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WAYS OF INCREASE OF CORROSION RESISTANCE POWDER MATERIALS

MOGUĆNOSTI UVEĆANJA KOROZIONE OTPORNOSTI PRAŠKASTIH MATERIJALA

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ABSTRACT

We have developed iron – based powder substances, containing copper granules of coke and cast iron. Technological scheme and installation design have been worked out to copper coke granules. The powder products are applicable for and used in tribotechnical units. Corrosion peculiarities, resembling to the above – mentioned powder substances, have been studied in the research. Resistance method, designated for impregnation of the products with oil – dissolving inhibitors, has been worked out.

Keywords: porous materials, corrosion resistance, oil – dissolving inhibitors.

1. INTRODUCTION

The prospects of application of products made by powder metallurgy are complicated by absence of the sufficient items of information about their corrosion resistance under operating conditions. Distinctive property of powder materials is that in comparison with compact materials they have more advanced surface connected with increased porosity, where there are more complex physic – chemical interactions of aggressive ions or molecules to metal. Therefore powder materials have, as it is usual, lower corrosion resistance, than compact materials. In spite of the fact that in the literature the various ways of increase of corrosion resistance of powder products are described. Now an integrated standard on the valuing of corrosion resistance of materials made from a powder [1].

In the present work we investigated the corrosion and electrochemical characteristics of powder samples made on the basis of iron containing coppered granules of coke and pig-iron. With the purpose of increase of the contents of coke in a material the used coke previously was exposed by copper covering in electrolysis. Using this way we managed to receive and to process products with the contents of coke up to 15 %, though it is known, that the introductions of coke in a powder are more than 4 % results in destruction of the received

material. We tested samples with the various contents of coke, and also samples processed by inhibited oil.

The materials, developed by us, have rather high physical - chemical properties, which are not inherent even by high alloy steels. However almost for all powder materials a vulnerable place is the low corrosion resistance, which limits spheres of their application in an industry. Complex study of the basic properties of the developed materials therefore is required, i.e. alongside with mechanical properties, important properties are their physical - chemical properties, namely their corrosion resistance.

2. METHODS

The electrodes for corrosion - electrochemical measurements were produced from powder compositions on a basis "iron with coppered coke", "iron + coppered iron with coppered coke" and "iron pig-iron with coppered coke", high speeds, working in conditions, of sliding both friction and influence of aggressive environments.

For corrosion - electrochemical measurements on the same level with powder materials the compact material St3 was tested also.

On the received dependence electrode potential E, the density of a current in define propensity of the investigated material to corrosion, and also some kinetically parameters.

The subsequent procedures of processing of samples essentially differed from processing used for compact samples. The reason to this was that the powder materials unlike compact have numerous tills of the various sizes on a surface. Electrolyte, getting into these pores cooperates with metal and forms products of corrosion of complex structure. These products after usual processing do not remove from a surface and as a result increase weight of a sample, that was repeatedly observed in preliminary experiences. Therefore for getting the reproduced data there was a necessity of removal corrosion products from surface pores.

In the literature data concerning the decision of the specified problem are absent. On the other hand, it is known, that the products of corrosion of iron and its alloys better are moistened in ethyl spirit. Proceeding from this we made attempt to remove products corrosion from pores with the help of spirit. Therefore after remove from a surface of a rust with the help inhibited acids samples have placed in 95 % ethyl spirit and have established, that during one day the products of corrosion from pores completely remove, what specifies improvement of reproducibility of the received data. After processing in spirit samples have been taken from spirit and have placed in a drying case at t = (100-1200C) during * 15 minutes with the purpose of removal of spirit from deep pores. This time at the specified temperatures was enough for removal of spirit, as more long time of processing of samples resulted in their oxidation and therefore to increase the weight of a material.

Unlike compact materials the data about corrosion - electrochemical behavior of powder materials in the literature practically are absent, and the having poor data concern only to problems of protection of similar materials from corrosion. It is connected basically with that, the methods used for research of corrosion properties of compact materials not always used for powder materials.

3. RESEARCH EXERCISES

Unlike compact materials powder have the advanced surface because of high porosity, owing to what it is difficult completely to remove products of corrosion collected in pores. Such phenomenon requires development of a special technique allowing to define speed of corrosion by traditional gravimetric method. The technique is developed by us, allows to define speed of corrosion of the investigated powder materials with sufficient accuracy.

Alongside with above-stated, with the purpose of study of kinetics of electrode processes with the help of pulse potentiostat of the mark PI - 50-1, were taken off cathodic and anodal properties in various aggressive environments, at speeds 12 mV/mines.

Researches of kinetics of cathodic and anodal processes give the valuable information on what which of them are the prevailing factors, by regulation of which are possible essentially to lower the process of dissolution of materials.

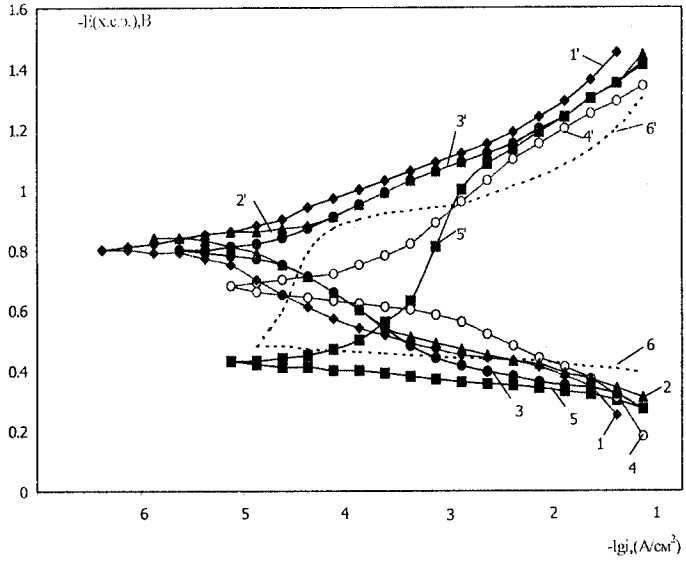

Fig. 1 - Anodal (1,2,3,4,5,6) and cathodic (1',2',3',4',5',6') samples of polarization curves in 3% solution NaCl at t=25°C

In fig.1 anodal and cathodic polarizing curves taken off on powders materials of various property in 3% solution NaCl at room temperature are submitted. As it is visible from figure, the powder iron after pressing is more

active (curves 1, 1*). Powder samples, processed in carbonyl- Mo (curves 2, 2*) and chrome (curves 3, 3*) on the corrosion-electrochemical properties differ from pure powder iron little. As their cathodic and the anodal curves are close among themselves and the stationary potentials Ect are within the limits of 0,780-0,800 on chlorine - silver electrode of comparison. The sample made of 95 % of an iron powder and 5 % of coopered coke (MK) is more corrosionally - stable (curves - 4, 4*), in spite of the fact that est is displaced 120 mV in the positive part. The increase of the content coopered coke (MK) up to 10% essentially changes an observable picture, as thus stationary potential is strongly displaced in the anodal part and there is a strong braking of process of dissolution (curves 5, 5*). For comparison in figure the polarizing given curves are taken off on compact steel St3 (curves 6, 6*). It is visible, that the compact steel St3 on its corrosional-electrochemical properties occupies an intermediate position between Fe + 10 % MK and other samples.

The study of their corrosion behavior in " complex systems " is of interest for practical application of the materials developed by us.

One of such "complex" system is the solution, which simulated earth waters at production of petroleum. As such modeling solution we chose water appropriate on structure to earth waters "Balachani" deposition.

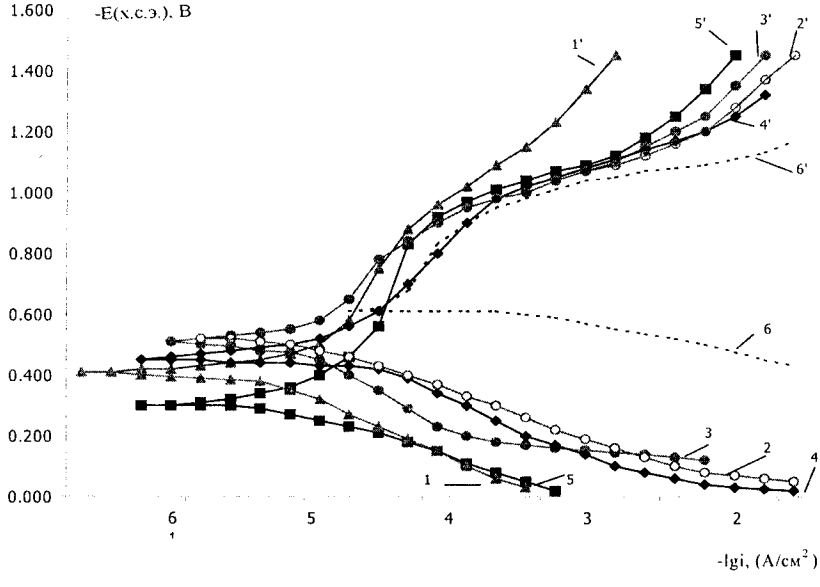

Fig. 2 - Anodal (1,2,3,4,5,6) and cathodic (1',2',3',4',5',6') samples of polarization curves in model solution at t=25°C

Corrosional-electrochemical data for the developed powder materials and compact St3 in above-stated environment are submitted in fig. 2. As it is visible from figure, the linear sites appropriate hydrogen depolarization (E<-0,90B) cathodic curves of all tested samples almost coincide, and in diffusion site of the

appropriate area of restoration of molecular oxygen cathodic processes are differ. Such phenomenon, on the one hand, can be connected with the complexity of structure of a solution, and on the other hand, is connected with dillection of electrolyte. At transition to anodal area of potentials the sample from compact steel St3 is exposed to the most active dissolution. The lowest speeds of dissolution are observed on samples made from powder iron (curves 9) and powder material containing 10 % MK. Other samples under the anodal characteristics occupy an intermediate position. The low concentration of total anional structure of a modeling solution in comparison with total anional by structure of the previous solutions promotes significant displacement of stationary potentials of samples in the positive part, that in its turn raises corrosion resistance of materials.

The work devoted to the problem of powder products of protection doesn't reduce the urgency of a task of improvement of methods of such protection [2,3]. Especially it concerns to products working in rigid and especially rigid climatic conditions without oil. Depending on conditions of operation of products, material the various methods of protection, are applied, one of which is the impregnation of these products oil dissolving inhibitors. This way is more acceptable on technological reasons and on other parameters. Proceeding, from these reasons we chose such kind of protection. As the inhibitors we took known products developed and well recommended in conditions of oil extracting in our republic and abroad. Inhibitors SK-3 are product of neutralization of sour liquid

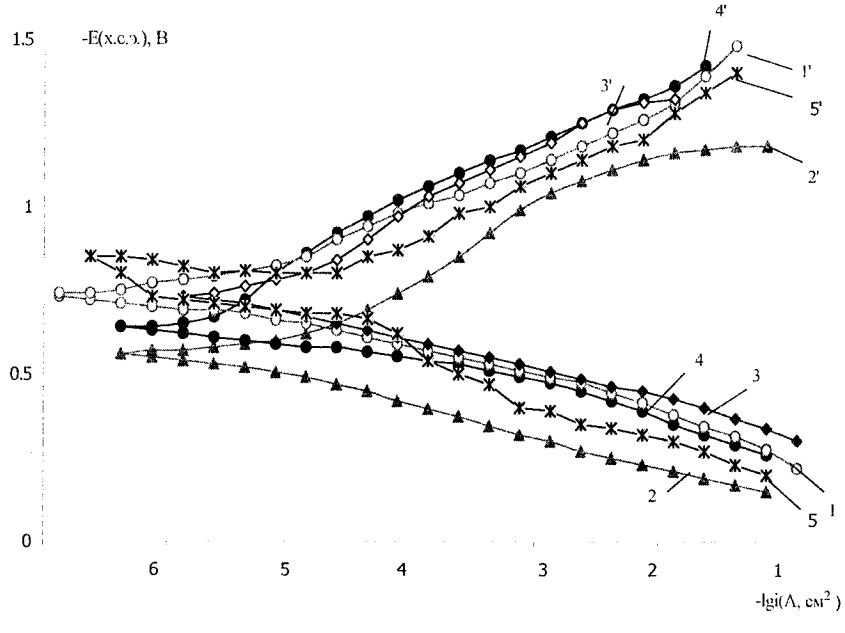

Fig.3 - Anodal (1,2,3,4) and cathodal (1',2',3',4") polarization

asphalt by slim at presence of diethanol amide, AGT-1 is developed on the basis of gossipolova gum, AGT-2 is a mixture of AGT-1 and product of condensation alkilphenov with ethalonanin. All chosen inhibitors are completely dissolved in oils.

The investigated samples from a powder material Fe-10 of % MK are processed in specified inhibitors by vacuum impregnation within 3 hours which are necessary for complete filling pores by inhibited oil. The results of research are submitted in inhibitors fig.3. As it is visible from figure, the processing of a sample in all inhibitors basically brakes cathodic process, i.e. are they inhibitors by cathodic type. In spite of the fact that (except AGT-2) investigated inhibitors accelerate anodal process however thus strongly suppress cathodic process, therefore the speed of corrosion considerably slows down in comparison with the samples which have been not processed by inhibitors (curves 5). In case of processing a sample by inhibitors AGT-2, alongside with strong braking of cathodic process there is also a weak braking of anodal process. Therefore in comparison with others investigated inhibitors AGT-2 is more effective inhibitors. The specified effect is visible in the table more evidently. As it is known, cathodic inhibitors reduce corrosion owing to braking separate stages of cathodic reactions; ionization of oxygen, diffusion of oxygen to the cathode and category of ions of hydrogen, that naturally inherent for such solutions as solutions NaCl [4].

Table 1 - Speed of corrosion in 3% solution NaCl of a powder composition Fe+10 of % MK, processed in various inhibitors

Inhibitors	Speed of corrosion on A/ sm^2	
	On extropolarization of cathodic and anodal curves	on gravimetric method
Without inhibitor	3,1·10-4	4,02·10-4
SK-3	1,15·10-5	1,20·10-5
IKSP	2,3·10-5	1,87·10-5
AGT-1	3,6·10-5	5,88·10-5
AGT-2	8,2·10-6	6,75·10-6

4. CONCLUSIONS

1. On the basis of the received data, it is possible to make the conclusion that the investigated materials Fe +10 % MK on its mechanical and physic - chemical characteristics not only does not concede, but even in some properties surpasses the compact steel St3.
2. Therefore investigated by us inhibitors, slowing down cathodic process of restoration of molecular oxygen in 3 % NaCl-e essentially reduces speed of corrosion of a porous material.

5. REFERENCE

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