KLEENTEK®

APPLICATION SPOTLIGHT

Varnish Solutions for Lubrication Systems in Gas Turbines

GAS TURBINE FAILURES

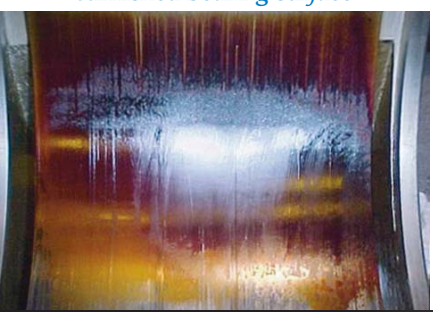
As gas turbines run, friction and heat combine to degrade lubricant oil and produce very small degradation by-products that settle throughout the system as varnish. Over time, these particles attach themselves to surfaces throughout the turbine producing a sticky coating. As varnish builds up, turbine performance suffers immensely.

Left untreated, varnish causes a multitude of performance-critical problems including: increased bearing wear, accelerated gear wear, lowered performance of heat exchangers and most critically, IGV Servo valve stiction and failure. Fuel control and IGV valves are particularly susceptible to varnish buildup, causing trips and unplanned outages. Additionally, varnish settles out in cooler spots in the system and in tight clearance areas, such as pilot stages on servo valves. The tacky nature of varnish attracts other contaminants, converting smooth metal surfaces to sandpaper while acting as a catalyst to shorten the life of the lubricant.

Varnished load gear

A serious concern for reliability engineers is that the onset of varnish cannot be predicted with routine oil analysis. Tests such as RBOT, RPVOT and TAN do indicate that there is oxidation potential in your oil, but only *after* varnish has effected the system. Both newly commissioned turbines and older installations are susceptible to these varnish-related failures.

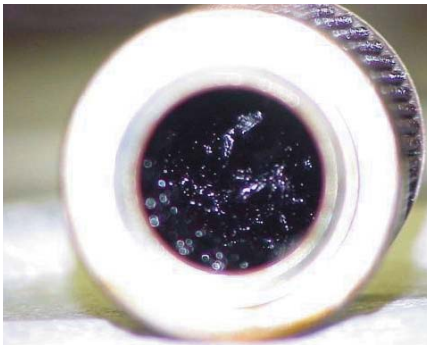
Varnished bearing surface



ROOT CAUSES OF VARNISH

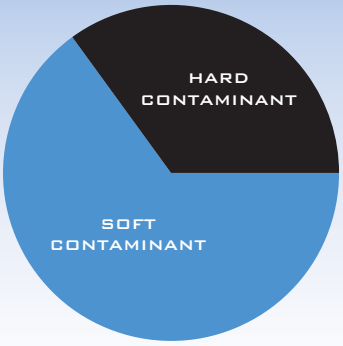
Varnish is a result of the base oil and additive system deteriorating in the lubricant. Heat, an unavoidable factor, is among the biggest enemies of turbine oil and is a primary factor in the creation of degradation by-products. When oil temperatures reach 300°C / 572°F, the hydrocarbon molecules begin to crack and break apart, thereby polluting the lubricant. Beyond general heat-related degradation, there are several additional root causes of varnish in gas turbines:

1. Static discharge from mechanical filters
2. Shared reservoir for hydraulic and lube oil circuits
3. Hot spots in the system
4. Additive depletion
5. Implosion of air bubbles
6. Recent formulation and base oil changes in turbine oils
7. Low flow hydraulic circuits with temperature differentials



Plugged filter from static discharge

TOTAL SYSTEM CONTAMINATION



Degradation by-products, or soft contaminants, make up the majority of insoluble materials in used turbine oils and are responsible for varnish. Soft contaminants are typically smaller than 1 micron in size — too small to be removed with traditional oil filters. Kleentek offers the best technology available to remove both hard and soft contaminants — 100% of the problem.

SOLVING VARNISH PROBLEMS

Kleentek electrostatic oil cleaning technology solves varnish problems in gas turbines.

Unlike traditional oil filtration, Kleentek's patented technology removes all insoluble contaminants, including degradation by-products that are responsible for creating varnish. Conventional filters remove only large particulates but leave the smaller particles that are at the heart of varnish buildup problems. "Clean" oil is not really clean if varnish is still present in the system.

Last chance filters on moog valve before Kleentek.

Last chance filters on moog valve after Kleentek.

Kleentek electrostatic oil cleaners actually clean the internals of the system. This patented technology allows the ultra clean lubricant to act as a system cleaner. Rather than depositing varnish over time, lubricants cleaned by a Kleentek system have the opposite effect; with clean oil stripping away varnish one molecular layer at a time.

Systems severely contaminated with varnish are cleaned, leaving shiny metal surfaces behind. Even systems with severe varnish contamination are reclaimed using the Kleentek system. Gas turbine users have eliminated valve stiction problems in as little as 14 days after the installation of Kleentek units.

Kleentek varnish removal systems are easily connected directly to the oil reservoir for continuous cleaning. They run virtually maintenance-free, requiring only a periodic collector change.

BENEFITS OF KLEENTEK VARNISH REMOVAL SYSTEMS

Kleentek systems provide significant benefits for gas turbine users. Some of these benefits include:

- Reliable, trip-free Servo valve performance
- Varnish-free lube and hydraulic oil circuits
- Extended oil life
- Avoidance of unplanned outages
- Decreased bearing and gear wear
- Improved heat exchanger performance
- Extended seal and O-Ring life
- Elimination of costly system flushes

Kleentek varnish removal systems provide unmatched return on investment. Systems often pay for themselves many times over in the first year of operation. Significant reductions in varnish-related trips and unplanned maintenance can easily cover initial costs.

Kleentek solutions become a key element of your reliability program and an essential partner in profitable operations and maintenance.

Kleentek electrostatic oil cleaners have been solving varnish problems in industrial applications for more than 25 years. Kleentek is a world leader in varnish and lubricant degradation research.

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