ZDDP DEGRADATION AND TRIBOCHEMISTRY REVEALED BY MASS SPECTROMETRY

C. Gabler[a], J. Brenner[a], M. Frauscher[a,b], A. Grafl[a], N. Dörr [a*]
*nicole.doerr@ac2t.at
[a]AC2T research GmbH,
Viktor-Kaplan-Str. 2C, 2700 Wiener Neustadt, Austria
[b]Vienna University of Technology, Institute of Chemical Technologies and Analytics
Getreidemarkt 9/164 1060 Wien, Austria

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ABSTRACT
Tribochemistry of ZDDP antiwear additives is reported by numerous publications, e.g., comprehensively summarised in a review by Spikes [1]. For tribofilmcharacterisation, secondary ion mass spectrometry (SIMS) is known forharsh ionization, hence connected with significant loss of molecular info. For the identification of ZDDP degradation products in lubricants, chromatography and nuclear magnetic resonance (NMR) spectroscopy, particularly ^{1}P-NMR, are known [2].

To overcome the limitations to satisfactorily describemech-anisms of ZDDP degradation and tribochemistry on the molecular level, an analytical approach based on MS is proposedjoining findings from oil degradation and ZDDP tribochemistry [3-4].

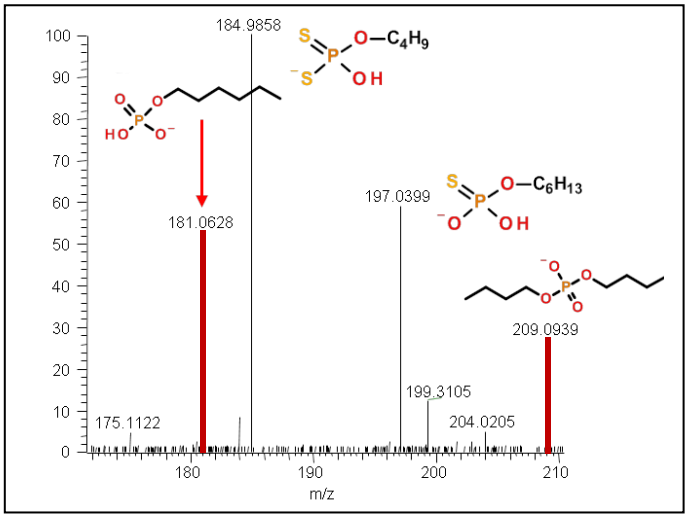

Fig. 1 Exemplary MS findings on ZDDP degradation – comparison of fresh and used oil – red bars indicate ZDDP degradation products only found in the used oil [5]

Used oils generated by oxidative and/or tribologicalstress were characterised fordegradation products using highly accurate MS and compared with fresh oil for a proper description of the used oil condition. Mass spectra disclosed the formation of alkyl phosphates in used oils originating from ZDDP (Fig. 1). It could be also shown that the fresh oil can contain ZDDP derivatives, being either by-products or oxidation products.

The findings from oil chemistry were connected with tribological performance assessed in an oscillating steel-steel contact. Mapping of the wear scars with MS and XPS revealedspecific distribution patterns of organic and inorganic moieties on the surface that account for the local tribological conditions along the disc wear scar.

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