TECHNI/TIPS
A Publication of the Lubrication Engineers Technical Department
LEADERS IN LUBRICANTS NUMBER 56

GREASE BASES USED IN THE MANUFACTURE OF LUBRICANTS

A lubricating grease is defined as a solid or semiliquid product representing a dispersion of a thickener in a liquid lubricant. Grease is used where it is required to hold the lubricating oil and appropriate additives together to lubricate those applications where an oil cannot be contained. Most greases are made in large kettles by mixing oils with various types of base materials called “soaps”. Although many manufacturers still use only open, single-action kettles, sophisticated producers like Lubrication Engineers, Inc., use open, double-action and closed pressure vessels where temperatures can be accurately controlled to produce high quality greases under exacting manufacturing procedures to consistently meet rigid product specifications. While “mineral oil base” greases are predominant, synthetic oil base greases are made for many severe or exotic applications.

As grease is used, the oils in the greases are gradually degraded by temperature and pressure in the workpiece being lubricated. This process will continue until the oil becomes carbonized, unless fresh lubricant is applied periodically. As the oil oxidizes in service, it becomes a contaminant and mixes with the collapsing and degrading base to become “Used grease”, which will be extruded regularly as fresh grease is added to the bearing or workpiece.

Sometimes synthetic greases are required. They are generally made with synthetic fluids rather than petroleum. They are affected in service in many of the same ways as are greases made from petroleum oils. Advantages of synthetic greases include high and/or low temperature capabilities and longer service life. The extent of these capabilities depends largely on the type of synthetic base fluid, thickener type and additive formulation. These lubricants are generally used for exotic or extreme type applications.

SOAP-THICKENED

Calcium-A hydrated lime, alkaline-type material used as a soap base makes a water repellent grease of smooth, buttery texture and is excellent for use under heavy churning action and around wet or highly humid environments up to around 175°F (79°C) operating temperatures.

Mineral oils thickened with calcium soap or “cup greases” constituted the first type of lubricating grease produced in any volume. They were the only products available for years. And although they continue to be relatively popular, they are being replaced by newer products.

To get away from the temperature and high speed limitations of calcium greases, anhydrous greases were developed - aluminum and sodium base.

Aluminum-These greases, which are also known as aluminum stearates, are very water resistant and fairly rust resistant. However, their heat resistance (i.e. low dropping point) is no better than the calcium. They also possess a low shear stability and have gel-forming tendencies. Little of this type of grease has been produced and marketed for the past 30 years.

Sodium-Sodium bass greases are fibrous and have a fairly high melting point suitable for antifriction bearings and other high speed centrifugal-operating conditions. It is an extremely good type of grease for use in heavy-duty applications taking shock-loading and pounding. Although sensitive to water, they have found their own niche. They can be used in dry conditions at temperatures 100°F. (38°C.) above the calcium base greases and are often more shear stable than the aluminum sterate and calcium soap greases. Sodium grease have been replaced by greases which are more water resistant and have equal or better heat resistance.

Lithium 12-Hydroxystearate - The latest and best of the simple soap based greases to evolve were the lithium-more specifically, lithium 12-hydroxystearate. These greases combine the heat resistance of sodium soap greases with the water resistance of calcium soap greases. They also display excellent mechanical stability and low temperature pumpability.

COMPLEX SOAP-THICKENED

In the 1930s and 1940s, researchers started to find new thickeners for "multipurpose" greases. Calcium complex greases were the first, followed shortly after by the lithium and barium greases. The barium greases never achieved the popularity of the lithium greases. They are heat and water resistant, but have some inherent low temperature problems and toxicological reservations.

Calcium complex greases became commercially available in the late 1940s. In recent years, this grease's share of the market has been failing. While they offer both water and heat resistance, they can be sensitive to water-becoming firmer or softer under different conditions-and, if overheated, they tend to harden. They do, however, carry high loads in operating bearings without the addition of extreme pressure (EP) additives.

Complex soap-based greases were developed to improve the heat resistance of previous simple soap based greases. Combinations of additives and oils are carefully selected to maximize the performance of the greases. They generally have good mechanical stability, low temperature pumpability-some will even have good reversibility characteristics and will operate at temperatures which are moderately high. Their dropping point may be 100°F. to 200°F. (38°C. to 93°C.) higher than the dropping point of corresponding soap greases.

They are generally formed by reacting a common base with two dissimilar organic acid compounds, such as a normal soap base and complexing agents, generally of short chain metallic or organic materials and made "in situ" (in place) in the grease kettle. This makes greases to meet more demanding requirements.

NON-SOAP THICKENED

Only two of the non-soap thickened greases are significant—clay and ureas.

Clay-A form of bentonite (clay-like) materials consisting of hydrous aluminum silicate, which is of very fine grain size and capable of absorbing large amounts of fluid, and has excellent plasticity. The clay is treated, making it very resistant to heat and adequately resistant to water. These are the nonmelt base materials.

Ureas -Also known as polyureas, they are made with ashless organic thickeners. These greases have a natural resistance to oxidation. Most polyurea greases are developed for a single specific application. Because of peculiar shear and rust preventive characteristics, they historically were not considered general application, multipurpose greases. However, recently new products are on the market with these claims.

LE GREASES

While many greases from various manufacturers appear the same "on paper", the real test is performance in actual applications. LE greases have continually demonstrated their ability to provide superior lubrication. They do this by resisting "water washout", resisting "pound out", extending lubrication intervals and not dripping at higher temperature; just to mention a few of the many benefits.

LE greases provide these benefits for several reasons. First, unlike other lubricant companies, we use proprietary additives to minimize wear, water washout and pound out-additives such as Almasol, Monolec and Quinplex. In addition, we use the finest base oils and most technologically advanced additive systems which have been formulated to produce the finest quality, high performance greases. And lastly, these products are manufactured in the most modern equipment available under exacting procedures to assure the user of the most consistent, high quality, high performance grease possible.

Most greases composed of "soap" and "oil" have third components added to effect certain stability, allowing the greases to become stable "gels". These components impart thermal stability and/or shear stability and may be additives, modifiers and/or peptizers, depending upon the purpose for which the grease is being made. Additives impart corrosion, rust and oxidation inhibition, water repellency, stabilization, preservation and wear-reducing characteristics (i.e. LE's Monolec and Almasol additives). The modifiers can be fatty acids and various derivatives of fatty materials. The peptizers are generally phenols, amines, glycerols or glycerides.

Realizing that no one product can satisfy all applications, Lubrication Engineers, Inc. uses only what we believe are the best additive systems which will provide superior performance in these various applications.

COMPARISON OF PROPERTIES OF VARIOUS BASE THICKENER GREASES

Thickener Classification	Thickener	Dropping Point F (C)	Upper Operating Temp F (C)	Shear Stability	Water Resistance	Oxidation Stability	Comments
Soap	Aluminum	230 (110)	175 (79)	P	VG	E	Higher torque required at higher and lower temperatures. Poor pumpability.
Soap	Sodium	350 (177)	250-275 (121-135)	F-G	P	F	Sensitive to water. Low temperature pumpability adversely affected by fibrous texture.
Soap	Calcium (hydrated)	205 (96)	175 (79)	F-G	VG	P	Loses water when heated and becomes unsatisfactory.
Soap	Anhydrous Calcium	280 (138)	230 (110)	G	VG	F-G	Satisfactory low temperature properties.
Soap	Lithium 12-OH	350-400 (177-204)	275 (135)	E	G	VG	Easily handled at low temperatures.
Complex Soap	Aluminum Complex	480 (249)	350 (177)	G-E	G-E	VG	Fair to good low temperature behavior.
Complex Soap	Calcium Complex	>500 (>260)	350 (177)	F-G	F-G	F	Tends to harden in storage or under pressure in lubrication.
Complex Soap	Lithium Complex	500-550 (260-288)	350 (177)	G-E	G	VG-E	Handles well at low temperatures.
Non-Soap	Polyurea	470 (243)	300-350 (144-177)	P	F-E	E	Satisfactory low temperature performance. Some have poor shear stability and don't work well in roller bearings or other high shear applications.
Non-Soap	Clay	None	400* (204)	F-G	E	F-G	Formulated for high temperature properties

Key to Chart

P – Poor **F – Fair**
G – Good **VG – Very Good**
E – Excellent *** – Requires frequent re-application at elevated temperatures to purpose degradation by products.**

Lubrication Engineers, Inc.®
300 Bailey Ave., Fort Worth, TX 76107 | 817-916-3200 | 800-537-7683
fax 817-820-1512 | www.LElubricants.com

LI 20056
03-95