Supplementary Materials

Effect of molecular weight on tribological properties of polyether amine derivatives under different contact modes

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1. TE77 reciprocating friction test conditions (line-on-flat contact)

The cylindrical pin (diameter 6 mm, length 16 mm) was used for line-on-flat contact reciprocating friction with a fixed steel plate (GCr15 bearing steel) at a certain frequency, the load was 160 N, the frequency was 2 Hz and the stroke was 10 mm. The friction diagram is shown in Figure S1.

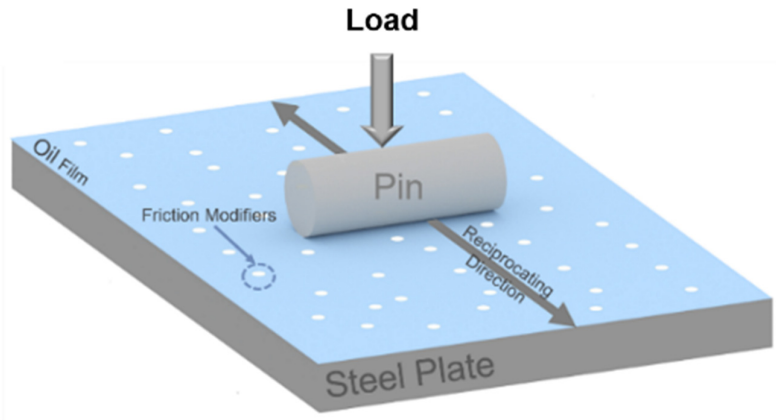

Figure S1. The friction diagram of the line-on-flat mode

2. Tribological properties of line-on-flat contact on TE77 friction tester

Comparison results of friction coefficient curves obtained from TE77 line-on-flat

friction experiments are shown in Figure S2. It can be seen that polyether amine alkylation derivatives can also play a certain role in reducing friction as OFMs under the line-on-flat friction mode. While compared with the results of point-on-flat friction mode, the influence of molecular weight on the friction reduction property of polyether amine derivatives was not obvious. The friction coefficient of base oil decreased from 0.182 to 0.144~0.149 by adding polyether amine derivatives. The friction coefficient can be reduced to 0.144 by D2000s, which is 20.9% lower than that of base oil. As can be seen from the friction coefficient curve in Figure S2b, the friction coefficients of lubricants with polyether amine alkylation derivatives were generally lower than that of the base oil, and the friction coefficient curve was relatively stable.

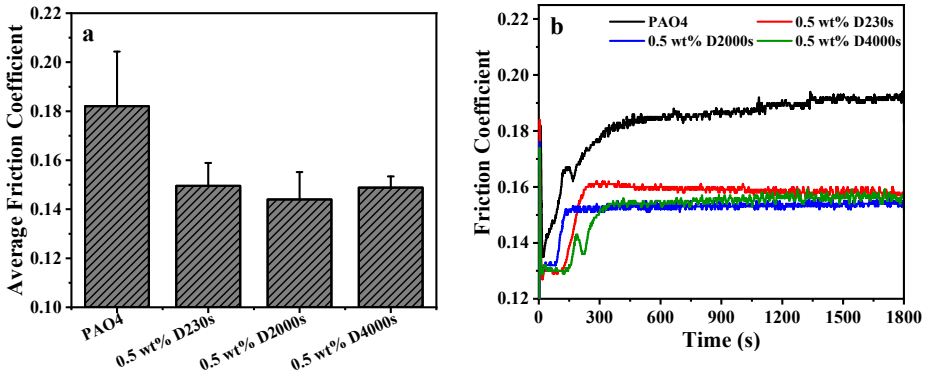

Figure S2. Average friction coefficients (a) and friction coefficient curves for TE77 line-on-flat friction tests

In the line-on-flat friction tests, the wear of the cylindrical pin of the upper specimen was too low to measure, so the wear trace of the steel plate of the lower specimen was measured by the white light interferometry (Figure S3). It can be seen that the polyether amine derivatives exhibited remarkable wear resistance and antifriction properties in the line-on-flat friction tests. The surface lubricated with the base oil showed uneven wear marks, and the deepest wear marks was 1.376 μm. The addition of polyethyl amine alkylation derivatives improved the wear of steel plate surfaces, and the average wear mark depth decreased to 0.361 μm~1.195 μm. The wear mark depth of steel plate lubricated by D2000s was the smallest, followed by D4000s and D230s.

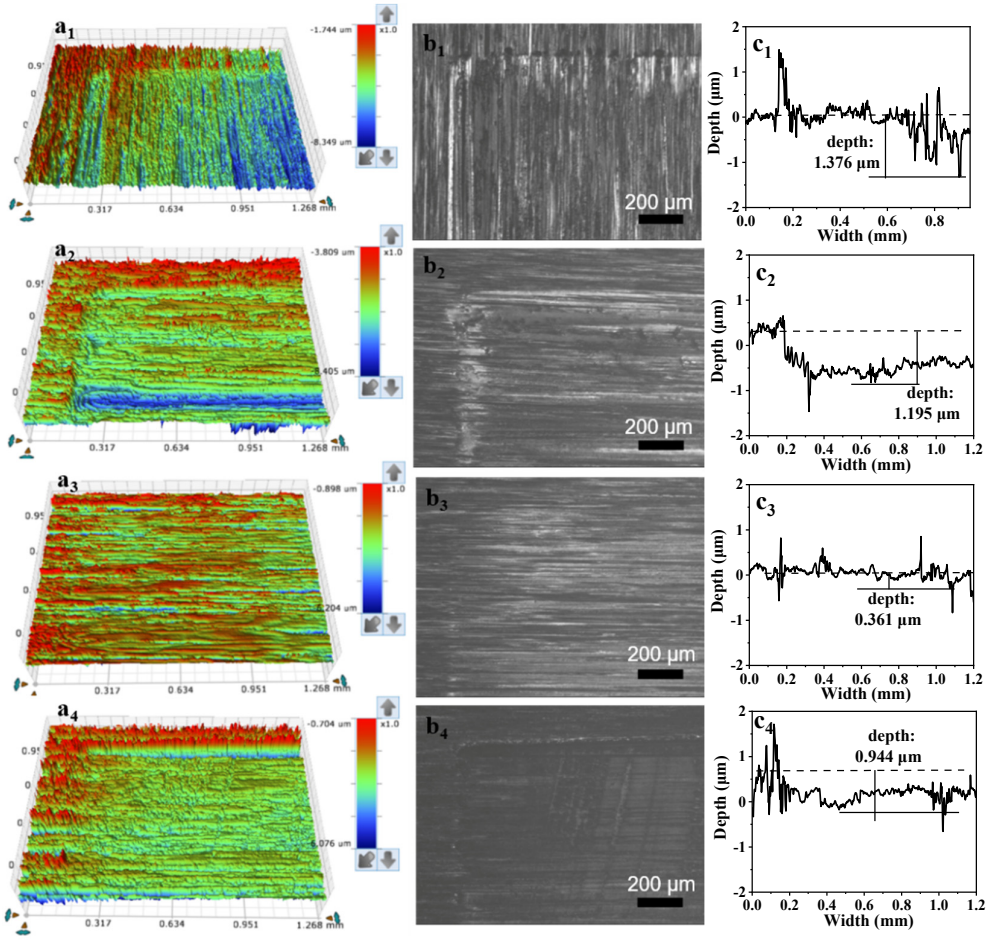

Figure S3. Surface morphology, micrographs and comparison of abrasion depth of steel plates for TE77 line-on-flat friction tests ($a_1/b_1/c_1$: PAO4; $a_2/b_2/c_2$: D230s; $a_3/b_3/c_3$: D2000s; $a_4/b_4/c_4$: D4000s)

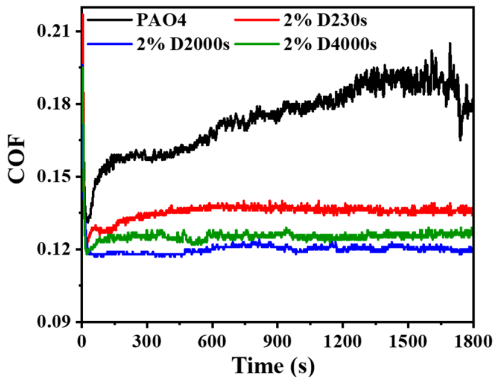

Figure S4. Friction coefficient curves for UMT point-on-flat friction tests at the concentration of 2.0 wt%