

## NANOL ADDITIVE AS ANTIWEAR AND FRICTION MODIFIER

I. Gair<sup>1</sup>, M. Ratoi<sup>1</sup>, L. Bowen<sup>2</sup>, C. Ponce De Leon Albarran<sup>1</sup>

[ig1n20@soton.ac.uk](mailto:ig1n20@soton.ac.uk)

University of Southampton,  
Highfield Campus, SO17 1BJ, UK

Nanol Technologies

Birger Jarlsgatan 2, 114 34 Stockholm, Sweden

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### ABSTRACT

The search for a sustainable, greener tribology focuses on both lubricant composition and application. A relatively novel area of research with high potential of improvements is the use of nanoparticles (NPs) as lubricant additives. When suitably functionalized and dispersed, NPs can penetrate the tribological contacts due to their small size, and reduce the contact area between parts. This reduces friction and wear, thus saving fuel and extending service life of parts without generating harmful substances such as sulphur and phosphorous in the environment.

This study investigates the lubricant additive Nanol, composed of oleate functionalized copper-based NPs, known to act as a friction modifier and antiwear additive. The research aims to identify the lubrication mechanisms of Nanol along with the kinetics and characteristics of the tribofilm generated on the wear track. This knowledge informs the effective use of Nanol in tribological applications operating in various conditions and optimize its performance. Copper is a cost-effective, recyclable metal which has great potential not only in sustainability but also in its tribological performance. Previous studies have demonstrated the superior performance of copper nanoadditives over plain oil and reported the mechanisms of copper to include a tribofilm formation and self-repairing effect (1). Oleic acid and oleate are documented to act as successful friction modifiers and functionalization groups for metal NPs (2).

The mini traction machine (MTM 3D-SLIM) with a ball-on-disc contact was employed to measure friction while the Nanol tribofilm developed. The lubricant, consisting of 1wt.% Nanol in synthetic oil (PAO6 and 10wt.% adipate ester) instantly reduces friction in the mixed and boundary regimes by about 40% when compared to the base oil (Figure 1), and gradually forms a thick, soft tribofilm (300+ nm) on the wear track (Figure 2).

The tribofilm growth and characteristics were investigated under various operating conditions (SRR, load etc.) similar to those encountered in common tribological applications.

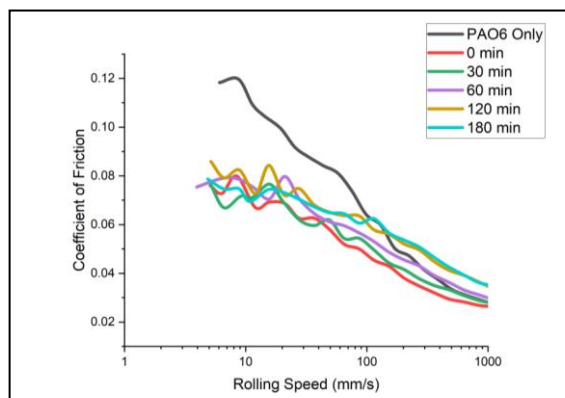


Fig.1 Strbeck curves for PAO6 with Nanol additive at different time intervals during rubbing at 100 °C, 30 N and 150% SRR

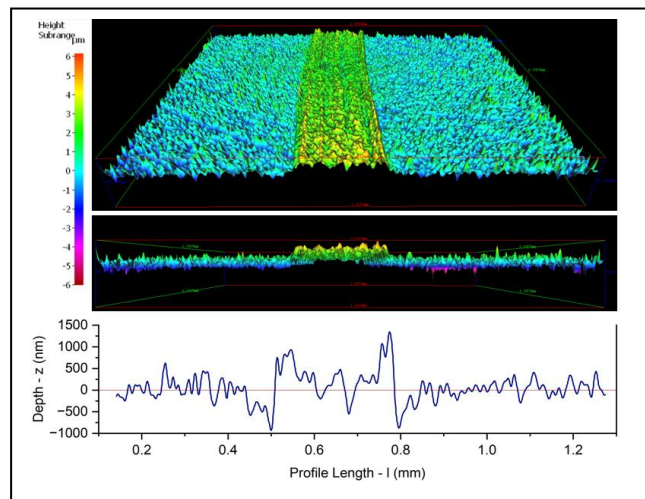


Fig.2 3D Optical images and surface roughness profile across the ball wear track

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