Development of Metal Composite Materials with Macroheterogeneous Structure for the Application in Friction Pairs Working in Heavy Conditions

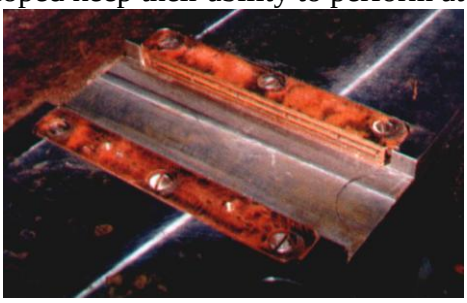
Uladzislau A. Kalinichenko, Head of laboratory, e-mail: kvlad@bntu.edu.by
Belarusian National Technical University, Minsk, Belarus

The development of new materials with improved service is the very important for material science. **M**etal **C**omposite **M**aterials with **M**acroheterogeneous **S**tructure (MCMMS) were developed in Belarusian national technical university for usage in heavy working conditions. Here was created new compositions of MCMMS based on the Cu- based matrix reinforced with rapidly solidified iron base granules. MCMMS are able to work under the high specific load matched with low sliding velocities and the elevated temperature when most tribological materials are unable to perform.

The production of MCCM parts is based on the casting technology. As a result the cost of these composite materials are lower compared to ones manufactured via a powder metallurgy route. The additional advantage is that the secondary nonferrous alloys and scrap can be used to cast composite parts. The casting technology is characterized with good flexibility resulting in the production of parts of the complex shape without any limitations in parts' sizes.

Casted composite materials were successfully applied to produce parts for the installation under the frame of the turbine's bearings support aiming the normalization of the turbine's thermal expansion.

Moreover some roller bearings can be replaced in friction units with plain bearings made of MCMMS. It is especially useful when the friction pair is working under the elevated temperature as the composite materials developed keep their ability to perform at the temperature up to 500 ^{o}C.



MCMMS plain bearings for the application in the system of the steam distribution

Another attractive feature of the MCMMS is the ability to form the friction film resulting in the considerable reduction of wear and the increase of the service life.

The additional increase in the reliability of friction parts and the service life can be achieved with the application of solid lubricative coatings, which are modified with special additions.

The question of reception of composite materials with macroheterogeneous structure sharply stands in global engineering. The given type of materials can be used both as pairs friction, and for other needs.

MCMMS parts in the friction unit to normalize the thermal expansion of the turbine

Also as an aspect of studying composite materials have been accepted on the based on the Al- based matrix reinforced with rapidly solidified iron base granules in diameter from 1,0 up to 1,2 mm. The way of introduction grains has been accepted as cast-mechanical.

For revealing optimum technology of reception of the given composition for a basis two kinds of moulding have been accepted, under normal and nonequilibrium conditions. It has been revealed, that at casting in equilibrium conditions incomplete wettability армирующей phases is observed, that at drives to formation of emptiness and shrinkable bowls. At use of nonequilibrium parameters this factor is out, thus growth dendrite structures of a matrix goes in a normal mode.

For use of any material as pair friction it should be investigated on tribotechnical properties.

Tribotechnical tests of samples of a composite were carried out on automated triometer unit, equipped by specially developed device for registration of factor of friction. At tests the counterbody made of tempered steel, with average speed of mutual moving ≅0,1 m/s was used.

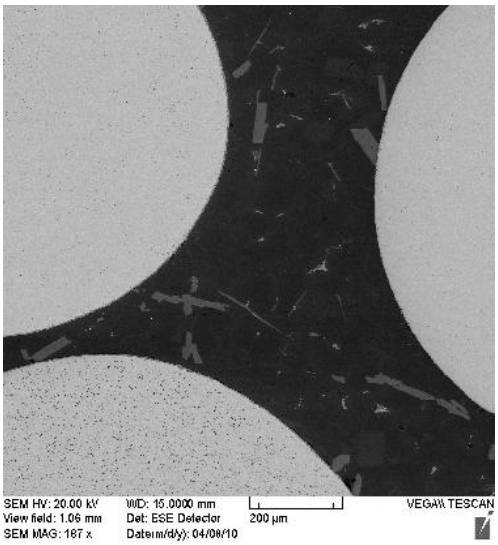


Image of Al – Fe composite Material

Specific loading made 2,0 MPa. Tests were carried out up to achievement of 15000 cycles with intermediate weighings after everyone 2000-5000 cycles. The way of friction for a unitary cycle of test made 0,06 m. The general way of friction at tests made 920 m. The copper counterbody has been revealed, that in process extra earnings of the rubed pair aluminium samples and, for example, become covered by a film of secondary structures. Thus friction is stabilized at loadings 0,5-2 MPa. Aluminium materials on antifrictional properties come nearer to properties of widely widespread electrocontact materials on an iron basis with lead, and under electric characteristics surpass them in 3 times.