

UNDERSTANDING THE BASICS OF GREASE

Since lubricating oil can oxidize, so can the base oil in grease. When the grease oxidizes, it usually darkens; there is a build-up of acidic oxidation products, just as in other lubrications. These products can have a destructive effect on the thickener, causing softening, oil bleeding, and leakage. Because grease does not conduct heat easily, serious oxidation can begin at a hot point and spread slowly through the grease. This produces carbonization and progressive hardening or crust formation. All things considered the effect of oxidation is more harmful in grease than in oil.

The rate of oxidation is mainly dependent on the temperature. Here it is good to understand that if a soap-based grease is heated, its penetration increases only very slowly until a certain critical temperature is reached. At this point the gel structure breaks down, and the whole grease becomes liquid. This critical temperature is called the DROP POINT.

Grease, when heated above its drop point and then allowed to cool it usually does not fully regain its grease-like consistency, and its performance subsequently will be unsatisfactory. Therefore, it follows that at no time should the drop point be exceeded. The problem with multi-purpose greases is that at least one of the agents will exceed its drop point thus adversely affecting the saponification process. Grease has a maximum temperature at which it can safely be used. Therefore, it follows that it must also have a minimum temperature. This minimum temperature is the point where the grease becomes too hard for the bearing, or other greased component, to be used. Again, the base oil of the grease determines the minimum temperature. Obviously, the base oil of the grease for low-temperature service must be made from oils having a low viscosity at that temperature.

The temperature limits for use of greases are therefore, determined by drop point, oxidation, and stiffening at low temperatures.

Grease can be divided into 6 general categories or types; i.e., mixtures of mineral oils and solid materials, heavy, asphaltic-type oils blended with lighter oils, extreme-pressure greases, roll-neck greases, soap-thickened mineral oils and multi-purpose grease.

MINERAL OILS MIXED WITH SOLIDS

These types of greases are very heavy lubricants for specialized applications. Such greases lubricate rough-fitting machine parts operating under heavy pressures or loads at relatively slow speeds. Examples of equipment that will typically use this type of grease include concrete mixers, bearings and rollers on conveyors and heavy construction equipment.

HEAVY ASPHALTIC-TYPE OILS BLENDED WITH LIGHTER OILS

These types of lubricants are classified as greases but are actually thick, heavy oils used to lubricate open-type gearing and wire rope. A primary advantage of these oils is that they form a heavy protective film when heated or painted on surfaces and then allowed to cool. Lighter oil is typically blended with the heavy oils in order to improve the pour point of the oil.

EXTREME-PRESSURE GREASES

The unique characteristic of this type of grease is that it contains additives to improve firm strength under various applications. In essence, film strength provides the resistance of the lubricant to being torn apart, thus preventing metal-to-metal contact of the equipment being lubricated. A film is formed by a chemical reaction of the metal to the additives in the grease. The chemical reaction is usually brought about (or accelerated) by pressure exerted on the grease, creating heat.

A few of the additives used in EP greases include compounds containing parts of chlorine, phosphorus, active and/or passive sulfur, chlorinated waxes and phosphates. Zinc and lead may also be added, as well as asbestos in some lubricants as a filler to cushion the shock loading on gear drives. The specific additive being used will always depend on the application for use. Factors to be considered for types of additives include specific equipment operating conditions such as load, speed, surface condition and inherent design characteristics.

ROLL NECK GREASES

Roll neck greases are specialized lubricants used almost exclusively for lubricating plain bearings in rolling equipment. For example, it's fairly common to use a block of NLGI No. 6 grease, which has the consistency of a bar of soap, carved to mate with the shape needed to accommodate the bearing of heavily loaded equipment.

SOAP THICKED MINERAL OILS

This is by far the most widely used category of grease in industry today. This type of grease varies by the additive that forms the soap in the lubricants chemical makeup.

Sodium-base greases are also general-purpose greases. Because they have a higher dropping point (approximately 300° to 350°F), they are often used to lubricate machine parts operating near heat. Sodium greases made with lighter oils are used for ball and roller bearing lubrications, as are combinations (mixed base) of calcium and sodium grease

Sodium-soap greases have a spongy or fibrous texture and are yellow or green in color. Because of their working stability and intermediate melting point, they are used for lubricating wheel bearings (other than disc brakes) and for general-purpose industrial applications. Typical examples include rough, heavy bearings operating at low speeds, as well as skids, track curves and heavy-duty conveyors.

Barium-soap greases are general-purpose types, valued for their ability to work over a wide temperature range. Their dropping point is approximately 350°F or higher, although they are not intended to be used in continuous operation at temperatures above 275°F.

Barium-soap greases are chosen for a variety of jobs, especially for nearly all types of bearing lubrications. They have a high-soap content. However, this makes this type of lubricant less suitable for use at low temperatures and in very high-speed applications. They have a buttery of fibrous texture and are reddish-yellow or green in color.

Lithium-soap grease handles extremes of temperature quite well, which makes them highly suitable for both high and low temperature application. They have a dropping point of approximately 350°F, and can be used in continuous temperatures of 300°F. One reason for their successful low-temperature performance is that they are made with oil having a low pour point. In fact, lithium-soap greases have been used successfully at temperatures of -60°F. Use of a lithium-soap grease at higher temperatures requires a different formula, however, the same grease can't be used at both extremes of high and low temperatures because the change would be in the viscosity of the oil used in the grease.

Basically, lithium-soap greases have very good stability; good water resistance, and are also readily pumpable. They have a buttery texture and a brownish-red color.

Calcium-soap, also called lime-soap greases, are probably the best known and most often used of all greases. Depending on the method of manufacture they are usually relatively inexpensive. Uses include axle grease, water pump grease and general machinery applications.

Because its water content begins to dry out, and the soap and oil separate, calcium-soap grease isn't suited to applications where the temperature will get above 160°F.

The major advantage of calcium-soap grease is that they don't dissolve in water. However, it is not suited to use in lubricating high-speed bearings. Ordinary general-purpose calcium-soap greases have a dropping point of approximately 175° to 200°F.

Calcium-complex grease has unusually high heat resistance making it of considerable value in extreme-pressure applications. The dropping point of this type of grease is 500°F or even higher. This means that this type of lubricant will maintain its stability while running continuously at high temperatures. However, this type of grease has not replaced lithium-soap greases because they are not as mechanically stable.

Calcium-soap greases are yellow or reddish in color, and have a smooth buttery texture.

Aluminum-soap greases are special-purpose lubricants. Their particular advantage is that they are very sticky making them perfect for applications requiring surface lubrication.

MULTI-PURPOSE GREASE

Multi-purpose greases combine the properties of two or more specialized greases. This permits the use of a single type of grease for a variety of applications. It is possible to replace as many as six specialized greases with single multi-purpose grease and get better results all at the same time. Most of the multi-purpose greases have a soap base of barium, lithium, or calcium complex. For example, the lithium-soap greases discussed earlier. They are not only water-resistant and corrosion inhibiting, but they have very good mechanical and oxidation stability as well.

By reducing the number of lubricants, which a company keeps in stock, the lubricator's job becomes much easier. Another advantage is that it helps reduce the chances of error in application.

Good multi-purpose lubricating grease has to perform well in a number of applications. It should have a high melting point, and operate well at continuous temperatures of 250°F or more. Such grease should also have good resistance to water, and exceptional stability.

SUMMARY

Of the numerous applications for grease, most are for lubricating bearings of various types. Bearings fall into two main categories; i.e., plain or anti friction. In addition, these types of lubricants are often used for the lubrication of ways and guides.

As a general rule, grease used for lubricating ways and slides are sodium-base greases. Plain bearings on the other hand use grease for limited speeds, typically below 300 RPM with a practical maximum of about 400 RPM. On the other hand, greases for anti-friction (high-speed) bearings include those used for plain bearings with the exception of barium greases. Barium should never be used for high-speed applications.

Extreme pressure greases are commonly used in heavy-duty ball and roller bearings, as well as plain bearing applications that are subjected to high-loading conditions. A gear set is a perfect example where EP grease is used to overcome high-load conditions. However, operating temperatures are typically limited to a range of 150° to 200°F for this type of lubricate.

About the author

Ron Hughes, a Mechanical Engineer, has spent 27 years as an engineer, supervisor, instructional designer and trainer. The bulk of Mr. Hughes' experience has been in the power industry. Mr. Hughes has conducted front end job/task analysis, systematic design and development of a vast array of training seminars. He has provided training in maintenance, engineering in the mechanical, electrical and civil arenas as well as various management topics. He is a certified nuclear instructor. In addition he is also experienced in defining performance standards and auditing their outcome. Mr. Hughes is employed with Reliability Center, Inc. as a Reliability consultant, trainer and instructional technologist - rhughes@reliability.com.