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A COMPARATIVE STUDY OF THE TRIBOFILMS DERIVED FROM ZDDP AND THIADIAZOLE WITH FOCUS ON THE TRIBOFILM-MICROSTRUCTURE RELATIONSHIP AND ITS IMPACT ON ROUGHNESS

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ABSTRACT
Anti-wear (AW) lubricant additives are often used to provide wear protection for hard steels used in tribological applications. Some additives, especially zinc dialkyldithiophosphates (ZDDPs), are known to have a negative impact on the surface roughness due to formation of patchy tribofilms, which is also reflected by an increase in the coefficient of friction [1,2]. A recent study [3] shows that the morphology of ZDDP tribofilm is related to the microstructure of the underlying material. In this work a novel atomic force microscopy (AFM) procedure [4] has been employed to investigate the extent of this relationship on the roughness of the tribofilms and the resultant coefficient of friction. Tribofilms derived from two model lubricants, containing ZDDP and thiadiazole AW additives respectively, on four distinctive martensitic steel grades (100Cr6, 440C, M2 and 16MnCr5) have been examined in detail. The results prove that the tribofilm thickness and roughness are correlated for ZDDP tribofilms, but such correlation is not observed for thiadiazole tribofilms. Evidence shows that when the thickness-roughness relationship is accounted for, the ZDDP develops smoother, less fragmented tribofilms on more homogeneous steel grades (100Cr6 and 16MnCr5) than on the high alloyed steels (440C and M2), containing a significant volume fraction of residual carbides. Although the tribofilm-microstructure correlation has also been observed for thiadiazole tribofilms, it this case no measurable impact on the tribofilm roughness or the friction coefficient has been noted.

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