Lithium Complex vs. Calcium Sulfonate Grease
The Workhorses of the Industry

Selecting the best grease for an important job requires narrowing down the choices based on what's going to perform the best in your specific application. Not all applications are the same and not all grease choices are good for every situation. In the grease world, the two most popular choices are lithium complex and calcium sulfonate grease. Which one is going to be the best choice for your application?

In order to make the best choice for your job, you have to know what you need the grease to do. Not in the sense of "I need to make sure my equipment doesn't get destroyed". We're thinking more along the lines of certain kinds of lubrication jobs having inherent issues like high temperature or high water exposure – issues that any grease used therein will need to be able to overcome.

Is the best grease for your job going to be the one that works best at higher temperatures? The one that doesn't break down from water washout? The one that responds best to extreme pressure? A combination of all of these? Or even something else?

Once you have a handle on what you think you need the grease to be good at, you need to know how that ability is reflected in the grease's specifications. How do you know whether a lithium complex grease is or is not going to be better than a calcium sulfonate grease in a high temperature environment? Or a high moisture environment?

Luckily, all of this information is there for the finding if you know where to look. Let's look at a couple important characteristics that may help you decide between lithium complex and calcium sulfonate greases, the two most popular multi-purpose workhorse greases of the lubrication world.

High Temperature Characteristics

These are documented by dropping point and high temperature life tests. Dropping point is the more common measurement that you will see. The definition of dropping point is the temperature at which the grease passes from a semi-solid state to a liquid state - the temperature at which a grease becomes fluid enough to drip. Dropping point indicates the upper temperature limit at which a grease retains its semi-solid structure. It is NOT the maximum temperature at which a grease may be used (which is always lower). The upper operating limit for a grease is usually recommended to be 100-150F lower than the dropping point.

In order for a grease to change state, one thing that has to happen is the soap matrix needs to break down, to degrade. So that tells us that the kind of thickeners used to make the grease will dictate how high its dropping point is. Calcium, lithium, aluminum, barium, polyuria, even clay – you'll see greases made with these kind of thickeners. And some of these are markedly superior to others when it comes to holding up at higher temperatures.

Sometimes you may see two greases that may seem similar – calcium vs. calcium complex, or lithium vs. lithium complex. The first one is made from what is known as a "simple soap". They took a fatty acid and reacted it with a metal hydroxide (in this case, calcium hydroxide), to form a simple calcium soap that's used to make the grease.

But they could take the same fatty acid and the same metal hydroxide (calcium hydroxide), but this time throw in an additional "short-chain organic complexing acid". You now get, in this example, a calcium complex soap. And this matters because greases made from these soap complexes have much better high-temperature properties.

When comparing our two multi-purpose workhorse greases, lithium complex and calcium sulfonate, the calcium greases tend to perform a little bit better in the Dropping Point test, again, because of the properties of their soap complex. Regular lithium grease will drop at about 350 deg F. Lithium complex steps that up to 500 deg F. But calcium sulfonate greases can go even further, approaching 600 deg F.

This extra 100 degrees in dropping point for calcium sulfonate greases means an extra 100 degrees in effective operating temperature range, which can be a real advantage for many industrial users.

Shear And Mechanical Stability

On a spec sheet, you may see a reference to Worked Penetration at intervals like 10,000 and 100,000 strokes. These are tests that document Shear Stability – one of the essential characteristics of any grease. Grease needs to maintain its consistency under high shear conditions over as long a period of time as possible, to be most effective.

So they use the ASTM D217 test to document how the grease's thickness may change over time. They put a sample of the grease in a machine and they work it for 60 strokes, then 10,000 strokes, then 100,000 strokes. And they test the thickness of the grease at each point to see how it changes. The smaller the change in number, the more shear stability the grease will exhibit. A more stable grease thins out less over time exposed to long-term stress, and that's what you're aiming for.

For a lithium complex grease, a typical score on this test may be around 30. If it's a Grade 2 grease, it may have started with a thickness score of, say, 280 (putting it in the middle of the range for a Grade 2 grease). After 100,000 strokes, the score may have changed to 310 (an increase of 30), which is just barely at the beginning range for Grade 1. So the grease changed from a mid-Grade 2 to a thick Grade 1. That's acceptable, if not ideal.

For calcium sulfonate grease, it is not uncommon for their scores to change by less than 20 units. That 280 Grade 2 grease may only change to a score of 295 or 300 instead of 310. Calcium sulfonate greases exhibit greater shear stability than lithium complex greases. And that means they will hold up under pressure, for longer, than lithium greases.

Oxidative Stability Or Oxidation Loss

We know that for every 20F rise in temperature above 200-250F, we see a doubling in the oxidation rate of a given grease. We also know that many lubricating scenarios have constant temperatures higher than that. If a grease can't resist oxidation, it will harden and cake prematurely, which destroys the base oil and inactivates its anti-wear properties. A better grease will exhibit superior oxidative stability, as documented on this kind of test.

The test itself is run by exposing a grease sample to a given psi of oxygen in a sealed chamber for a controlled amount of time. If it oxidizes, the grease will react with the oxygen, using some of it up and causing the psi pressure to drop. The lower the change in psi pressure, the less the grease reacted with oxygen (the better). We've seen many lithium-complex greases score around a 10.0 psi drop after 500 hours of exposure on the test. On the other hand, there are calcium sulfonate greases that can go twice as long (1000 hours) and only approach an 8.0 psi loss. This is obviously preferable.

Compatibility

At its heart, grease is basically a heavy oil mixed with enough soap (the product of an acid+base; we're not talking about Ivory soap or Dawn here) to make it stringy and clingy enough to stay in place when it's put into places like bearings or high-speed moving parts.

But not all soaps and compatible with each other. This matters when you're introducing grease into an area thay has previously been "greased" before and may have remnants of the old grease still in place. If an incompatible grease is introduced, there will be an interaction that results in the soap and oil separating, and the oil leaking out. Bad things typically result.

This is a big issue in, for example, bearing packs. If an incompatible grease is introduced, you'll see oil leaking out of the bearing pack after a week or so, depending on use. A big clean-up job then awaits.

Lithium complex and calcium sulfonate greases both have the advantage of being compatible with both each other and many types of other common greases. That's a big plus. In fact, the only greases that are incompatible with lithium complex and calcium sulfonate greases are conventional polyurea grease and bentonite clay grease (calcium sulfonate is also incompatible with calcium complex grease, but you wouldn't typically put those two together).

When The Dust Settles

So when the dust settles, what do we learn from the comparison of lithium complex and calcium sulfonate multi-purpose greases?

We find that while both of these are good choices for multi-purpose greases, the calcium sulfonate greases tend to exhibit superior performance in these three areas of dropping point, shear stability and oxidative resistance. This means that you’re going to be able to use calcium sulfonate greases at higher operating temperatures, and you’ll be able to expect the sulfonate grease to “hold up” better under stress for longer periods of time than the more popular lithium complex greases.

By: Erik Bjornstad