

Experiment Number 16

Can we use a stop-start test to deplete the additive and thus make the test more sensitive to additive concentration?

Background

Many tribological experiments are run under steady state conditions. Running stop-start sequences allow surfaces to be progressively modified and can increase sensitivity of results to additive concentration.

Test Conditions

Moving Specimen: 6 mm diameter x 10 mm long 52100 cylinder in line contact

Fixed Specimens: NSOH BO1 tool steel (through-hardened)

Initial Load: 20 N

Stroke: 25 mm

Frequency: 0 to 5 Hz

Number of cycles: To be determined

Temperature: 50°C

Fluid: 10 ml PAO + FM

Test Sequence :

Apply 20 N load

Ramp speed to 5 HZ in 1 minute

Ramp load to 200 N in 1 minute

Run in at 200 N and 5 Hz for 13 minutes

Ramp frequency to zero in 10 seconds, hold for 10 seconds, ramp speed to 5 Hz in 10 seconds, hold for 10 seconds. Repeat sequence for 100 cycles total

Ramp speed to 5 HZ in 1 minute

Ramp load to 300 N in 1 minute

Ramp frequency to zero in 10 seconds, hold for 10 seconds, ramp speed to 5 Hz in 10 seconds, hold for 10 seconds. Repeat sequence for 100 cycles total

Test Results

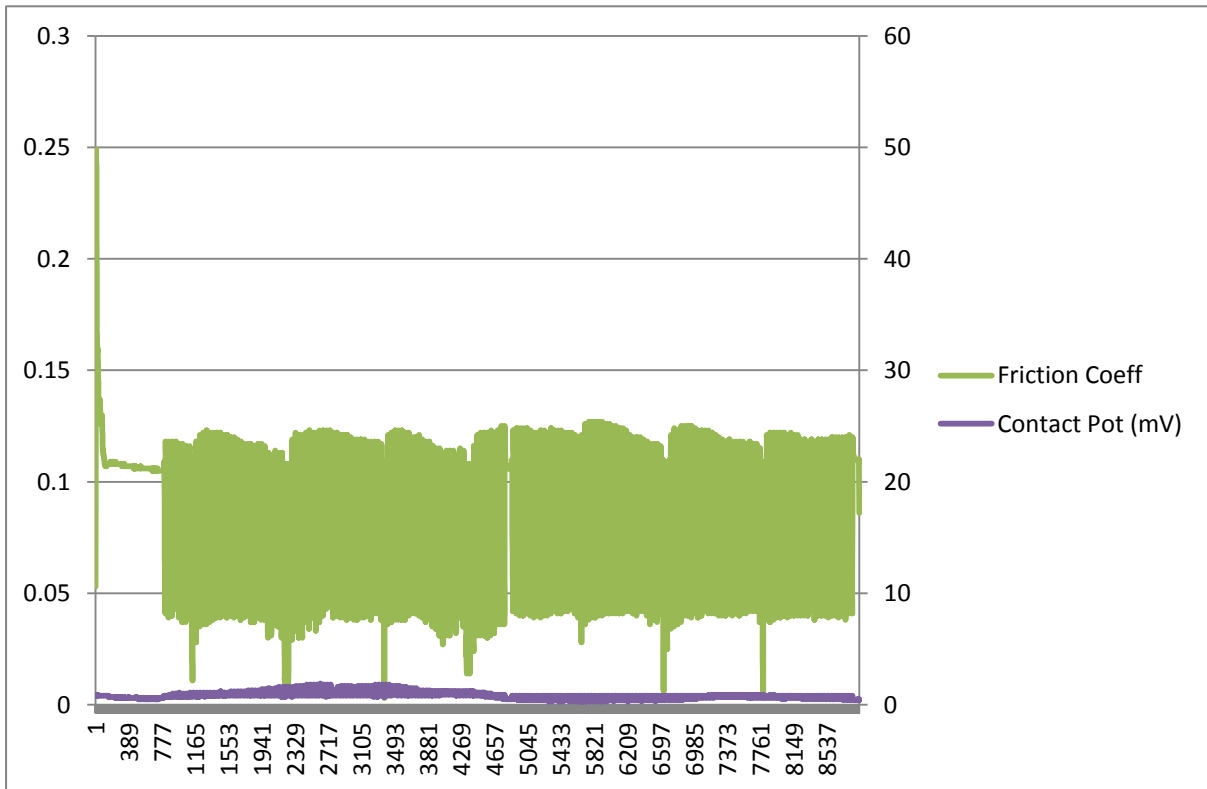


Figure 1: Stop/Start - Hard Plate - 0.5% FM

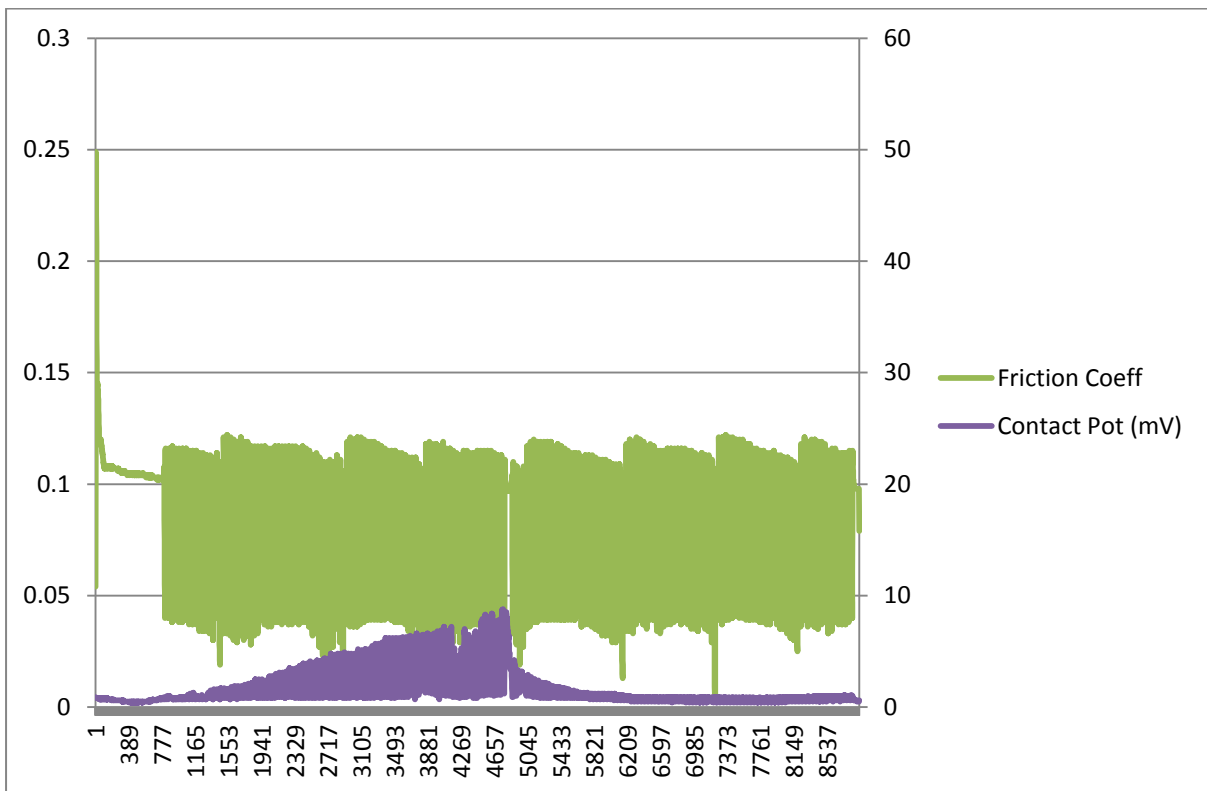


Figure 2: Stop/Start - Hard Plate - 1.0% FM

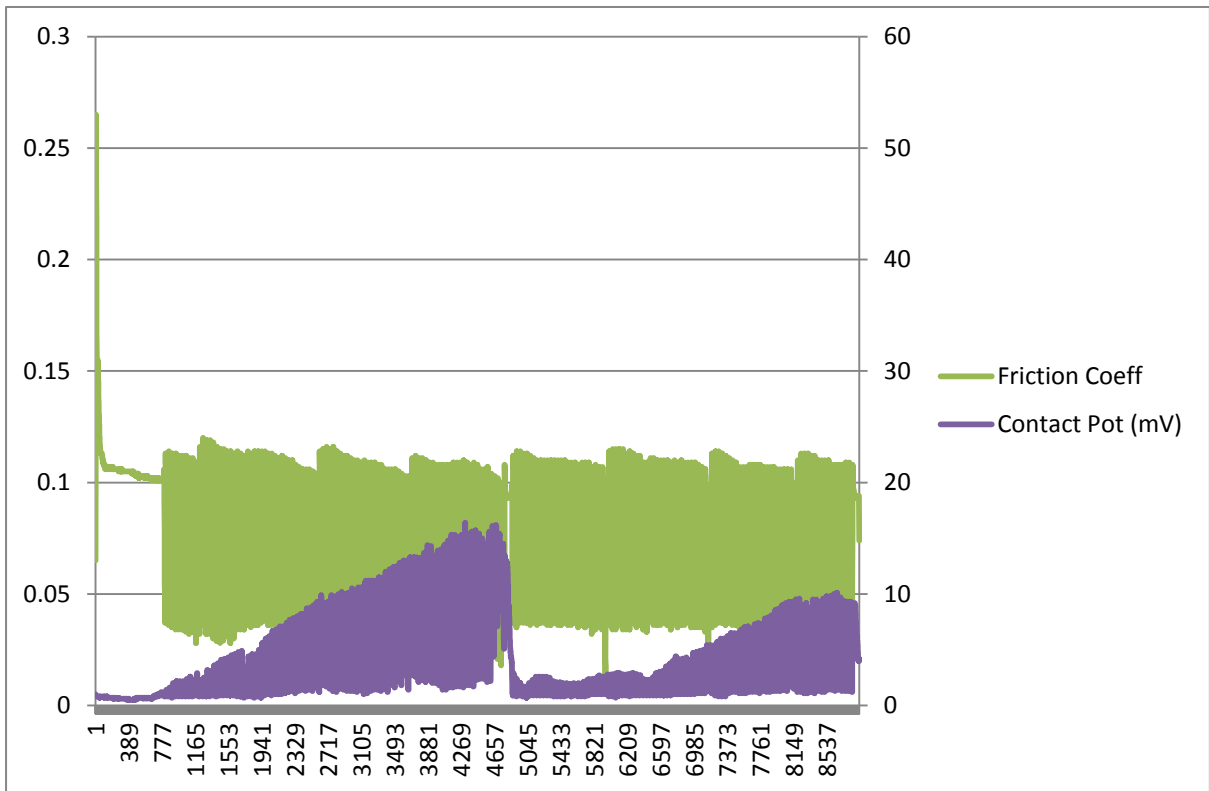


Figure 3: Stop/Start - Hard Plate - 1.5% FM

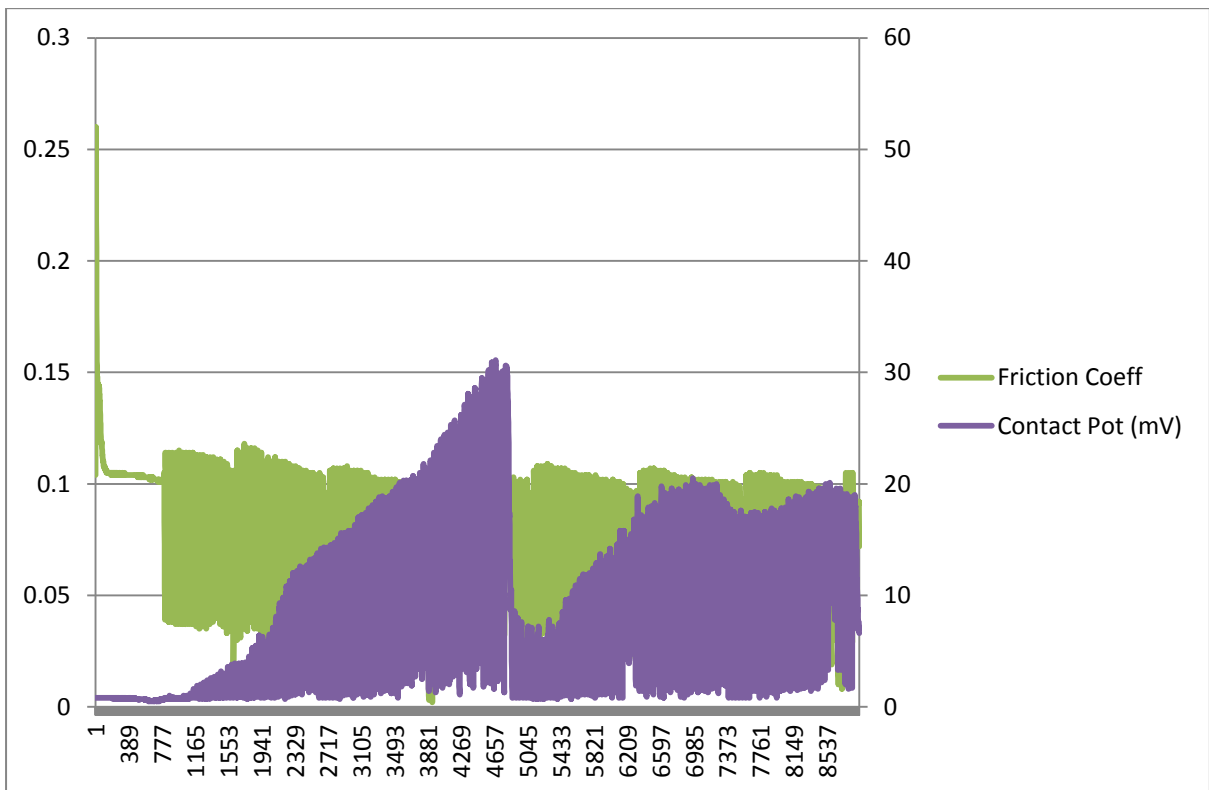


Figure 4: Stop/Start - Hard Plate - 2.0% FM

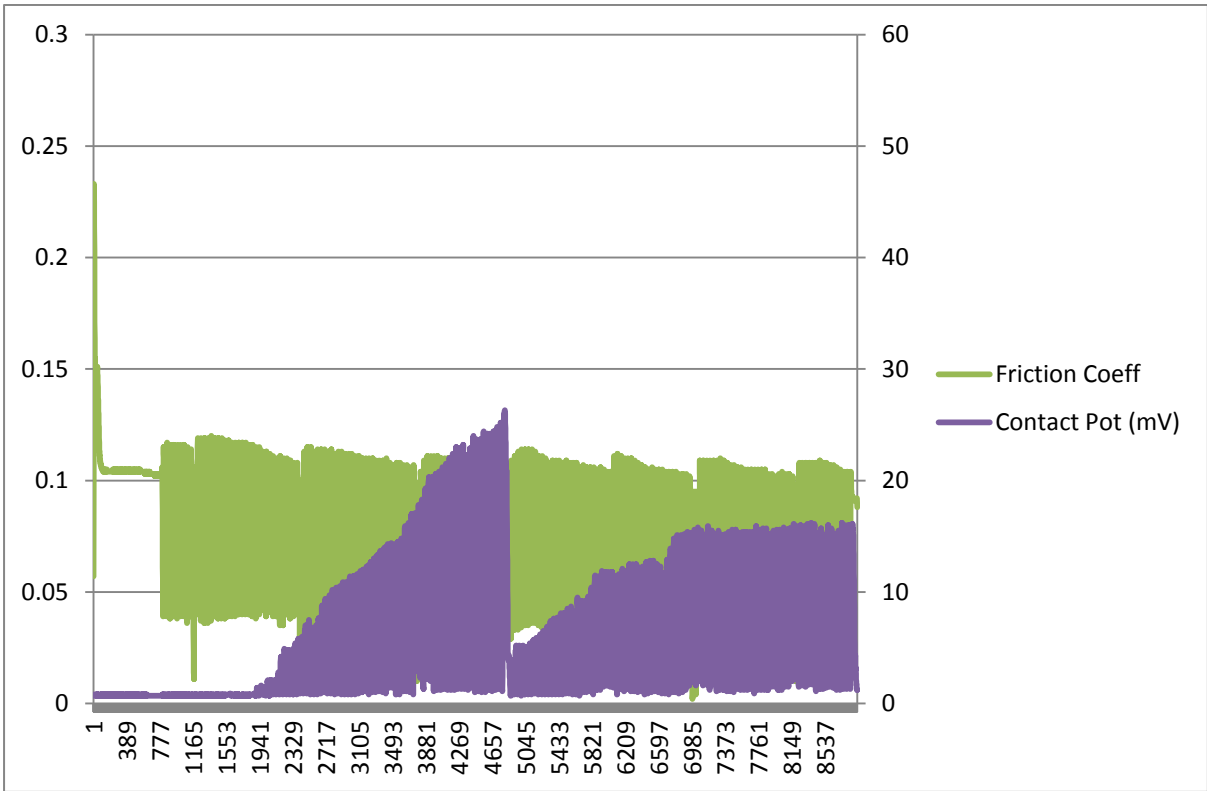


Figure 5: Stop/Start - Hard Plate - 2.5% FM

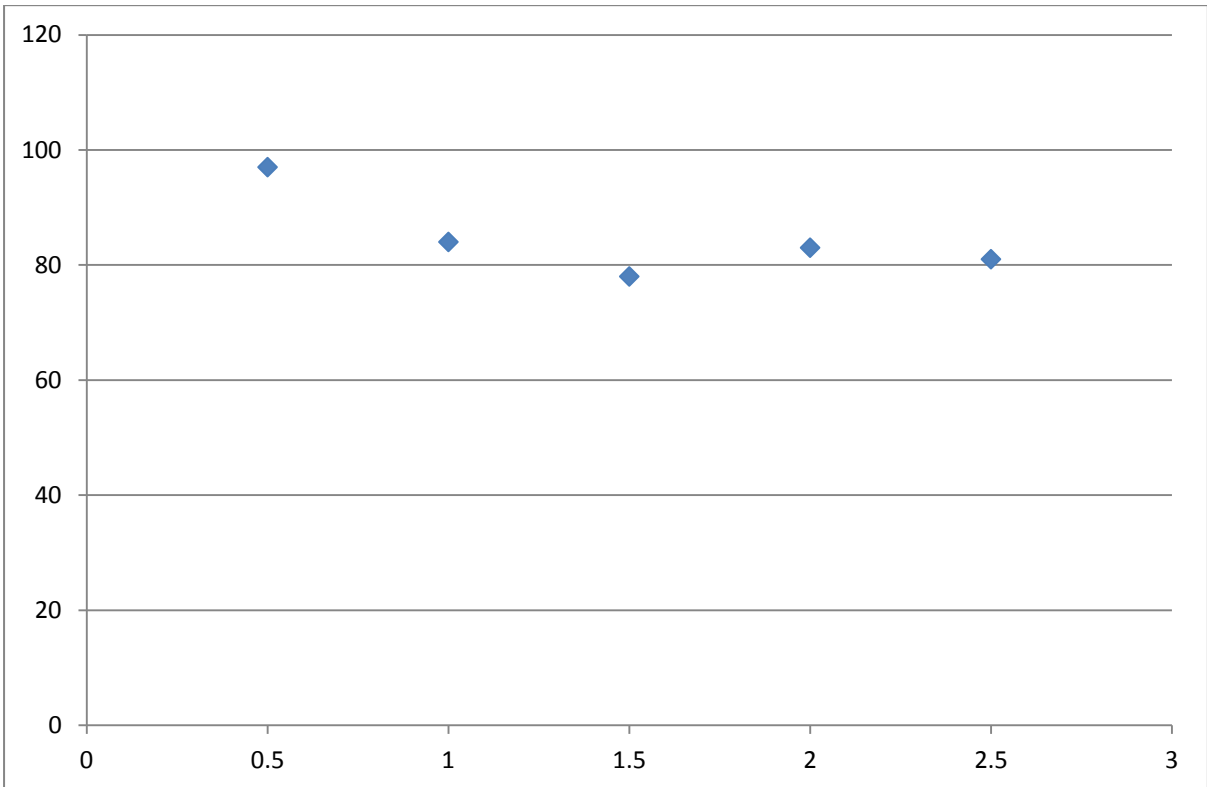


Figure 6: Mean Wear Scar Width (microns) versus % FM

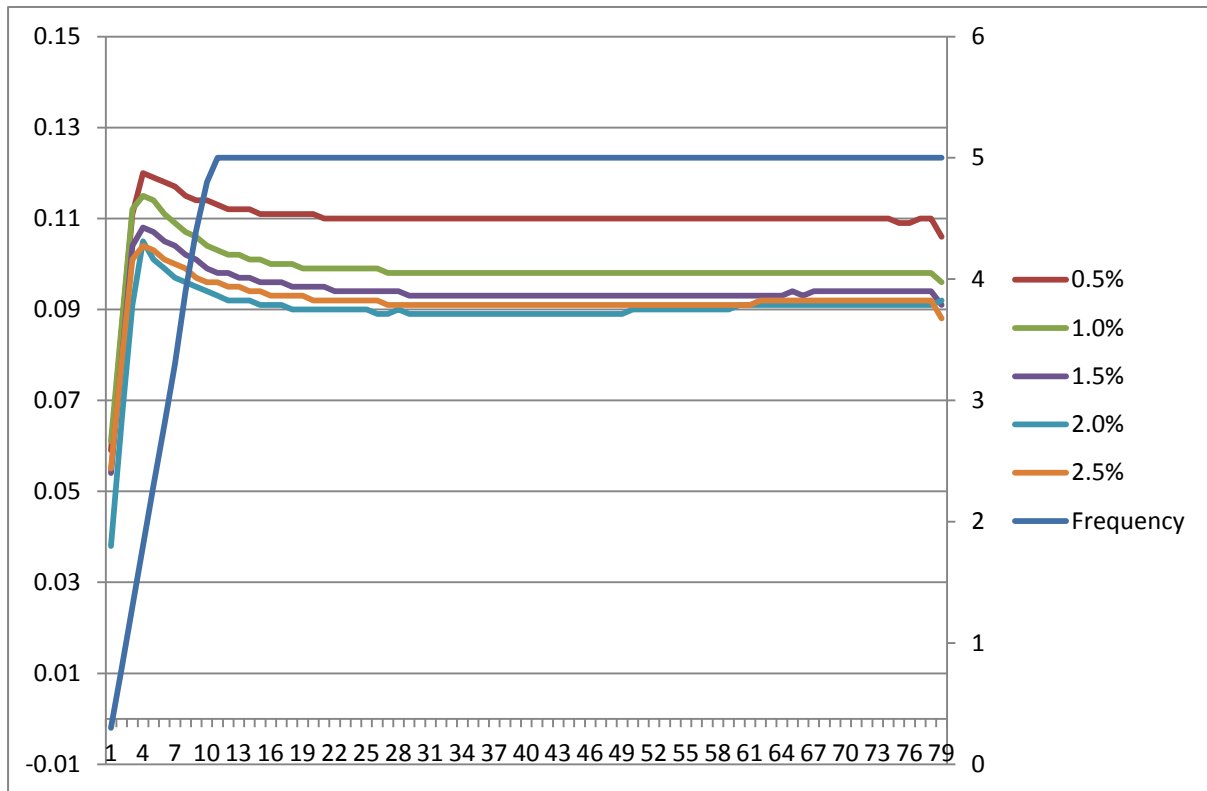


Figure 7: Friction Coefficient - Last Cycle

Conclusions

We cannot learn much from the wear scar data or the mean friction signals. There is however a significant difference in electrical contact potential, suggesting progressive smoothing of the surfaces as the tests progress. Plotting the friction coefficient for the last cycle of each test run, a significant difference between the lower two concentrations (0.5% and 1.0%) and remaining three (1.5%, 2.0% and 2.5%), is apparent, but no significant difference between these three higher concentrations. Furthermore 2.0% and 2.5% would appear, for some as yet unknown reason, to be in reverse order. Despite this reservation, this experiment does demonstrate the potential benefits of running a stop/start test procedure, with line contact specimens, with precisely controlled sample volumes and then exploring parameters other than simple wear scar dimensions, as a measure of additive concentration.