The Effect of Slider Geometry on the Performance of a Powder Lubricated Bearing

By:

Hooshang Heshmat, Ph.D., (Fellow STLE)
Crystal A. Heshmat (Member STLE)

Mohawk Innovative Technology, Inc.
437 New Karner Road, Albany, NY 12205
TEL.: (518) 862-4290/ FAX: (518) 862-4293

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Abstract

The experimental investigation was carried out for dry contact tribosystems to elucidate the ascertained, yet uncharacterized, relationship between the coefficient of friction, η, and apparent contact geometry in sliders. This paper presents the results of various experimentally evaluated slider pad width to length ratios, B/L (L is signified with direction of motion), while maintaining the unit loading constant. The empirical data is intended to provide guidance in design and in theoretical prediction of optimum bearing geometry for solid/powder lubricated systems.

In this experiment, a liquid lubricant, two different dry powders (MoS_2 and TiO_2), and four test specimens with B/L ratios ranging from 0.5 to 2.0 were used. An alternative experimental method has been used to simulate wear debris in the dry contact tribosystems, vis-à-vis dry powders, which were introduced into the interface gap to address the affinity of the wear process. Slider pads' performance characteristics as a function of the applied load (ranging from 34.5 to 345 kPa) and surface speed (0.004 to 4.5 m/sec) were determined at ambient condition. Experimental evidence shows that in the pre-hydrodynamic regime (low speed) the friction coefficient, η, decreases as B/L ratio increased from 0.5 to 1.5. Beyond a B/L ratio of 1.5, η increased with increasing B/L ratios. Optimum B/L ratio of 1 (based on measured minimum η) was identified for operation in the hydrodynamic regime. Overall reduction in η as a function of load was observed which is independent of B/L ratio and lubricant type. Also presented are the velocity effects on slider frictional performance.

Nomenclature

B	slider pad width
D	journal bearing diameter
h	film thickness
h_0	inlet film thickness
h_L	minimum film thickness
L	length (extent of slider)
ℓ	pivot distance
P	pressure, or unit load
N	rotational frequency (rps)
R_i	inner radius of the track
R_o	outer radius of the track
R_1	inner radius of the disk
R_2	outer radius of the disk
R_p	average radius = $(R_i + R_o)/2$
U	linear velocity
U_0	average velocity = $R_o (2\pi N)$
W	normal load
η	friction coefficient
θ	angular extent of the pad

Key Words

Friction

Hydrodynamic

Solid Lubricated

Hydrodynamic Lubrication

Lubricant Rheology

Quasi-Hydrodynamic Powder Lubrication*

Solid Lubricants

Molybdenum Disulfide

Titanium Dioxide

Solid Lubrication

Third-body*

Wear Regime

Solid Lubricated

* indicates key word which should be, but is not, in the STLE Key Word list

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