NASA TECH BRIEF

Composites of Porous Metal and Solid Lubricants Increase Bearing Life

The problem:

Solid lubricants are normally used as coatings or dry films bonded to dense metal substrates. In sliding contact, lubricant coatings eventually wear through, substrate metal contact occurs, and galling plus metal transfer results. Although wear life can be extended by use of composite bearing materials, those prepared by the customary powder metallurgy techniques have definite strength limitations.

The solution:

Self-lubricating composites of porous nickel and nickel–chromium alloy impregnated with a barium fluoride–calcium fluoride eutectic, plus an added thin film of solid lubricant to the load bearing surfaces.

How it's done:

Porous nickel specimens of 50% and 60% density, having a foam-like structure, are obtained commercially. Porous nickel–chromium alloy specimens are prepared by a standard powder metallurgy technique from 100-mesh powders. The powders, hydrostatically pressed at 20,000 psi and sintered in hydrogen for 1 hour at 2150°F, produce a porous metal body of about 65% density with typical pore diameters of 25 to 35 microns.

A porous metal specimen is placed in a metal container with an amount of powdered fluoride salt in excess of that required to completely fill the voids in the porous metal and sufficient to completely cover the specimen when the salt melts. The container is placed in a chamber that is sealed, evacuated, and heated to 2,000°F. Capillary action causes the molten salt to infiltrate the porous specimen and a slight overpressure is used by the introduction of argon or nitrogen to assure penetration of the innermost voids. After cooling, the specimen is spray coated with 0.001 inch of fluoride eutectic and sintered in hydrogen at 1750° for 10 minutes to establish a good bond between specimen and coating.

Notes:

1. While higher friction coefficients obtain, compared with coatings of the same fluorides on dense metals, lower wear characteristics resulting in longer wear life make this technique attractive for load-bearing sliding surfaces.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B67-10007

Patent status:

This invention is owned by NASA, and a patent application has been filed. Royalty-free, non-exclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

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Category 03