ABRASIVE WEAR OF PLASMA SPRAYED TUNGSTEN-BASED COATINGS AND CHROME-BASED COATINGS FOR USE ON CYLINDER SLIDING SURFACES

Summary

The thesis concerns an innovative material solution of aluminum-silicon cylinder liners, which will allow for the improvement of functional properties, in particular, the reduction of the friction mean effective pressure (FMEP).

From unpublished data from manufacturers of internal combustion engines, it is known that scientific and research work as well as implementation work is being carried out on the use of thermally sprayed coatings containing carbides in a metallic matrix for the shaping of cylinder sliding surfaces. This data is not published because companies find it very sensitive and consider it to be their know-how. The solutions presented in the work belong to the "high technology" group.

Based on the results of previous research on the selection of thermally sprayed coatings for heat exchanger elements operating in abrasive wear at high temperatures, in the aspect of improving their durability, it was assumed that for the purposes of this work, WC-Co coatings or Cr3C2-NiCr coatings may be useful.

The substrate of the test specimens was aluminum-silicon plaques cut from an automobile engine block. The selected powders forming the coating were sprayed with the APS (Atmospheric Plasma Spraying) method.

The reference samples were made of gray cast iron with flake graphite used for Mahle cylinder liners.

Steel counter-samples were covered with chrome, and their rubbing surfaces were prepared by polishing.

The rubbing surfaces of the test specimens were made in two variants of the friction surface preparation, by polishing and by plateau honing.

The rubbing surfaces of the standard samples made of gray cast iron with flake graphite were prepared only by plateau honing, because this is how the cylinder liners - inserts of the blocks of engines of popular cars are prepared.

The abrasive wear tests were carried out on a test stand designed for this purpose, ensuring reciprocating movement in relation to counter-samples, with the frequency of changing the direction of movement f = 33 Hz. The load on the samples was 0.8 MPa. The abrasion process was carried out for 100 hours. During the abrasive wear resistance tests, breaks were made after 12 and 24 hours in order to perform profilometric tests of the surface of the sliding surface to determine the altitude parameter St (μm) and the altitude wear Δh (μm).

Sliding surfaces were also assessed using the metallographic method using a scanning microscope. The results of these tests were the basis for establishing further directions of research on improving the functional properties of the tested coatings.

The obtained test results confirm that the most useful coating is the WC-Co variant IB with a polished finish coat surface, for which the height wear Δh, after an abrasion time of 100 hours, was 0.32 μm and was significantly lower than the commonly used material solution, in the form of a honed cylinder liner - gray cast iron insert with flake graphite.