

I INTERNATIONAL CONFERENCE
KRASNOYARSK, RUSSIA
30 July 2020



Science and Technology City Hall
KRASNOYARSK, RUSSIA

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«International Conference on Advances in Material Science and Technology - CAMSTech-2020»

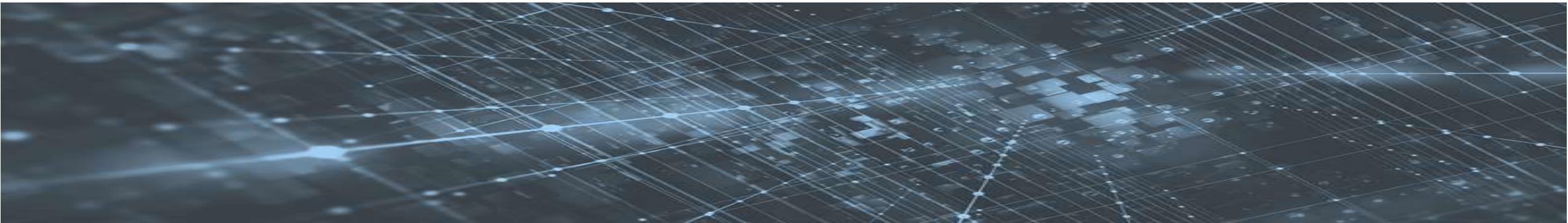
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«Influence of structural form of elements on corrosion of metal
structures»

S N Gushchin

Problem statement

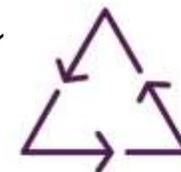
- Local corrosion of metals and alloys plays a significant role in the destruction of structures, chemical devices, pipelines, heat exchangers, condensers, machines, devices and its consequences are the most dangerous. Of the local types of corrosion, the most significant are: intercrystalline corrosion, corrosion cracking, contact corrosion, crevice corrosion, pitting corrosion.
- Since local corrosion concentrates the entire material effect of the process on a very limited area, its danger is extremely high. Local corrosion also often appears suddenly, it is impossible to detect it in a timely manner, and therefore it leads to unexpected structural damage.
- Protection of structures or devices from local corrosion is also very difficult. If General corrosion, which does not significantly weaken the cross-section of structures and devices, can be eliminated using conventional means of protection, for example, the use of electroplating or paint coatings, then such types of local corrosion, such as pitting or crevice corrosion, usually can not be eliminated by conventional means.



Solution methods

- One of the reasons for the dissolution of individual sections of the metal surface with different speeds may be different values of the initial potentials. In well-conducting media, due to polarization, the potentials in the corrosion process are aligned (it is unlikely that there are areas with different potential values on the metal surface under such conditions). This should also help to equalize the dissolution rates, since the speed of the anode process is directly dependent on the potential. However, this does not happen. This is explained by the fact that due to the structural heterogeneity of alloys, the rate of anodic dissolution of individual structural components, and sometimes bulk elements of the alloy with the same chemical composition, becomes uneven even at the same potential value. In addition, as will be shown when considering individual local corrosion processes, there are many reasons that do not relate to the alloy, but to the conditions of flow around the metal surfaces of the electrolyte, removal of the products of the anode reaction, which also contribute to the dissolution of individual sections of the alloy at different speeds.
- In this regard, it is often observed, even in highly aggressive acidic environments that contribute to the alignment of potentials across the entire surface, uneven dissolution of individual surface areas, and sometimes the predominant dissolution of individual structural components (grain boundaries, intermetallic compounds).

As for neutral electrolytes, in which the process of cathod to the diffusion of oxygen to the surface, which is often usually local, even in well-conducting electrolytes.



Conclusions

Results, implementation

Based on thermodynamic and electrochemical considerations, it is not necessary to associate the possibility of corrosion of an alloy with the presence of trace elements on the surface. If the potential of the metal is sufficient for the anode ionization reaction to occur, the dissolution of the metal will be observed regardless of whether there are microelements on the surface or not. Therefore, theoretically, it is necessary to recognize the possibility of dissolving the purest metals.

Observations, however, show that when we are dealing with real alloys, the situation changes dramatically; due to a number of reasons related to the structure of the metal and the heterogeneity of the electrolyte, the conditions of diffusion and convection of electrolytes to the metal surface, the latter is relatively quickly differentiated into areas where electrochemical reactions occur at different speeds. In the extreme case, as is observed in local corrosion, the anode reaction ceases to occur on a significant part of the surface and focuses on individual areas, and the cathode reactions focus on the rest of the surface.

To avoid corrosion, if possible, measures should be taken to obtain a homogeneous structure that is more stable, to exclude internal stresses that contribute to an increase in potential and corrosion cracking, to prevent the presence of macroscopic cracks, in which crevice corrosion begins, and microcracks that become stress concentrators that contribute to corrosion cracking. Corrosion cracking of chemical equipment occurs often and due to improper Assembly of individual elements.

Contacts

• **S N Gushchin**

• Vyatka State Agricultural Academy, Oktyabrsky prospect, 133, Kirov, 610017
Russia

E-mail: max.dvs@mail.ru

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