The Thermal and Thermogalvanic Effects under Iron's Corrosion in the Solutions with Different pH and Anion's Composition.

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Thermogalvanic (TG) corrosion is a reason for the most dangerous kinds of the destruction for heat-exchanger from iron and it's alloys [1] It's intensity depends from parallel action of the thermal and TG effects appearing under the influence of the tangential temperature gradient. The creation of prognostic models, enabling to operate given process, should be based on knowledge of it's mechanism in thermal and hydrodynamic conditions, adequate to real. In content with this, at the present work the decision of this problem was proposed for TG corrosion of iron dissolving from active, passive state and under conditions active-passive transfers.

The investigations were carried out in 20 non-isothermal systems differing by solution's nature (pH, anions, stimulators, inhibitors) and by thermal conditions. The experimental plant [2,3] is imitated flat plate with tangential temperature gradient contacting with flowing electrolyte. The thermal and TG effects were estimated with help of special electric and commutation transistor schemes permitting to determine the distribution of temperature, potentials and corrosion currents along non-isothermal surface. The experiments were conducted in the temperature's interval 20-70^{0}C under the temperature difference's variation in a system or temperature distribution's law on the metal's surface.

The experimental data allows to make the conclusion about the solution composition's and thermal condition's significant role in the iron's TG corrosion and the individual approach's necessity the given phenomenon's complex characteristic in each concrete case. So, in the acidic and alkaline electrolytes, where the iron's surface state (active or passive) does not changing in the zone of tangential temperature gradient arising and acting the TG elements with different polarity. In the acidic solutions the heated areas of the plate having the anodic function, but in the alkaline solutions – more cold areas. Thus in the mediums with pH<3 the thermal and TG effects are enhanced the operation one to another, in the mediums with pH>10 they are directed to the mutual compensation. Because of this the destruction's intensification on the more heated areas in the first case and on the contrary the destruction's redistribution with it's carry in the cold zones in the second case are observed. However the common metal's mass-loses are increased under TG corrosion in 1,4-1,7 times.

The optimum TG effects are found in neutral and near alkaline chloride and bicarbonate solutions, where the iron's corrosion process is complicated by change physic-chemical properties interface metal/electrolyte. In result the potential's and corrosion current's distribution along non-isothermal surface becomes non-monotonic, there appears the minimum and maximum points on them [3].It breaks the stringent arrangement of the anodic and cathodic areas and reduces to the destruction's localization in the middle part of the plate (t=40-50^{0}C).The essential exceeding of TG effects above thermal effects, sharply expressed in the bicarbonate solutions (where the active-passive transfers are observed) causes the significant (in 2,5 – 7,0 times) iron's mass-loses increasing under TG corrosion. The experimental results are interpreted on basis modern corrosion theories and additional physic-chemical investigations [3].

In the theoretic approach frames, founded on the general positions of electrochemical kinetic with allowance for system's specificities, in which the temperature equilibrium is absence, the calculation (under the special program) of the point's coordinate, which is separated non-isothermal plate on the anodic and cathodic areas and the corrosion currents distribution's functions along it, is carried out [1,4,5]. The approbation of the given calculation has shown the satisfactory experience and theory correlation only for the systems without diffusion limitations – under the TG corrosion of iron in acidic and alkaline solutions.

The obtained in the work results are not only assumed the TG effects count necessity under the different types of the technologic equipment's exploitation, where the potential gradient's appearance is possible in the variable temperature's field. It also demands the theoretic approaches to their estimation development with computer modeling methods using with allowance of all complex heat- and mass-transfer phenomenon in liquid and solid phases and on it's interface, and also the state and properties of the last, which one can be vary in a temperature equilibrium's absence.

References

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