TRIBOCHEMISTRY OF UNSATURATED METHOXYPHENOL DERIVATIVES

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ABSTRACT

Unsaturated compounds show a relatively good efficiency as antiwear additives, because of their ability to chemical conversions during friction (1). However, presence of these compounds, particularly 1-alkenes, may involve intensive oxidation of the lubricant and thereby its deterioration. For example, this process for low-molecular 1-alkenes mostly relates to formation of organic acids (2). Therefore, it is of interest to investigate other type of compounds including both double bonding and other functional groups.

This work investigates 4-allyl-2-methoxyphenol:

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\text{CH}_2\text{CHH}_2\text{OCH}_3\text{OH}
\]

which can combine with a free radical to produce another radical intermediate reactive species prone either to the polymerisation and/or oxidation process. Earlier work (3) shows that solutions of this compound in n-hexadecane have some anti-wear action in a steel-steel system.

The primary objective of the research reported here is to study tribochemical reactions of 4-allyl-2-methoxyphenol aiming at determining the chemical structure of the formed surface products that reduce wear of steel substrates in a pin-on-disc tribometer. To analyse the boundary film of the tested system several modern surface analytical techniques were applied.

SEM image (fig. 1) indicates the formation of organic products on the metal surface at ambient temperature. EDS analysis enabled to find that these compounds contain carbon and oxygen atoms in the structure.

Figure 1. SEM image of the steel disk surface with deposited products of triboreactions

Examination of wear tracks by means of FTIRM (fig. 2) provided clear evidence for oxidation reactions proceeding under the boundary lubrication process.

Figure 2. FTIR spectrum of the deposit generated during friction test lubricated with n-hexadecane containing 1% 4-allyl-2-methoxyphenol

Although the tribochemical reactions seem to be very complex, the presence of carboxylate structures combined with the steel substrate provide a good evidence for the oxidation process of the tested compound. Thus, it can be concluded that the double bond undergoes the oxidation reaction and tribopolymerization one. Additionally, the carboxylate structure formation was confirmed by XPS results. It is also of importance that the hydroxyl group of that molecule takes part in triboreactions.

REFERENCES

