ANTISEIZING PROPERTIES OF TITANIUM ALLOYS UNDER DIFFERENT CHEMICAL AND HEAT TREATMENT

Ju. M. Vinogradov, V. D. Dovzhenko and E. M. Polikarpova

Research Institute of Chemical Engineering
U.S.S.R.

Chemical and heat treatment (CHT) of titanium alloys for preventing their failure upon friction is based on general principles designed for ferroalloys but has its own characteristic properties related to the different chemical nature of these metals. The development of antiseizing CHT of ferroalloys was made based on the conception that a decrease in friction between metal surfaces and prevention of seizure upon friction was achieved by modifying friction surfaces with chemical compounds. As a result friction surfaces have lower resistance to shear, microcontact rupture upon friction is localized and is not followed by the tearing out of depth metal.\(^{(1,2)}\) From this conception it is stemmed that to obtain a high antiseizing effect chemical interaction between active compounds entering into the composition of salt baths used for CHT (or into the composition of material lubrication) and friction metal surfaces\(^{(3)}\) is necessary. In accordance with this conception the choice of chemical compounds for chemical and heat treated titanium alloys is made with the use of the method of thermography applied advantageously upon the development of sulphurization methods for ferroalloys.\(^{(3)}\) Chemical interaction was determined by the appearance of characteristic current on the heating curve of a differential thermocouple.

In order to evaluate the change in antifriction and antiseizing properties of titanium alloys different types of friction machine were used, namely: a four-roll friction machine that shows the load at which the seizing of rubbing specimens begins; a friction machine with backward-rotary motion of specimens based on the disk-spherical slider arrangement. At multiple passes of this machine the friction coefficient was measured at specific pressure in the range from 10 to 30 kgf/mm\(^2\) and an average rate of sliding equal to 0.04 m/min.
The following grades of titanium used in the machine building industry of the USSR were studied: BTl-0, OT4-1, OT4-Y, BT3-1, BT-6, AT-3, AT-6, etc.*

The recording of thermograms on the Kurnakov pyrometer allowed the following regularities of modifying titanium alloys to be revealed. Unlike ferroalloys for which the greatest effect is obtained when the surface is enriched with chemical compounds including the VI group elements (sulphur, selenium, tellurium) for titanium alloys these compounds give a less significant effect. The more active effect is obtained upon treatment of titanium alloys in salt baths containing the VII group compounds, in particular iodine compounds.

Figure 1 shows a thermogram of interaction between AT-3 titanium alloy and cadmium iodine. Two thermoeffects are seen: the melting of cadmium iodine at 390°C and interaction between cadmium iodine and AT-3 titanium alloy cutting. The close temperature range was obtained for other titanium alloys.

BTl-0 chemically pure titanium showed the highest activity upon chemical interaction. The higher the alloying of titanium the weaker is the modifying effect. In this respect there is an analogy with the processes of ferroalloy sulphurization.

*Editor's Note: Chemistry should be given.