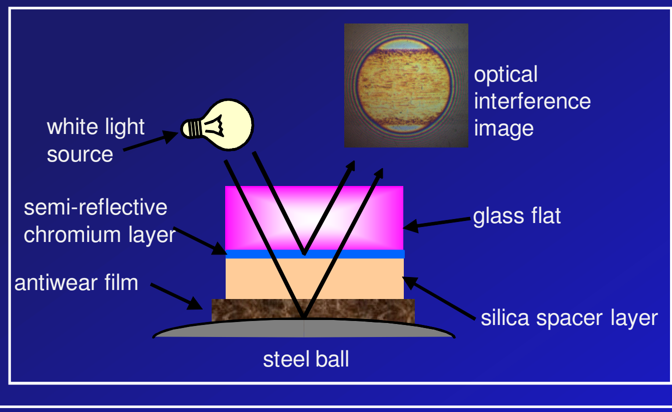
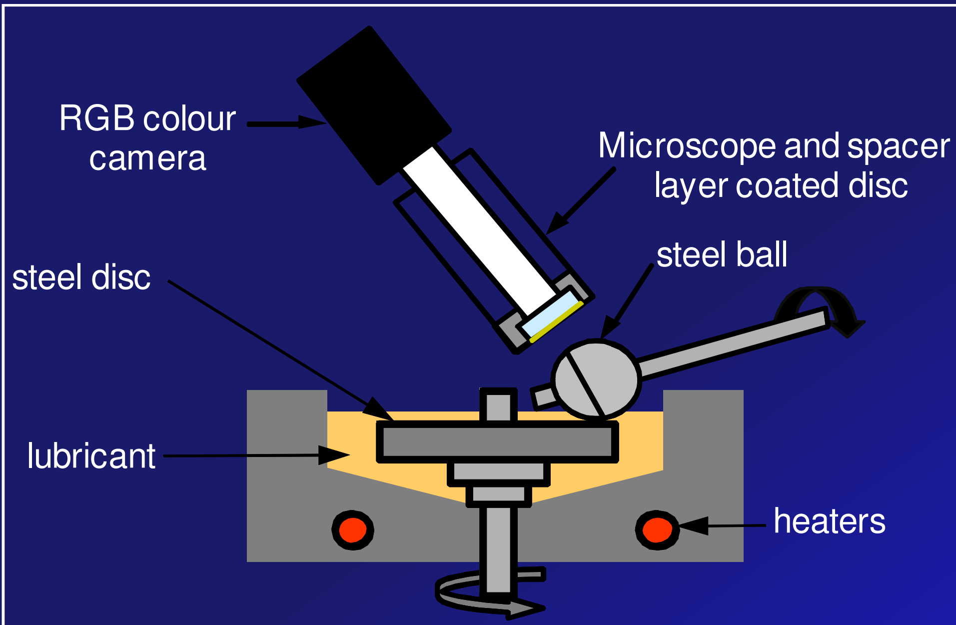
PCS Instruments

MTM2 3D SLIM Option - Additive Build-up Study

Principle

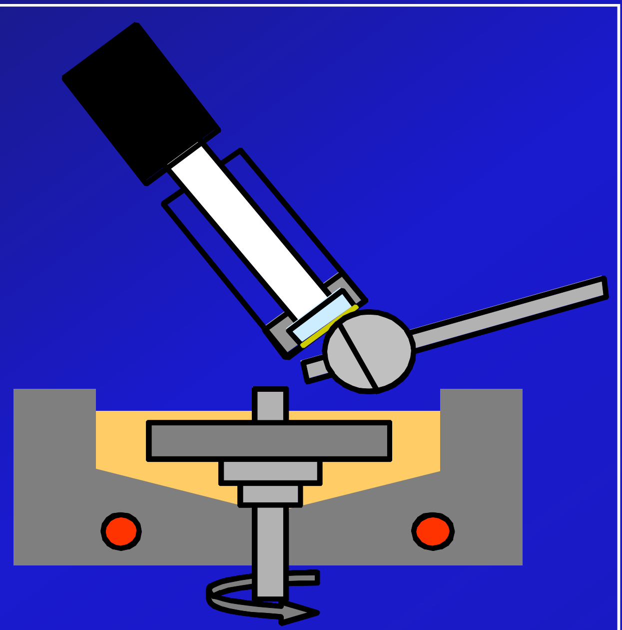
The 3D spacer layer imaging (3D-SLIM) option uses optical interferometry to measure sub-micron additive films on the specimens as they form during the test. To make the measurement the steel test ball is loaded against a glass disc coated with a chromium and silica layer. The contact is illuminated by a white light source directed down a microscope and through the glass disc. Part of the light is reflected from the chrome layer on the disc and part travels through the silica layer and any additive film and is reflected back from the steel ball. The recombining light paths form an interference image which is focused onto the imager of a high resolution RGB camera. The camera image is captured by a digital frame grabber and can be analysed by the control software to determine a film thickness map of the contact.



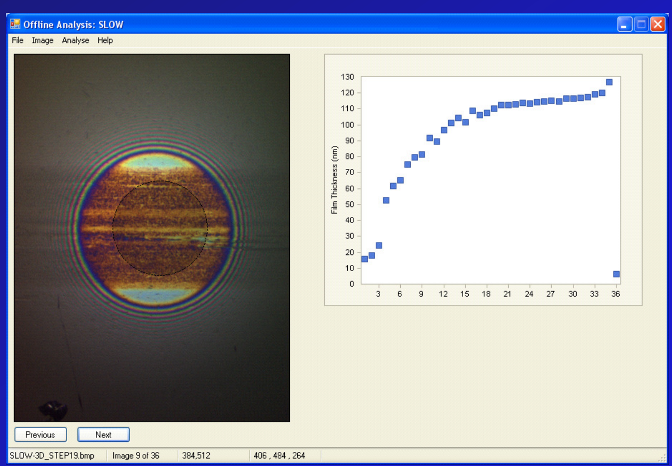


Step 1 (left)
The test ball is run against a steel disc for a pre-defined time.

Step 2 (right)
After a pre-defined time, the test ball is reverse loaded against a coated glass disc and an image is taken the ball is then lowered and the test continues.

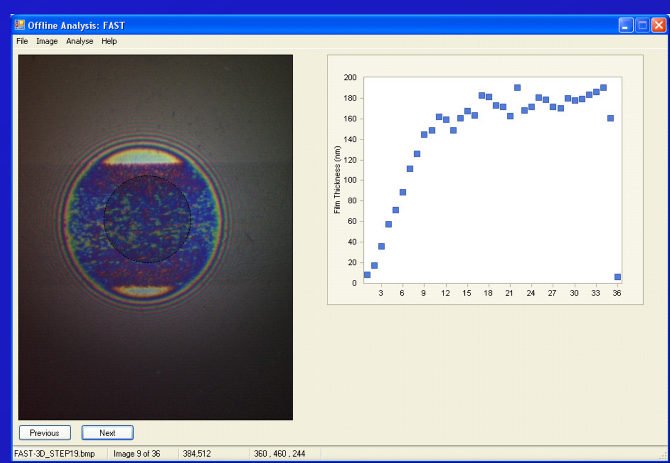


To perform the test the steel ball is loaded against the steel disc and run under mixed sliding/rolling conditions for a fixed duration. Periodically throughout the test, the ball is stopped, loaded in reverse against the glass disc and a film thickness map of the complete contact area is taken. This allows film thickness measurements to be taken of any reaction films as they form. When used in tandem with the friction measurement, this provides a full, real time picture of both the chemical and physical effects of the films formed in the contact.



Analysis

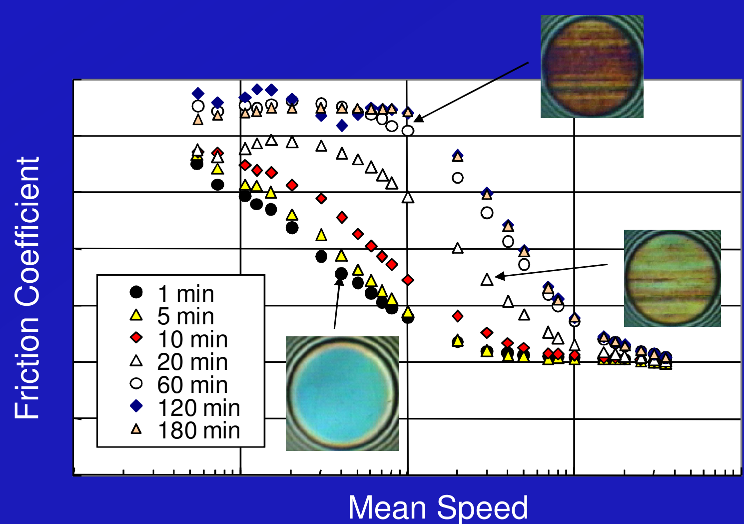
The screenshots on the left and right are 2 results from the analysis software showing slow (left) and fast (right) additive build-ups. The images displayed at the same running time during a test.



Applications

Two recent trends in engine oil formulation are a progressive reduction in phosphorus concentration and an increase in dispersant concentration. Both of these trends make it more difficult to generate and retain effective antiwear films on lubricated surfaces.

The MTM2 has been shown as a suitable test method for monitoring antiwear film thickness during rolling/sliding and to explore how various factors, including operating temperature, antiwear additive type and concentration, and the presence of dispersant, influence both the formation and removal of the tribofilms formed by the antiwear additive zinc dialkyldithiophosphate (ZDDP).



The graph above shows the typical friction and film development over time for a ZDDP lubricant.

www.pcs-instruments.com