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Shouldn't Grease Upper Operating Temperature Claims Have a Technical Basis?

Abstract:
Grease high-temperature claims based on different standards can vary widely. The range of approaches commonly used in the industry to define the maximum temperature at which a grease will provide adequate lubrication can be confusing for customers wishing to select the best product for their application. A lubrication decision based upon a published grease temperature range can lead to undesired consequences unless the user understands the basis for the high-temperature limit being claimed.

Factors limiting grease high-temperature performance include degradation due to oxidation, and / or the loss of base oil from bleed and evaporation. In general, dynamic grease life determinations based on standardised bearing tests, better represent what occurs in the field, providing a measure of grease high-temperature performance limits, which is more realistic than claims based on dropping point.

A test program was conducted on a variety of commercial greases, which included DIN 51821 FAG FE9 Life, ASTM D4290 Wheel Bearing Leakage, ASTM D2265 Dropping Point, and ASTM D5483 PDSC testing, and the test results were compared to product data sheet claims. Interesting discrepancies were found between product high temperature claims and their relative ratings based on FE9 or Wheel Bearing Leakage testing.

An industry standard approach to high temperature claims would be preferable to the various claims made by suppliers today. Such a basis would be far superior to the "rule-of-thumb" guidance provided in the NLGI Lubricating Grease Guide (Maximum Usable Temperature in the Grease Application Guide table), which is based solely on thickener type, and would benefit consumers and producers alike, reducing confusion in the marketplace. For example, not all lithium complex greases are the same. Complexing agents, manufacturing methods and base oil type can influence the high-temperature performance of a lithium complex, or for that matter, any high-temperature grease.

Introduction:

Historically, grease high temperature operating claims have been based on Dropping Point, thickener type, actual field experience, various laboratory bench or rig tests, or a combination of the above. When basing upper operating temperature limits on Dropping Point, a margin of safety is usually applied, such that the recommended limit is some number of degrees below the dropping point. Various "rules of thumb" have been applied, such as 50oC below the dropping point.

Background:

Table 1 is an example of industry "generic" guidance, based on thickener type, extracted from the NLGI Grease Application Guide 1. Table 2 is a similar example, extracted from an ExxonMobil grease training module 2.

Table 1 Example: NLGI Grease Application Guide

Thickener Type	Dropping Point, °C	Maximum Usable Temperature, °C
Simple Lithium	175	135
Lithium Complex	260+	177
Polyurea	243	177
Organo Clay	260+	177
Conventional Calcium	96 - 104	93
Anhydrous Calcium	135 - 143	110
Calcium Complex	260+	177
Aluminum Complex	260+	177
Sodium	163 - 177	121

Table 2 Historical ExxonMobil Guidance

Thickener Type	Dropping Point °C	Maximum Service Temperature °C
Simple Lithium	175	120 to 135
Lithium Complex	250+	150 to 175
Polyurea	250+	180 to 200
Modified Clay	280+	190 to 220
Calcium Sulfonate	260+	150 to 175
Lime Soap	90	60 to 70
Anhydrous Calcium	140	90 to 110
Calcium Complex	260+	150 to 175
Aluminum Complex	260+	150 to 175
Sodium	190	135 to 150
Sodium Complex	250+	150 to 175

Examination of the "deltas" between the reported typical dropping points and the recommended maximum service temperatures in these two examples illustrates the inconsistency in this approach: