Processing and formulation of lithium lubricating greases

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Lubricating greases are highly structured suspensions, consisting of a thickener dispersed in mineral or synthetic oil. The rheology and the microstructure of this complex fluid are highly affected by its composition and processing conditions [1].

Processing of lubricating greases is extremely complex from a rheological point of view, because the rheological properties of the medium dramatically evolve during its manufacture. In this work, the manufacturing process has been followed through the mixing rheometry technique, by measuring the evolution of torque with processing time (Figure 1). The grease formation has also been investigated by means of rheological and morphological measurements. It is apparent that the evolution of the above-mentioned characteristics strongly depends on some processing variables such as rotational speed, processing maximum temperature, cooling profile and homogenisation treatment [2].

On the other hand, the influence of both soap concentration and base oil viscosity on the microstructure, rheology and mechanical stability of lubricating greases may be explained taking into account the balance between the solvency of the thickener in the base oil and the level of entanglements formed by the soap fibres. It has been found that the structural skeleton (size and shape of the disperse phase particles) is highly influenced by the base oil viscosity [3]. In this sense, large fibres, but a weak structure and low density of entanglements, are obtained for greases prepared with high viscosity base oil, which results in high values of the loss tangent in small amplitude oscillatory shear measurements, and poor mechanical stability. On the other hand, the microstructural network of the lubricating greases becomes stronger as soap concentration increases [4]. As a consequence, the apparent viscosity and the linear viscoelasticity functions increase, although neither the relative elasticity nor the mechanical stability of the lubricating grease seems to be affected.

Lubricating greases usually content some performance additives. In this sense, the use of reactive diisocyanate-terminated polymers results in a significant increase in the linear viscoelastic functions of lithium lubricating greases. It has been found that the poly(1,4-butadienol) tolylene 2,4-diisocyanate (PBTDI), having a relatively low molecular weight, reacts chemically with the lithium soap, yielding a well-developed sponge-type microstructure with a high level of entangled fibres in comparison to that shown by the additive-free grease, resulting in an improvement in the mechanical stability of this material.

References

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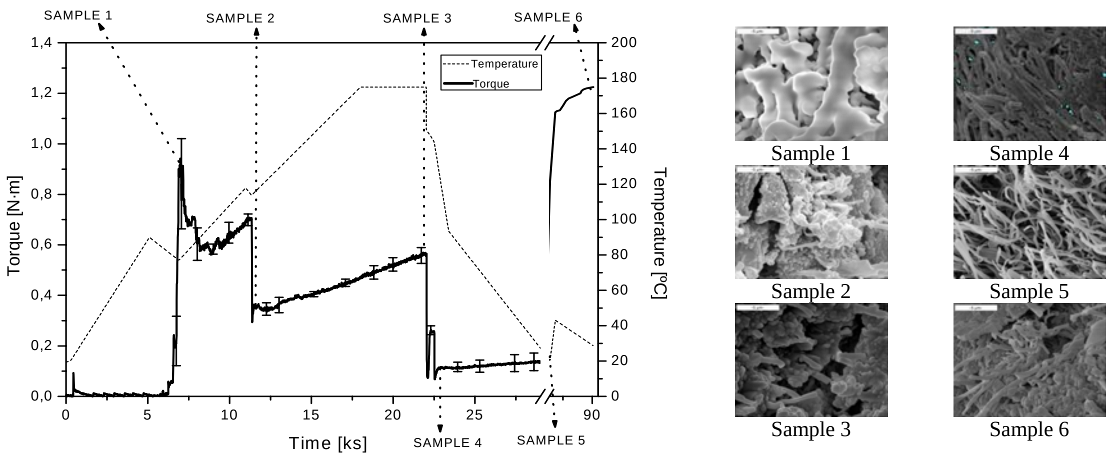

Figure 1: Evolution of torque and microstructure during processing for a selected lubricating grease.