Abstract for the ECOTRIB Joint European Conference on Tribology and Final Conference of COST 532 action: Triboscience and Tribotechnology, June 12-15, 2007, Ljubljana, Slovenia, http://www.ctd.uni-lj.si/ecotrib2007.htm

ISOMER SPECIFIC TRIBOLOGICAL BEHAVIOUR OF HYDROXYQUINOLINES

R. Kolm, C.A. Pieczetowski, I.C. Gebeshuber*
Institut f. Allgemeine Physik, Vienna University of Technology,
Wiedner Hauptstrasse 8-10/134, AUSTRIA
TEL: 43 1 58801 13436, Email: ille@iap.tuwien.ac.at

Abstract

Experiments from the macro- to the nanorange show that different isomers of hydroxyquinoline have different lubrication properties on tribologically relevant surfaces, e.g. 100Cr6 steel or copper.

On the macroscale, highly refined low sulfur diesel fuels with 2-, 4-, 6- and 8-hydroxyquinoline as additives were tested by means of a high frequency reciprocating rig tribometer (steel ball against steel plate). In this study, attention was especially paid to the connection between the position of the hydroxyl group at the molecule and the resulting influence on the "lubricity" properties of low sulfur diesel fuel. 2- and 8-hydroxyquinoline showed excellent wear reducing behaviour, even at concentrations as low as 125ppm. Of these two isomers, 2-hydroxyquinoline had the larger potential for film formation, even at low concentration [1].

The molecular level of the tribo-system was investigated by means of angle resolved X-ray photoelectron spectroscopy (VG ESCALAB Mk III equipped with a special preparation chamber, permitting the transfer of samples from a fluid cell to the analysis chamber under Helium protective gas) [2]. Monomolecular lubricant films were deposited from the liquid phase onto ultra thin copper films sputtered onto silicon wafers as well as onto 100Cr6 steel plates. Spectra of the samples immerged into the lubricating fluid and after tribotesting were recorded. It showed that the tribological behaviour of the additives on copper is contrary to their behaviour on steel. Angular resolved XPS investigation of 8-hydroxychinoline on copper samples demonstrated that, without tribological stress, full coverage of the surface with 8-hydroxyquinoline is not possible. Furthermore, XPS revealed that the additives undergo reactions during adsorption. After tribotesting different compositions of the tribofilms were found for the various isomers tested.

The results from the macroscopic level were reproduced on the nanoscopic level by atomic force microscopy measurements (MFP-3D, Asylum Research, Santa Barbara, CA, USA). An isomer specific reduction of friction was found [3].

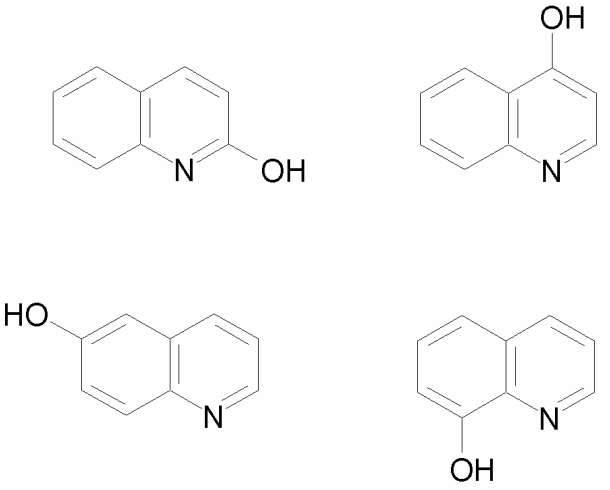

Fig. 1: The different hydroxyquinoline isomers tested for their wear behaviour by reciprocating rig method, by angle resolved photoelectron spectroscopy and by atomic force microscopy: 2-, 4-, 6- and 8-hydroxy-quinoline (top left, top right, bottom left, bottom right).

References

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[2] H. Störi, et al., Proc. 14th Int. Colloquium Tribology,, Technische Akademie Esslingen, **III** (2004) 1663.
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