



WEAR AND FRICTION CHARACTERISTICS OF PTFE RUNNING AGAINST STEEL UNDER DRY AND OIL MIST LUBRICATED CONDITIONS

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ABSTRACT

The literature on the subject of wear and friction of materials has been around for more than a century. Still, to date, there is no generalized expression which can relate wear or friction to the operating parameters. This has presented the designers with a challenging task of determining the life of critical mechanical components that must operate safely during a specified life of the machine.

The objective of the current research is to determine the life of a bearing isolator, that is, in turn to determine the length of the time the contact pair PTFE vs. steel will run before certain amount of wear occurs, which is considered a failure. The approach taken is experimental.

A series of tests with different combinations of operating conditions is carried out with PTFE running against steel, to explore its characteristics in terms of wear and friction. The projected life is estimated by extrapolating the wear curves obtained. An attempt is also made to plot the performance trends for the bearing isolator by combining the data from multiple tests. Lastly, the effect of oil mist lubrication on the performance is also studied.

INTRODUCTION

Bearing isolators are extensively used in rotating machinery to isolate the bearings from the outside environment. Their primary function is to prevent the lubricating oil from leaking out, and also to prevent the entry of external contaminants and moisture into the housing. These applications demand the accurate knowledge about the performance and the degradation of material with time. Knowledge of the wear/friction characteristics in the operating range helps monitor the functioning, and any repairs or replacements can be anticipated and properly planned to avoid failure.

In some applications, the contact is dry while in others oil mist lubrication is utilized. In the latter case, the oil film is broken into fine, fog-like oil particles which are conveyed to the final location where they again coalesce into bigger droplets which deposit on the bearing surfaces to lubricate them. The presence of oil mist around the contact surfaces

is expected to give improved performance in terms of reduced wear rate, coefficient of friction, and surface temperature than in the case of a dry contact. By conducting experiments with oil mist, this improvement can be quantified. The parameters like volumetric mist flow, velocity of mist etc. can also be optimized by studying the variation of the performance with these parameters.

EXPERIMENTS

Testing a product at full scale by simulating all actual loads and speeds, though is the best method to find out the actual running life, is expensive and most importantly, not always feasible within the laboratory testing limits. Instead, number of accelerated tests of shorter duration under different pressure and velocities can be performed on the testing specimens to obtain wear patterns, and to deduce the component life.

As a part of this study, the author is currently engaged in performing a large number of experiments at Center for Rotating Machinery (CeRoM) at LSU using vertical type tribometer. Real-time values of wear, friction, and temperature are recorded for each of the tests. For conducting tests with oil mist, an attachment has been designed and manufactured to provide the oil mist environment surrounding the contact surfaces. Tests also have been run for same running conditions, with and without the presence of oil mist for the sake of direct comparison.

RESULTS & DISCUSSION

A sample test result is presented in Figure 1. The test was run under 20 psi and 750 fpm for 5 hours duration. The testing samples used conform to ASTM D 3702, which outlines the standard test method for determination of wear rate and coefficient of friction using a thrust washer test machine.

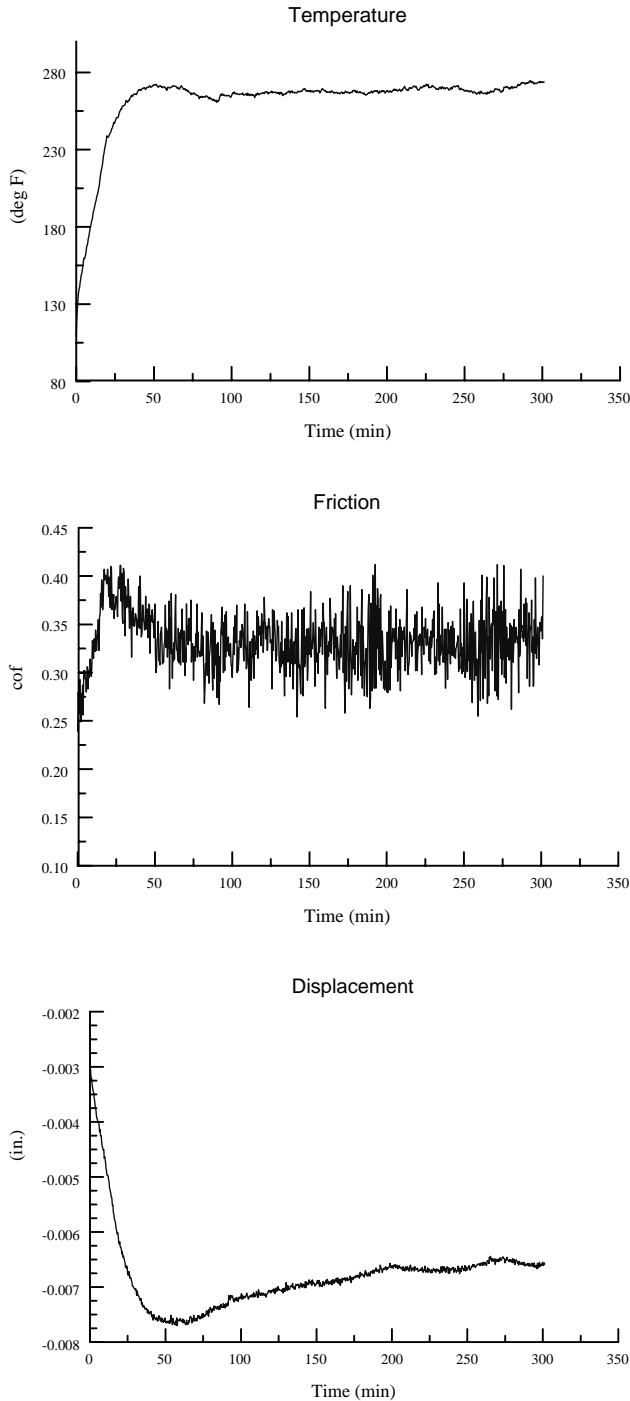


Figure 1 :Variation of temperature, friction, and displacement with time

The temperature increases until it reaches a steady state, the time taken for which depends on the operating conditions selected. The coefficient of friction also reaches its steady value around at the same time. The negative slope in the displacement curve initially is due to thermal expansion of the test samples. Wear rate and wear

coefficient (K) can be calculated from the displacement graph against time.

Insight into the wear characteristic and performance of bearing isolators can be gained by collectively analyzing the wear data for all the tests. Appropriate analysis will include accelerated wear to predict the life of the component under a given operating condition. Fitting a master curve to all the test data and developing a general equation for wear, valid for this bearing isolator within a certain range of pressure and velocities, will be useful to the designer and the end users of these components. It is anticipated that the extrapolation of this equation will enable determination of the wear life under given conditions. The dependence of the constants in the equation can be shown to the pressure and velocity values. This forms the basis for ongoing and future work.

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