zinc, tin, chromium and other metals) and non-metallic (coating with varnish, paint, enamel and other substances). These coatings separate the metal from the external environment. For example, tin for roofing is made of zinc: galvanized tin is used in many household and industrial products. The zinc layer protects the iron from corrosion, although zinc is a more active metal than iron (among the standard electrode potentials of metals, it is coated with an oxide film. When the protective layer is broken (scratched, roof perforated, etc.) a galvanic pair Zn / Fe is formed in the presence of moisture. It has an iron cathode (positive pole), zinc - anode (negative pole). Electrons pass from zinc to iron and bind to oxygen molecules (oxygen polarization), and zinc dissolves; but iron until all the zinc layer is destroyed. It is protected, which happens for a long time. Covering the surface of iron products with nickel, chrome not only protects against corrosion, but also makes the appearance of the product beautiful.

Formation of alloys with anti-corrosion properties. Corrosion-resistant stainless steel is obtained by adding up to 12% chromium to the steel. The addition of nickel, cobalt and copper enhances the anticorrosive properties of the steel as the alloy tends to become passive. The development of anti-corrosion alloys is one of the most important ways to combat corrosion losses.

Tread protection and electrical protection. The tread is used when the structure (underground pipe, hull) is protected in an electrolyte environment (seawater, groundwater, groundwater, etc.). The essence of such protection is that the structure is attached to the tread * - a more active metal than the protected structural metal. Magnesium, aluminum, zinc and their alloys are commonly used as treads to protect steel products. In the process of corrosion, the tread serves as an anode and erodes, thus protecting the structure from erosion. As the treads wear out, they are replaced with new ones.[2]

Electrical protection is also based on this principle. The structure in the electrolyte environment is also connected to another metal (usually a piece of iron, rail, etc.), but through an external power source. In this case, the protected structure is connected to the cathode, the metal - to the anode of the current source. The current source receives electrons from the anode, the anode (shielding metal) is corroded, and the oxidant is returned to the cathode. Electrical protection has an advantage over tread protection: its radius of action is about 2000 m, and tread protection is about 50 m. Electrochemical protection method is used in shipbuilding, aircraft construction, steam boilers, pipelines and others.

Change the environment. To slow down the corrosion of metal objects, substances called corrosion inhibitors or inhibitors (often organic) are added to the electrolyte. They are used when it is necessary to protect the metal from acid corrosion.

In the following years, volatile inhibitors (i.e., atmospheric inhibitors) were developed. They are soaked in paper, and metal objects are wrapped in this paper. The vapor of the inhibitors is adsorbed on the metal surface and forms a protective film on it.

Inhibitors are widely used in the chemical cleaning of steam boilers, the removal of soot from the surface of processed products, as well as the storage and transportation of hydrochloric acid in steel containers. Inorganic inhibitors include nitrites, chromates, phosphates, silicates. The mechanism of action of inhibitors is the subject of research by most chemists.

Thermal method involves heating the appliance in air or water vapor. This creates 3 μm thicknesses on the surface of the product. Depending on the composition of the metal and the oxidation regime, the curtain can be of different colors. When the product is heated to 250 ... 350 ° C in a mixture of 80% caustic soda and 20% sodium nitrate, a black film is formed, and when heated in a mixture of 55% sodium nitrite and 45% sodium nitrate, a blue film is formed. To form a black protective coating on the surface of the steel product, it is heated to 450 ... 470 ° C and immersed in linseed oil. The thermal method is used to oxidize cutting tools and some small parts.

[2] K. Kamalov, S. Sh. Xabibullayev. Corrosion protection. Study guide. - 2006.
[3] U. M. Mardonov, M. N. Murodov. Corrosion protection. Study guide. - Bukhara: Bukhara Institute of Food and Light Industry Technology, 2004.
[4] L. V. Korovina, Sh. K. Agzamov. Chemical resistance and corrosion protection of materials. Study guide. - G., 2004.