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Researches on Wear Evolution of Xylan 1052 Two-Layer Coating under Hard Working Loads or Different Rotational Speeds

Assuming that vibration and noise amplitude depend on coating thickness, here were performed important tests about wear of the Xylan 1052 coating. Applying variable contact stress by different load pressures on a disk coated, and keeping the rotational speed constant, a wear evolutions diagram has resulted. Also, a diagram with the wear evolutions of Xylan 1052 coating has been achieved by using the same load pressure and varying the rotational speed. This information offers significant knowledge about Xylan 1052-film wearing, reflecting an appreciation of the running-in period and the coating thickness. Further on, the proper working time is accomplished, as well as the minimum coating thickness whereas the covering becomes irrelevant to use.

Keywords: *wear evolution, Xylan 1052 coating, contact stress, rotational speed, coated disk*

1. Introduction

Wear evolution concept gives an important amount of information about how the equipments, systems or one element wears out during operating time. Usually, all the components of mechanical equipment are under a controlled wearing in the running-in period, in order to get the proper parameters for best operation. Operational period of a component consists in working under optimal parameters and it is ending when one of the determinative parameters gets out of the functioning admissible range. In this case, the material under testing is a special fluoropolymer - Xylan 1052. Thus, a 35 µm Xylan 1052-two layers coating, applied on a steel disk, was the subject of various tests.

2. Hylan 1052 coating

Xylan 1052 is not pure Teflon. Each type of the Xylan coating is a combination of ingredients and each one is designed for a variety of applications. Xylan 1052 was developed specifically for dry film lubrication and anti-galling. It contains a mixture of MoS_2 (molybdenum disulfide) and PTFE (polytetrafluoroethylene).

Usual, thin-film coatings presents pin holes. All organic coatings are inherently subject to pin holes, tiny, but visible, actually perforations in the surface of the coating caused by incomplete flow or bubbles that explode during cure. Thus, Xylan coatings have been engineered to maximize flow and minimize bubbling. One coat simply cannot assure the absence of pin holes.

All Xylan coatings are designed to meet certain specifications. Some may be for low friction, for release, abrasion resistance, chemical resistance, UV stability, etc. For now, it is chemically impossible to create one coating that is best at providing all of the qualities and characteristics listed above.

3. Testing disk conception

The conception is based on the amount of tests that have to be up to at least 30. The 140 mm diameter offers the possibility to get an important variation of sliding speed with a small variation of disk rotational speed, as well. The test area is inferior limited at 40 mm and superior at 120 mm. Area between 120 mm and 140 mm is kept as spare one, in the case of mistakes occur during tests.

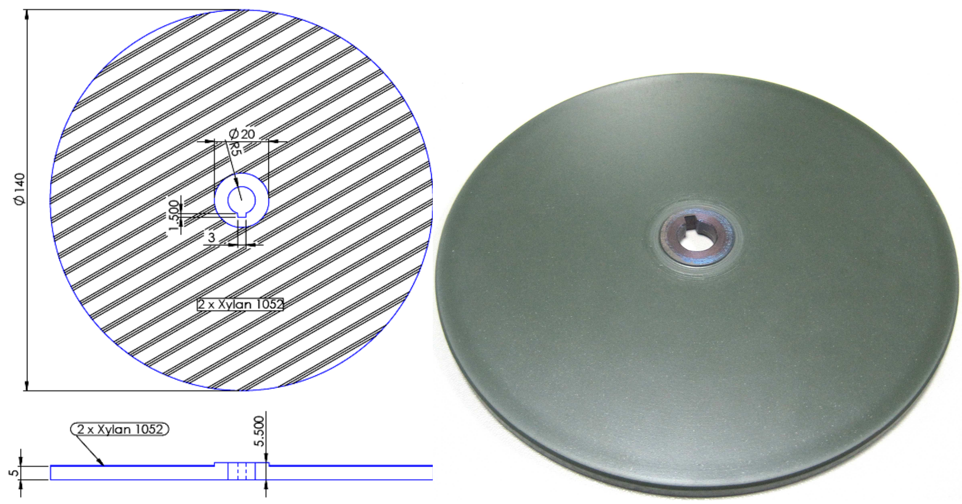

Figure 1. Disk dimensions and realization

The disk is made from steel (OLC 45) that represents the support for Xylan 1052-two layer coating. All the characteristically dimensions are given above in Figure 1.

4. Testing stand description

Testing stand provides, basically, possibilities to rich the all demands suchlike in the case of pin-on-disk tests.

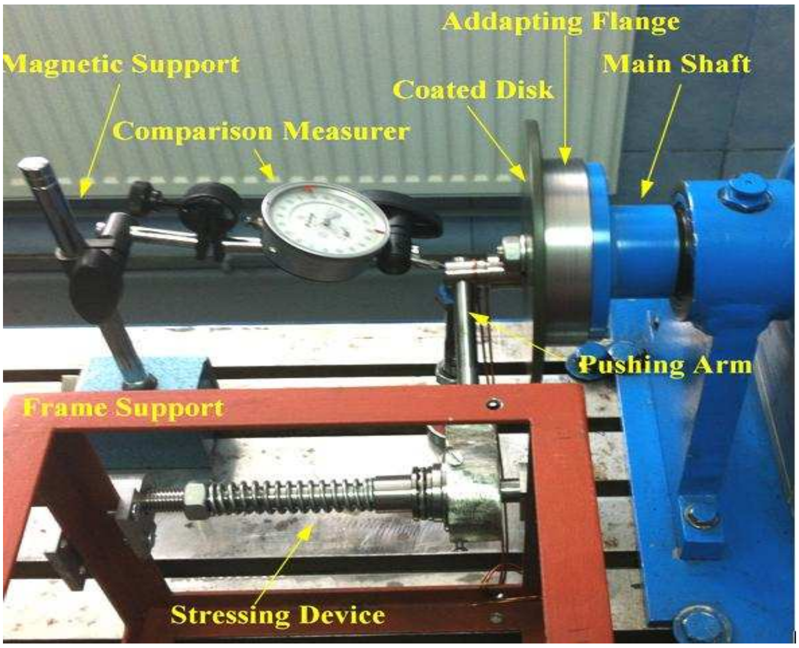

Figure 2. Testing stand

The testing stand provides, basically, possibilities to rich the all requirements suchlike in the case of pin-on-disk tests. The disk is driven by a DC motor via the main shaft. Adapting flange ensure the fixing of disk to the main shaft with minimum frontal and radial errors.

The contact stress values require for tests are given by the stressing device wich is fixed in a frame support. This creates the load pressure using a helical spring through a pushing arm which ends with a ball bearing head. The last nominated fixes the 9 mm diameter ball bearing and ensure the sliding along the arm for the wear path establishing.

The measurments are performed by a mechanical comparison measurer with 1 μm base unit. The display assure the approximation of a half of unit, if needed. It is mounted in a magnetic support.

5. Results

In figure 3, the wear of Xylan 1052 coating was tested at 30 N/mm^2 constant load pressure and variable sliding speed, accomplished by reading the displacement of ball bearing head, in the perpendicular direction to the disk. Sliding speed has been varied on three levels: 970, 1900 and 2910 mm/s.

The reading time intervals are variable in the following way: 0, 0.01, 0.05 0.1, 0.2, 0.3, 0.4, 0.5, 1, 1.2, 1.4, 2, 2.2, 2.4, 3, 3.2, 3.4, 4, 4.2, 4.4, 5, 5.2, 5.4, 6. Unit means the number of hours and subunits the tenth of minutes, respectively minutes. These were converted to hours and decimal of hours, 60 minutes becoming proportionally to one unit of an hour.

Intervals are smaller in the beginning for the tests with high wear speed and bigger for long time test, in order to receive accurate information in several cases.

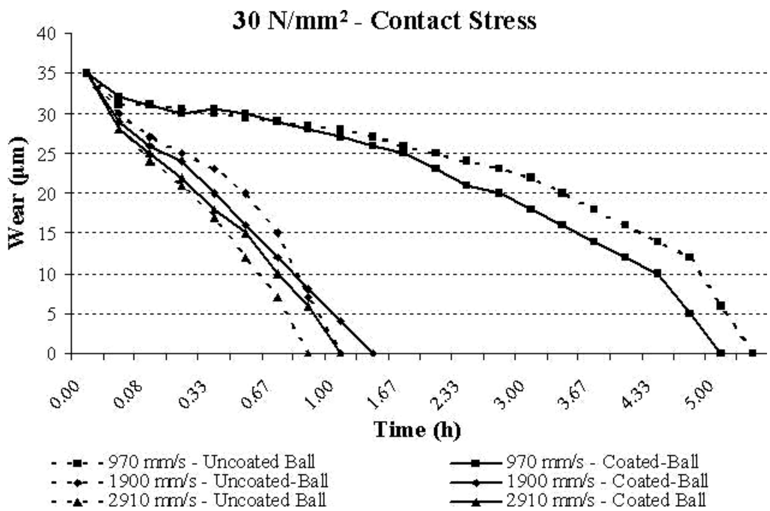

Figure 3. Results for dry tests at variable rotational speed

At the first look, it is easily to observe that the wear is hardly diminishing with the sliding speed increment. The tests with uncoated ball bearing were elapsed in about the same time as in the case of coated ball bearing.

It is visible the grouping of wears for low sliding speed and high sliding speed, where the wearing evolution is very fast.

Further on, in figure 4, the sliding speed is maintained constant at 970 mm/s, the contact stress being changed between: 30, 60 and 120 N/mm^2. Also in this case were used uncoated and coated ball bearings against coated disk. It can be highlighted from the diagram shown above the fact that the evolution curves under the same load are grouped more distinctly.

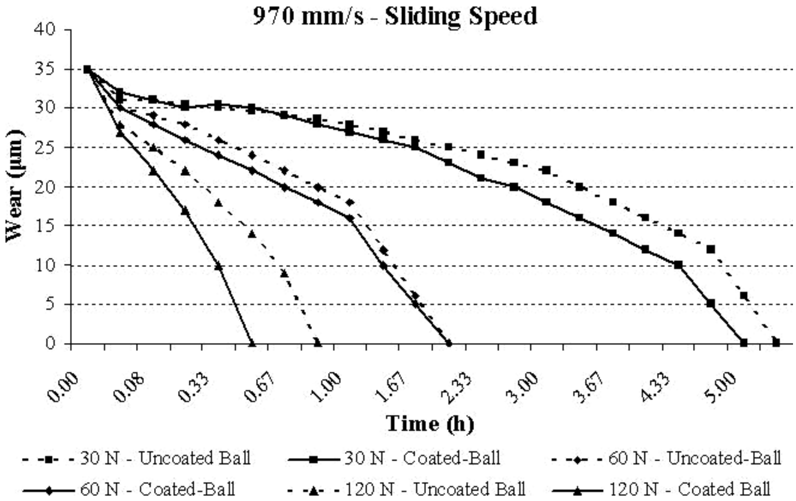

Figure 4. Results for dry tests at variable contact stress

6. Conclusion

Dry tests were revealed three important facts. The most important is the identical shape of all wear evolution curves that presents three stages:

- in the first 5 minutes in which, with small deviations, all tests show a fast wearing of Xylan 1052 coating, this behavior could be assumed as running-in period, in which the material is going to supporting a kind of compaction;
- after compaction, a steady state period is occurring, in which, proportionally to the entire wearing time, Xylan 1052 coating has mostly a linear wear evolution, which is much longer than the other;
- at the end, wearing evolution is drastically manifesting, the last micro-meters disappearing fast.

The second fact reflects a great difference between 970 mm/s sliding speed and its increasing over this limit, but under the same proportionally contacts stress, the coating behavior being not the same.

As a last thing, it is important to understand that under dry tests, is not a notable difference regarding the contact of the same both-coated surfaces and uncoated ball and coated disk.

Acknowledgement

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