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Lubrication Influence on Wear Evolution of Xylan 1052 Coated Disk Tested at Various Rotational Speed and High Contact Stress

This paper relates the lubrication influence on the Xylan 1052 coating applied as the surface layer of a testing disk. By pressing a coated and uncoated bearing ball against the surface of coated disk having different rotational speeds, wear evolution diagrams have been achieved. Tests were performed in three specific conditions, when the disk coated surface is: dry, under poor or continuous lubrication. These conditions allow understanding the influence of poor or continuous lubrication on the behavior of coated disk surface at the contact stress. Such conditions could practically occur due to some problems appearing in industrial environment.

Keywords: *wear evolution, dry test, poor lubrication, continuous lubrication, Xylan 1052 coated disk*

1. Introduction

In industrial environment sometimes mistakes can occur, leading to loses of the lubricant between mechanical parts. It is important to know how long the mechanical parts coated with Xylan 1052 can operate in such conditions and in what way the wear progresses.

To acquire this information, several tests on a disc of 35 μm thickness Xylan 1052 coated were performed. The tests consist in applying a force, considered from previous tests as high, by a ball bearing pushed on the disc covered surface. A high pressure has been applied in order to decrease the testing time. In the same time, the wearing evolution diagram keeps mostly the same shape particularities.

Showing also interest to the nature of area which performs the pressure, another ball bearing with the same dimensions was coated with Xylan 1052, as well.

After the moment of the lubricant losing, the surface will still remain poor lubricated for a while. This condition was achieved by once-moistening the disk surface with lubricant, the method being called one-touch lubrication.

2. Conceptual presentation of the test stand

The testing stand was developed in order to accomplish wear test requirements for different conditions, suchlike: variable rotational speed, variable load pressure, wear fending and wearing measurements.

The principle is quite easy to understand, consisting in a 9 mm diameter ball bearing which is pushed against the coated disk surface.

Rotational speed is provided by a DC motor and transmitted to disk through a turning shaft.

Helical spring drives a pushing arm which ends with a ball bearing head, in this way being achieved the variable contact stress. The pushing arm and the helical spring glide along a vertical axis. The ball bearing head ensures the wear path variation between the disk center and the edge of it.

For the two kinds of surfaces having contact, two ball bearings were used. One ball was Xylan 1052-two layer coated for coated-to-coated contact. The other ball was left uncoated for uncoated-to-coated contact achievement.

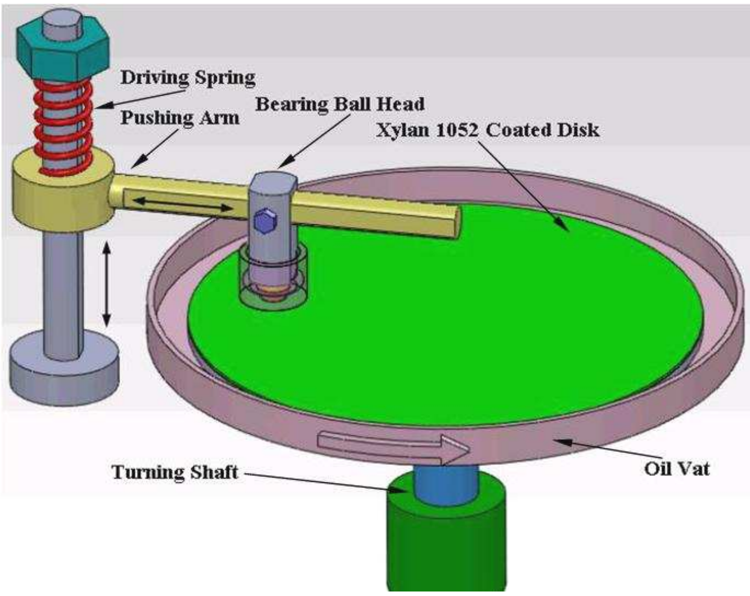

Figure 1. Functional scheme of the testing device

Figure 1 shows the scheme of the test stand, which represents a part from a simulation performed in SolidWorks software platform.

3. Xylan 1052 coated disk wearing

Figure 2 highlights, in the left side, an important part of the tested disk and reflects the wearing paths. Right side pictures shows the wear areas disposed for various types of wearing.

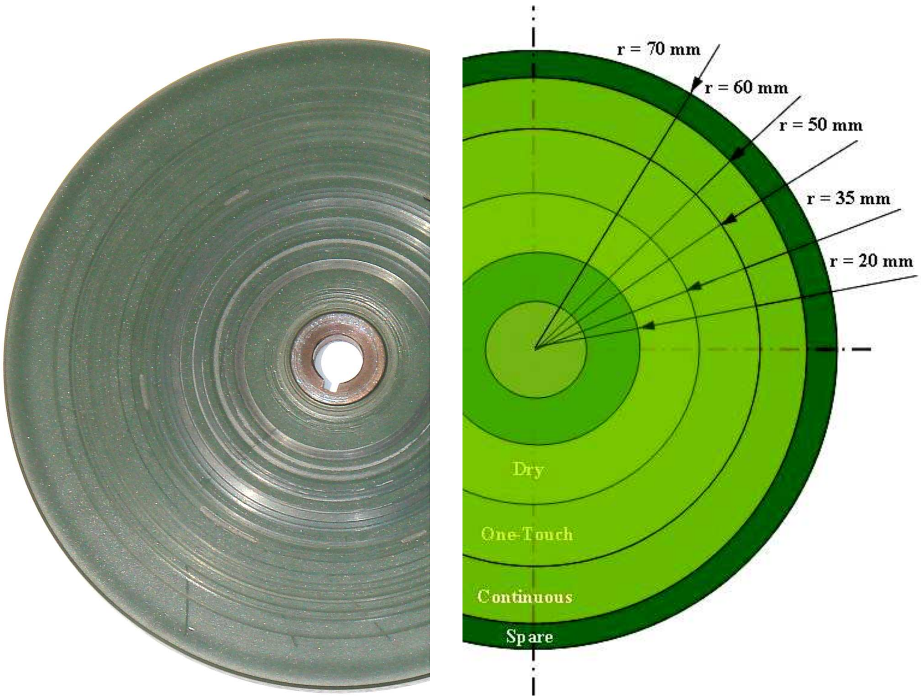

Figure 2. Coated disk presenting wear paths and the location of tested areas

Basically, wear paths were accomplished by dry, under poor and continuous lubrication tests, taking in account that into the each area lower sliding speed was located closer the center of disk and higher sliding away from it.

Poor lubrication was achieved by moistening the coated disk surface just one time. This procedure has been named one-touch lubrication.

4. Results

The results obtained during tests are given below as wear evolution diagrams.

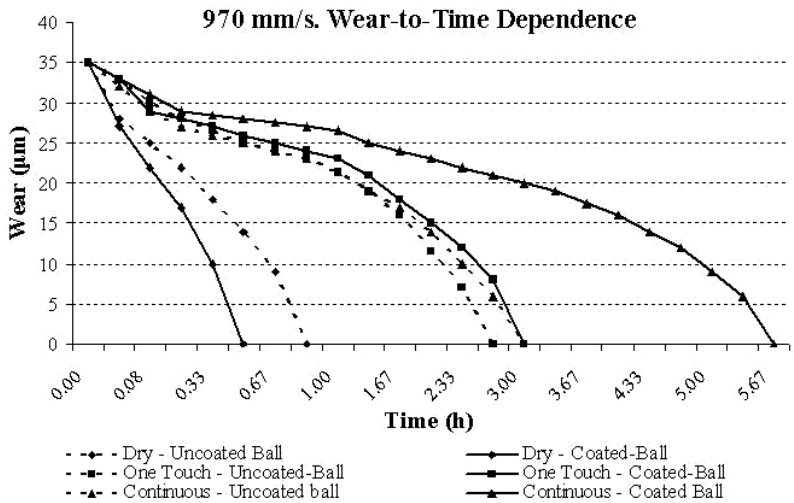

Figure 3. Wear evolution diagram for 120 N/mm^2 contact stress and 970 mm/s rotational speed

Thus, at the 970 mm/s sliding speed, using coated and uncoated ball bearings, results for three types of contact state have been achieved. It was observed that the wearing test corresponding to coated ball under continuous lubrication of disk surface has the best behavior and the longest time duration. Opposite, uncoated and coated ball against dry disk surface tests have the shortest wearing time.

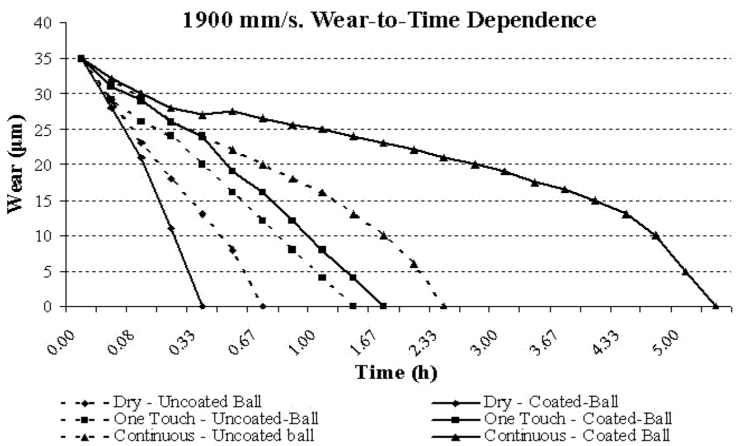

Figure 4. Wear evolution diagram for 120 N/mm^2 contact stress and 1900 mm/s rotational speed

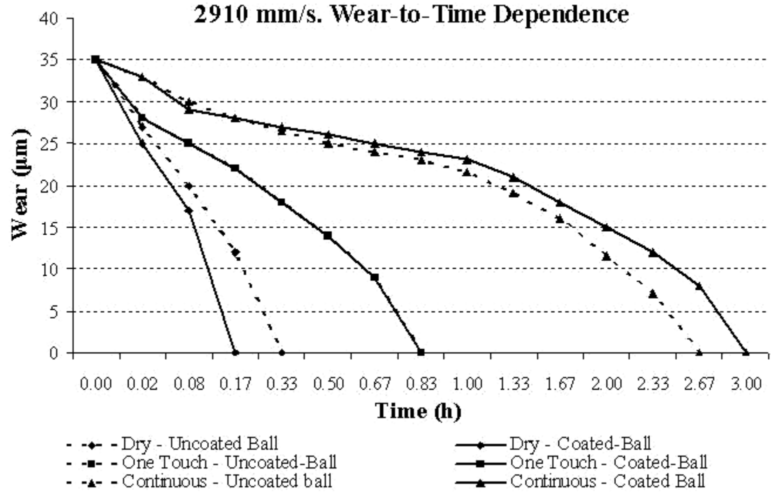

Figure 5. Wear evolution diagram for 120 N/mm^2 contact stress and 2910 mm/s rotational speed

Increasing the sliding speed, a better grouping of wearing evolution curves is observed, figure 4 and 5. Wearing time becomes shorter almost proportional to the sliding speed increment as well.

5. Conclusion

The most important observation is the great difference between tests with coated and uncoated ball at dry or continuous lubrication. Thus, better behavior of coated ball under lubrication is not repeated in the case of dry tests and this is not depending on sliding speed.

Very important is also the fact that the wearing curves group of the one-touch lubrication tests at 970 mm/s, the sliding speed being nearly of continuous lubrication group and, once with the speed increment, the one-touch group moves nearing of dry tests group. That means that in the case of lubricant losing, Xylan 1052 coating will wear not proportionally faster at higher speeds.

Another important fact is the drastically decrement of wear time between 1900 mm/s and 2910 mm/s sliding speed, meaning that the Xylan 1052 coating is not properly adapted for those applications that could use sliding at high speed.

Acknowledgement

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