Technical Topic

Grease Oil Bleed — An Essential Characteristic

Have you ever opened a container of grease and found a puddle of free oil? Most of us have, and we immediately wonder if the grease is suitable to use. Thoughts of machine failure and unscheduled downtime are quick to enter our minds.

This phenomenon is called static oil bleed and we need to review grease fundamentals to comprehend the root cause of this behavior. Grease is manufactured by dispersing a thickening agent in lubricating oil. A grease thickener can be thought of as a sponge, a matrix of fibers or platelets with high surface area forming a dense network of micro-asperities (voids). It is in these voids that the oil is stored until it is needed to lubricate.

The oil must be liberated from within the thickening matrix to provide protection of the lubricated application. The grease thickener matrix imparts little or no lubricating characteristics (except during very slow speed rotation or oscillation).
The sponge analogy is rather appropriate. The sponge releases water when squeezed and a grease releases oil when it is squeezed or stressed. This stress can be generated either mechanically or thermally in an application (dynamic oil bleed) or during storage (static oil bleed). If the thickener did not release the oil when stressed, the grease could not perform its lubricating duties.

Static oil bleed or oil puddling occurs naturally for all greases at a rate dependant on their composition. This phenomenon is affected during storage by factors such as temperature changes or vibrations or an uneven grease surface (presence of low and high spots). These cause extremely weak stresses relative to mechanical application stresses, but still result in the release of small amounts of oil. Over time, a puddle of oil is formed.

Frequently Asked Questions

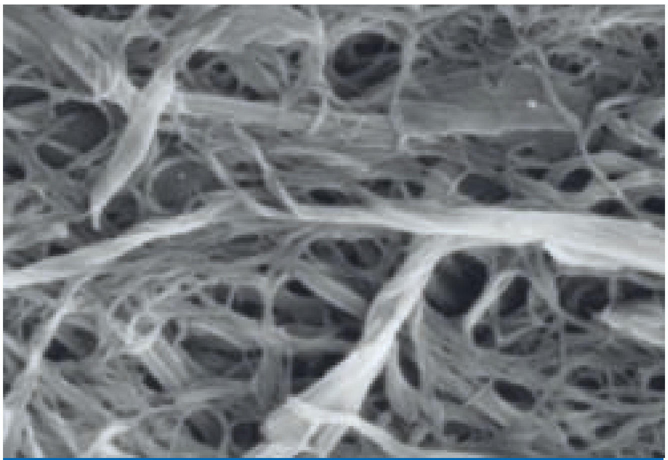
So is the grease suitable for use?

Yes, with the following caveats:

1. The amount of oil is covering only low spots.
2. The grease readily absorbs the oil upon stirring.

How do I use the grease then?

You may remove the oil surfacing in the container or manually stir back the oil into the grease, using a clean implement. The separation of a couple hundred milliliters of oil in a container represents a mere fraction of the grease (<1% typ.) and will have minimum effect on the grease performance.



Grease contains a thickener (soap fibers pictured above or clay or polyurea platelets) that holds lubricating oil by capillary forces

Can grease be formulated to prevent oil separation during storage?

Few types of grease are designed not to release oil except under very high stress, such as Mobilgrease XTC used in ultra high speed couplings. For most other applications, greases are developed to readily release oil at expected operating stresses to provide proper lubrication. Unavoidably this also leads to static oil bleed during storage although at a reduced rate.

Anything I can do to avoid the oil puddle?

Static oil release eventually occurs as a matter of time.

These best practices will limit its extent:

1. Store containers away from heat, cold or temperature variations.
2. Level the grease surface after usage as depressions will drain oil from the high spots.

Static and Dynamic Oil Release

Oil release from greases comes in two distinct modes:
Static Bleed is the release of oil from the thickener matrix in a package or non-moving part while Dynamic Bleed is the controlled release of oil and additives in application as a result of application stresses such as rotation. Without bleed, greases will not provide lubrication for the application as designed.
The balance between these two phenomena is key to a grease's performance.

ExxonMobil uses both in-house and industry standard tests to assess the oil bleed rate of grease when exposed to various conditions of stress and temperature. Tests used are selected for their relevance to the intended application of the grease. The oil bleed rate of the grease is adjusted through optimization of the composition (thickener and base oil type, addition of polymers, …) through the manufacturing process (contactor, open kettle or continuous production) to dial in the appropriate amount of bleed needed by the application. Manufacturing process plays a central role in determining the distribution of the thickener matrix within the lubricating fluid, and consequently the bleed characteristics of the finished lubricating grease. The ability of the grease to retain or release the oil depends on these compositional and manufacturing parameters.

The various oil bleed tests can be categorized in two groups: static and dynamic bleed tests. ASTM D1742 pressure bleed, ASTM D6184 cone bleed and IP 121 are static bleed tests that can be used as quality control in grease production. They predict oil separation from the grease in its container during storage or in the pre-greased equipment when not in service. They are referred as static tests because they operate on undisturbed grease exposed to relatively low stress.

Dynamic bleed tests such as M1066 CGOR (Churned Grease Oil Release, in-house proprietary test), ASTM D4425 Centrifugal Oil Bleed and Trabon (Method 905A) determine the amount of oil separation after the grease is mechanically sheared as would occur in rolling element bearings or is exposed to high levels of centrifugation stress typically found in shaft couplings and universal joints, or is pumped through a central system distribution block.

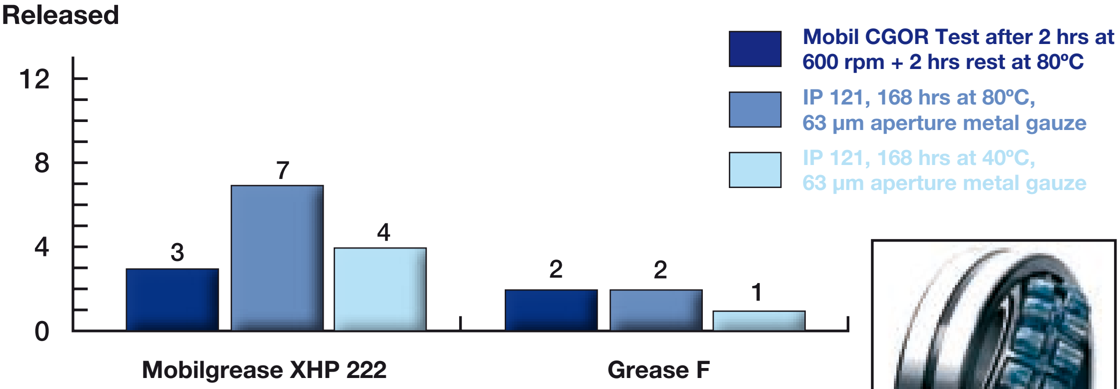
CGOR measures the oil separation after the grease has been churned by the rolling action of 3 large stainless steel balls, similar to what can occur in a bearing. In this way CGOR simulates the application and provide insight into how the grease will release oil in application. Too much and the grease dries out quickly, too little and the grease fails to provide adequate lubrication.

Relevance of Oil Bleed Testing

As mentioned previously, different oil bleed rates are targeted depending on the end application. For very high speed application where centrifugal forces are important greases are formulated to present minimum separation of oil. Conversely, for applications operating at low speed or with reciprocating motion of small amplitude, little churning of the grease occurs requiring a grease that is designed to be susceptible to mechanical shear to release oil under the effect of small stresses.

Elevated temperatures will soften grease and lead to more oil separation. At high operating temperatures, the risk is that excessive oil release leads to rapid loss of oil (leakage, evaporation) and premature grease ageing. On the other hand grease with a low although sufficient oil bleed at high temperature may under-perform at ambient temperature because of oil starvation as illustrated in the case presented below. As shown, Grease F which performs satisfactorily at 130°C in roller bearings leads to premature lubrication failure at the milder temperature of 60°C. This is the consequence of too little oil bleed at the lower temperature and failure to effectively lubricate the contacting elements in the bearing.

% Oil Released



SKF R2F

@ 130ºC	Pass	Pass
@ 60ºC	Pass	Severe Wear

Sufficient oil release is compulsory for adequate lubrication at the lower operating temperature of the R2F large roller spherical bearings

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