How much do you know about varnish?

Let’s take a deeper look at some of the ways varnish impacts your operation, including why it forms in the first place, which equipment types and operating conditions are more likely to experience varnish formation, and how some methods work—and don’t work—when you’re trying to halt varnish buildup in its tracks.

The main cause is high heat

Heat speeds up any chemical reaction, such as oxidation or oil breakdown. Varnish is one of the precursors of heat breaking down the oil. The cooling of the oil then allows the varnish precursors to agglomerate and subsequently drop out of suspension.

Some equipment is more susceptible

In the power generation industry, larger gas turbines are particularly more prone to varnish. Frequently, these turbines have a bearing in the middle of the machine instead of just on the ends. Heat in that bearing isn’t able to dissipate as quickly as it would on the outside bearings, so the oil in the middle bearing tends to break down more quickly as it passes through. As a result, varnish tends to form more quickly.

Certain components are affected differently

Let’s take the example of a turbine’s hydraulic system. The hydraulics control the gas valve, which in turn controls the amount of gas fed to the unit that affects the speed and power of the system. But the circulation oil in the turbine itself is the same as the hydraulic oil for the unit. If varnish is an issue, the gas valve will likely fluctuate improperly and cause a trip or “fail-to-start.” Valves are one of the most likely components to need replacing due to varnish.

Operating conditions matter

The way that equipment is run can have a direct effect on the likelihood and speed of varnish buildup. Peaking units that start and stop more frequently, for example, are more susceptible to varnish formation than units that run more continuously. That’s because the increased starting and stopping heats the fluid, leading to varnish precursors—and then when the unit cools, those precursors are more prone to agglomeration and the settling out of solution in low points or narrow passages.

Is varnish the priority it should be?

For many reliability engineers, varnish is simply not viewed as a high priority relative to the other day-to-day or urgent issues. That means they're not recognizing the hidden effects of varnish buildup until it's too late—and they have a new urgent issue on their hands. Learn more about why varnish buildup can cost you even more later than it does now.

There's a point of no return

Eventually, equipment can become too unreliable for continued operation due to varnish, no matter if it's a peaking or base load unit. The system will often be flushed—sometimes with a chemical cleaning and manual cleaning to remove varnish—before charging with new oil to get the unit back up and running.

Filters aren't as effective as you might think

One of the first considerations in dealing with varnish is filtration, which removes insoluble varnish. That doesn't remove varnish in its soluble form, however, which remains in the system and can lead to the formation of new deposits. Electrostatic filters offer a somewhat more reliable option than conventional mechanical filters[1] because they're able to attract smaller particles that conventional filters can't remove.

The best protection is prevention

When we consider the alternative options available to help plants deal with varnish buildup, taking steps to ensure less varnish forms in the first place is a better approach than trying to remove varnish after it's already formed.

- **Not effective:** High-velocity flushing removes weld slag and particulates from the system but typically won't remove varnish. Hydroblasting can also remove rust and scale but it has little impact on varnish. Similarly, a "rinse" (dilution) flush can remove any old oil or cleaners used but won't do much to help you with deposited varnish.
- **Somewhat effective:** Timing an operating condition change with an oil change is an option available to reliability engineers. Basically, this involves running the turbine 10 degrees hotter for a week with a chemical cleaner added to the oil before an oil change and removing both the oil and dissolved varnish while it's still hot. This approach won't remove all of the varnish but it can help maximize varnish removal at change-out time without additional cost.
- **The most effective:** Varnish that never has a chance to form is the easiest varnish to remove. Over years of product development, a premium turbine oil is optimized with the right combination of base stocks and additive systems. Used at the right dosage, that product can improve the system's varnish resistance overall and prevent or significantly reduce the amount of varnish that forms.

1. How Electrostatic Filters Control Varnish. *Noria.* Retrieved from https://www.machinerylubrication.com/Read/28839/electrostatic-filters-varnish.