

Friction and wear behavior of greases and the role of surface adhesion force

F. Alemanno, D. Halenahally Veeregowda
 Ducom Instruments Europe B.V., Groningen, The Netherlands
 *Corresponding e-mail: deepak.v@ducom.com

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ABSTRACT – Lubrication behavior of grease can be influenced by its ingredients like base oil and thickeners. However, the mechanism behind its influence on grease lubrication is unclear. Here, we map the friction behavior of three commercially available greases (lithium based thickener and mineral base oil) as a function of speed using the Ducom Ball on Disk Tribometer. Friction test were conducted at room temperature and at 80 °C. The friction profile for grease B and C represented an “inverse Stribeck curve” behavior, that is, lower friction at low speed. However, the grease A represented a normal Stribeck curve behavior, that is, higher friction at low speed, triggered by boundary condition. Interestingly, this trend is not influenced by temperature at 80 °C. At 80 °C the friction was lower, and its surface profile was smoother compared to the room temperature. Also, the wear, measured in terms of mean wear scar diameter of the ball, was lower compared to test at room temperature. We attribute this low friction at low speed to the behavior thickeners (lithium based) because there is insufficient oil film built up at low speeds for lubrication. By using MicroForce (see Fig. 1) we have measured the pull-off force and adhesion energy of grease A, B and C. Grease A showed almost two orders of magnitude higher pull force compared to grease B and C (see Figure 2). High pull off force was accompanied by high friction at low speed for grease A. Overall, thickener can reduce grease friction at low speed. Furthermore, grease friction was in relationship with its pull off force and adhesion energy.

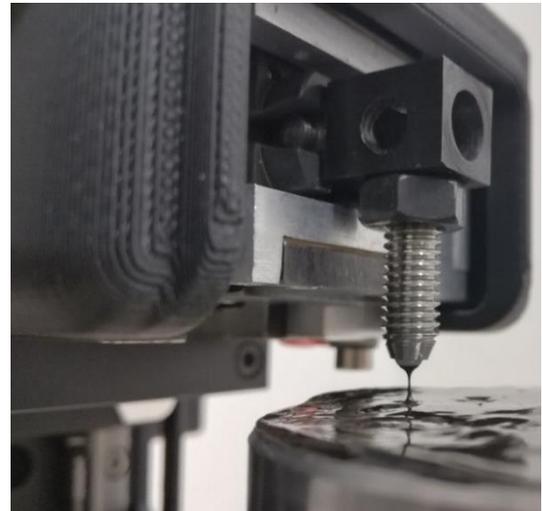


Figure 1. Ducom MicroForce Stretching of grease structure during retraction.

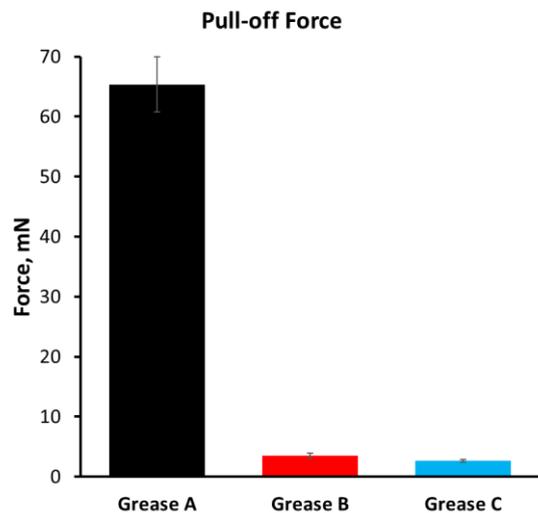


Figure 2. Pull-off force measured for three different greases using Ducom MicroForce.