Experiment Number 14

How quickly does the wear scar grow in a sliding point contact experiment and what effect does this have on the nominal contact pressure?

Background

In running ball on flat wear tests, there is often an implicit assumption of a linear wear rate, from which it is assumed that the longer the test, the greater the resulting difference in wear scar dimensions, between nominally good and nominally bad candidate samples.

Test Method

Ball:	6 mm diameter 52100 steel
Plate:	NSOH BO1 steel gauge plate
Plate Hardness:	Annealed
Stroke:	20 mm
Frequency:	5 Hz
Load:	28 N
Temperature:	50°C
Lubricant Samples:	Base Oil

Method

On-line wear displacement measurements were taken. Post-test measurement of the resulting wear scars were used to back-calibrate the displacement measurements to generate a nominal change in contact area, hence contact pressure.

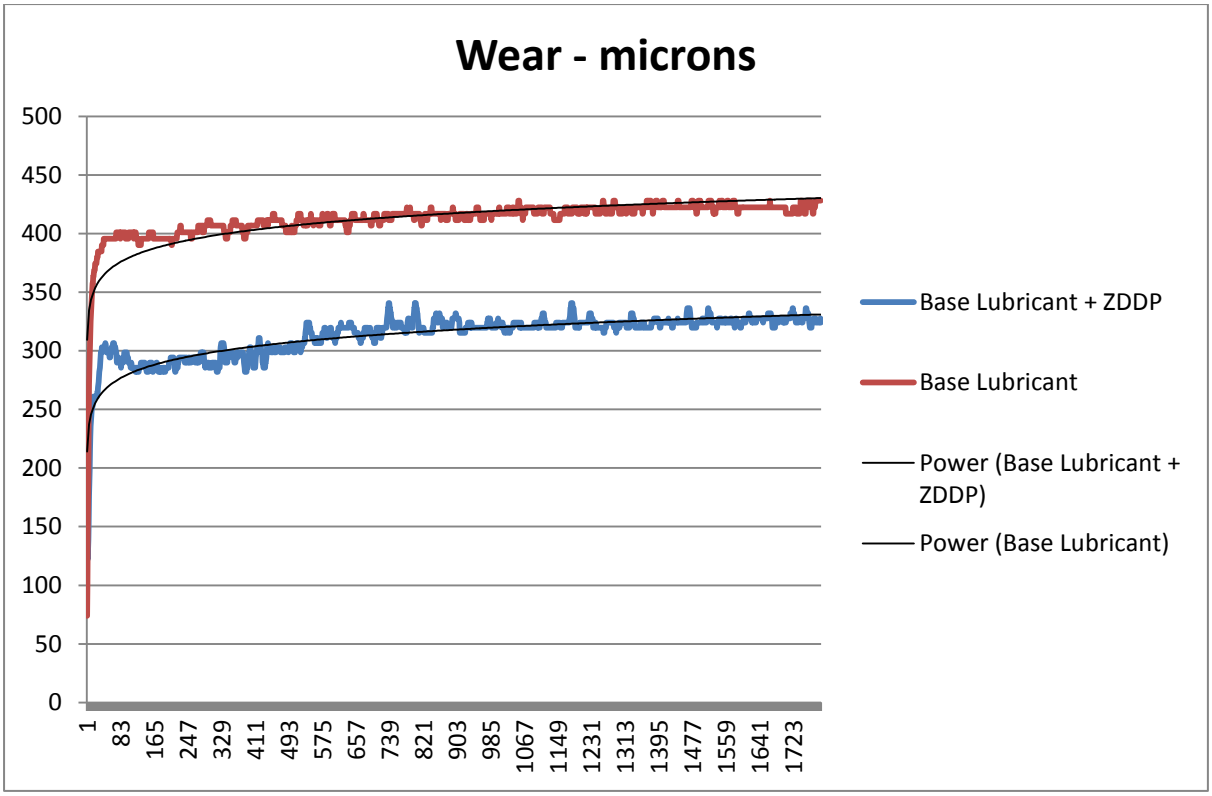

Figure 1: Comparative wear displacement, back-calibrated from post-test scar measurement

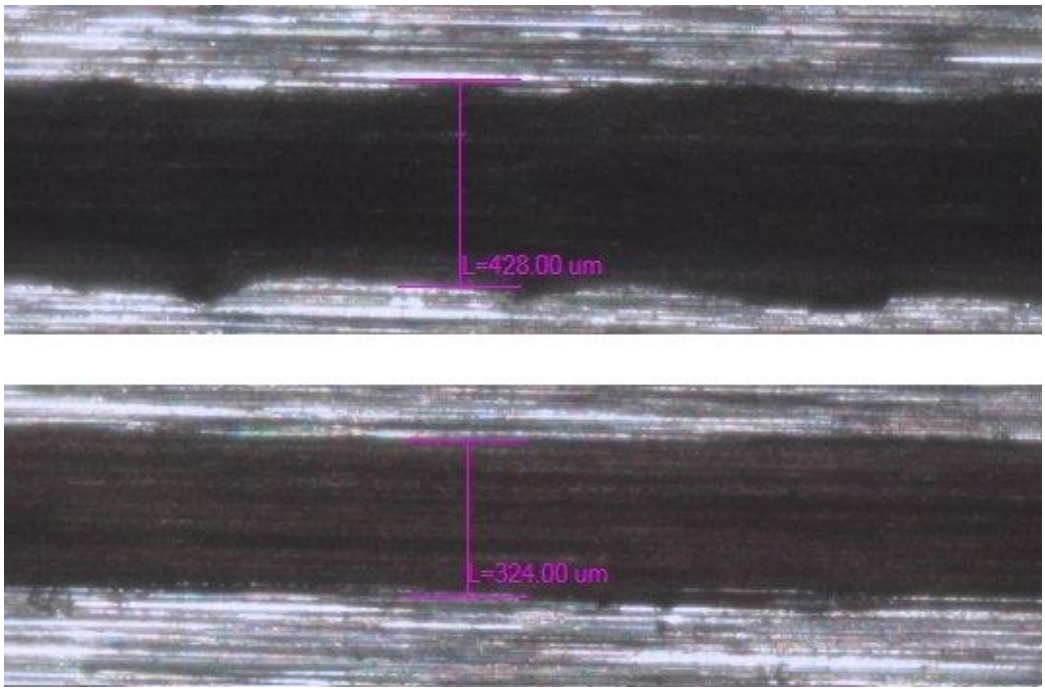

Figure 2: Microscope measurements of wear scar

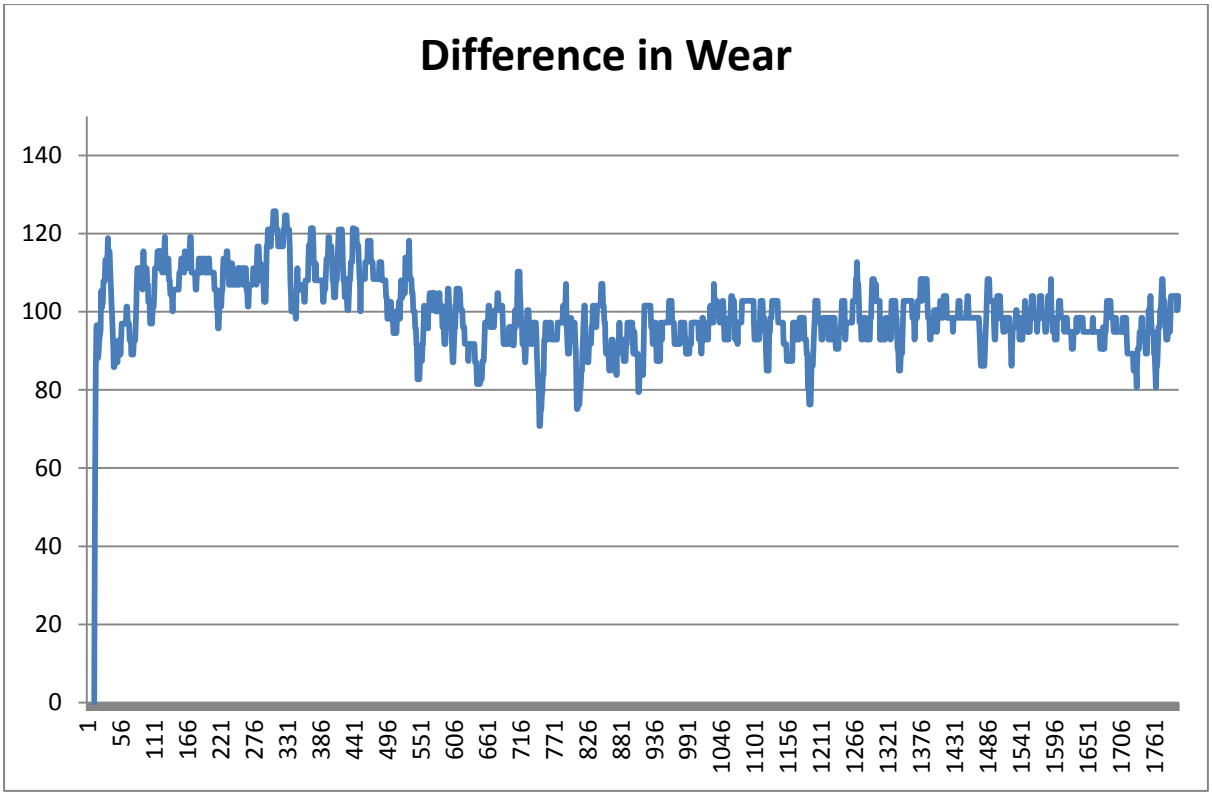

Figure 3: Difference in wear scar width Base Oil minus Base Oil + ZDDP

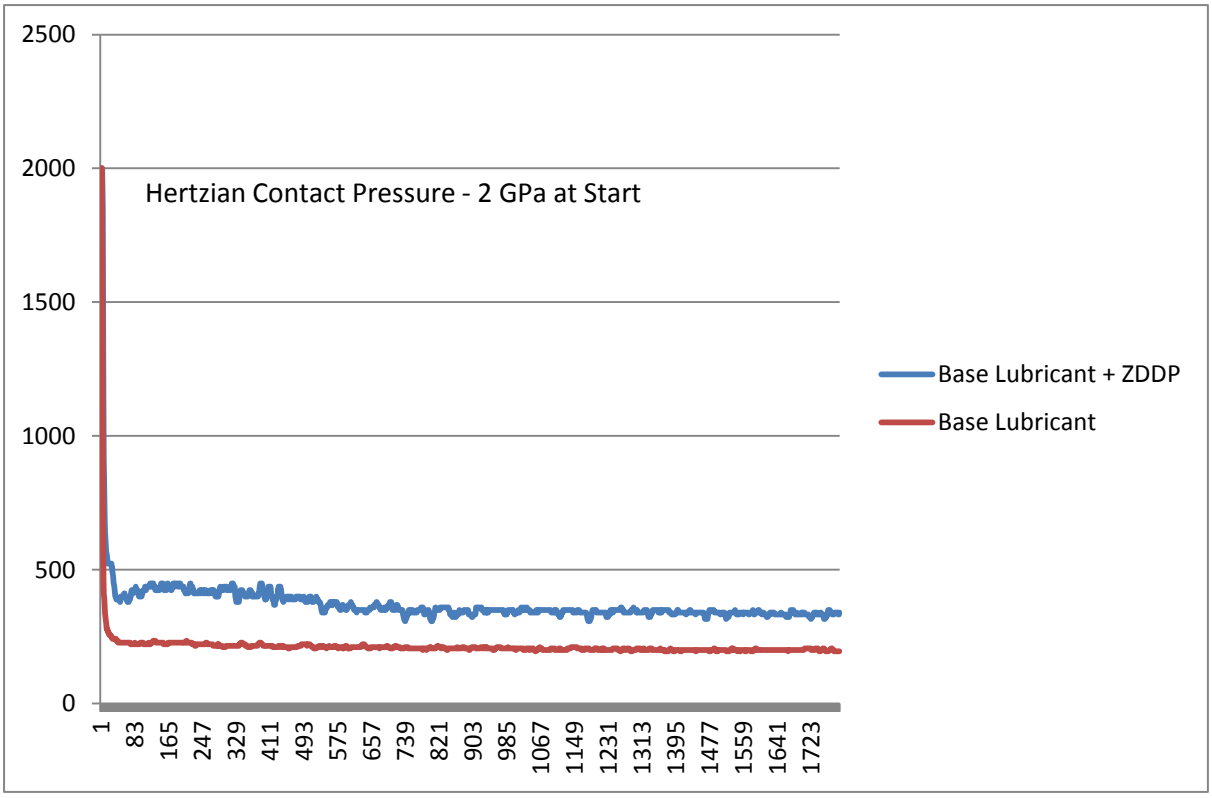

Figure 4: Calculated contact pressure (MPa)

Comments

Figure 1 shows that with both lubricant samples, after an initial running in period during which the wear displacement increases rapidly, reducing the resulting contact pressure, the wear processes stabilise and the rate reduces to a low level. The trace for the Base Oil + ZDDP sample shows that the efficacy of ZDDP only becomes apparent once the wear scar has reached a certain critical size.

Figure 3 shows that the difference in wear scar width is established within the first minute of running. In this example, the difference stabilises at approximately 100 microns. This difference does not increase significantly with elapsed time, raising the question as to whether there is any advantage in running long duration tests with this test configuration.

One minute of running under these test conditions produces a total sliding distance of 12 m. This compares with a total sliding distance of the standard HFRR fuel lubricity test of 900 m.

Figure 4 shows the effect on nominal contact pressure of the increase in contact area associated with the wear process. The transition from a high hertzian starting pressure to a relatively low area contact is almost digital, which goes some way t explaining the general insensitivity of this test configuration.