A System Engineering Approach to Reduce Soot Wear

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An investigation into the interaction between soot and steel surfaces can improve the development of soot wear resistant lubricants. In this study, we have tested the friction and wear response of carbon black (surrogate for engine soot) on different steel surfaces, using the high frequency reciprocating rig and SEM - EDX. Results show that CB reacts to the preconditioned steel surface differently than non-preconditioned steel surface. Chemisorption of ZDDP on the steel surface prior to friction test resulted in severe wear but the shear induced chemisorption of ZDDP on the steel surface showed the lowest wear. Changes in wear was related to the concentration of Zn and P - a representation of antiwear phosphate film on the surface. Chemisorption of ZDDP prior to test triggered an aggressive response by CB in 0W20, it resulted in complete removal of antiwear phosphate film. Thus, unprotected steel was exposed to S – corrosion enhancer in the lubricant that contributed to severe micro- pitting and grooves on the disk surface, a representation of corrosion - abrasion wear mechanism. Shear induced chemisorption of ZDDP on steel surface allowed retention of the antiwear phosphate films. It could be influenced by surface topography and strength of shear induced film to resist shearing. As a result, the steel surface was protected and there were no grooves or severe micro-pitting on the disk. It represented an abrasive wear mechanism. Preconditioning the steel has showed a profound effect on the soot wear mechanism. It can give more clues in lubricant formulation.

High Frequency Reciprocating Rig (HFRR 4.2)

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