Varnish Removal Unit

Solution for removal of dissolved and suspended soft contaminants from oil in

Gas & Steam Turbines

"Avoid varnish related turbine trips and expensive oil changes"

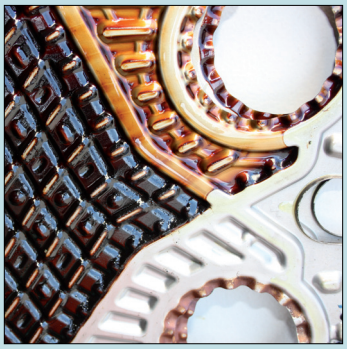
The Problem

turbine trips | oil aging | valve sticking | inline filter blocking

When varnish strikes, the costs associated with a production outage are often very high. The precursors to varnish, the so-called soft contaminants, are created in the hot spots in the oil system, e.g. bearings, pumps and high flow in-line filters. Recent studies have found that the soft contaminants exist in both dissolved and suspended phases and should be removed in order to avoid varnish formation. Once formed, varnish can seize and clog valves, filters and other small passages and reduce the oil life considerably.

When soft contaminants are dissolved in oil, typically at temperatures above 40ºC (100 ºF), they cannot be removed through standard mechanical filters or electrostatic filters. The soft contaminants are polar in nature and adsorb onto dipolar, colder metallic surfaces in "cold spots", e.g. valves and coolers. They will also settle out when the oil temperature decreases during outages. The soft contaminants also have lower thermal stability than the oil so they are more likely to bake onto hot surfaces, e.g. journal bearings.

Varnish coated in-line filter of IVG servo valve hydraulics



Varnish on plate heat exchanger

Varnish on valve spool

Varnish on journal bearing, gas turbine

FACTS

Consequences of Varnish

- Valve sticking ▸ loss of control, which results in turbine trips or fail-to-start
- Filter blockage ▸ restriction of oil flow, which increases oil temperature and wear
- Sandpaper surface ▸ increases component wear
- Ineffective heat exchangers ▸ increases oil temperature
- Lacquer baked onto bearings ▸ flow restriction, increased wear and temperature
- Frequent oil changes and system flushing

The Solution

high efficiency | low maintenance | reliable | easy to install

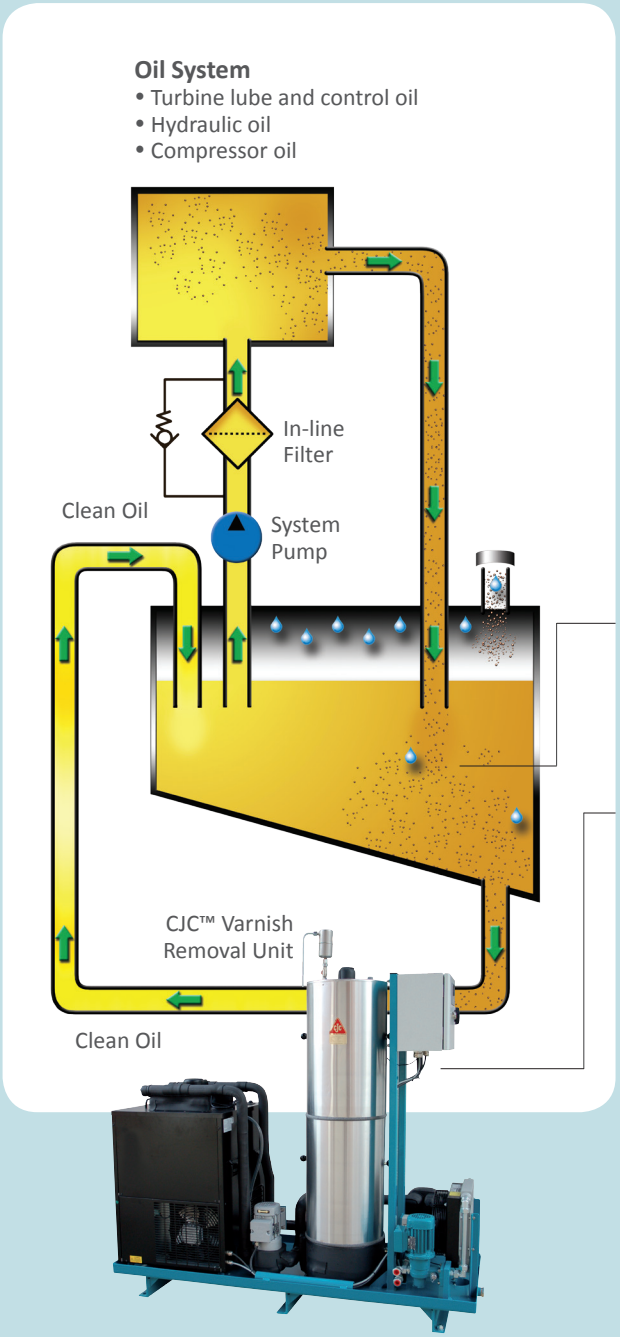
Principle Drawing
CJC™ Offline Filtration

C.C.JENSEN A/S introduces the CJC™ Varnish Removal Unit with a revolutionary high efficiency for removing soft contaminants from oil – dissolved and suspended – even from hot operating gas and steam turbines.

The CJC™ VRU is designed to remove dissolved and suspended soft contaminants by polar attraction in the optimized, cellulose based CJC™ Varnish Removal inserts, VRi. It does this without any additional power, chemicals or beads which may be harmful to the oil's additive package.

The warm system oil is drawn from the bottom of the tank to the VRU by its own transfer pump. The oil is treated and filtered continuously in the CJC™ VRU before being pumped back to the system tank as varnish free oil.

The varnish free oil will start cleaning all system components it comes in contact with, ultimately resulting in a completely varnish free system. The varnish level in the oil will typically be cut in half within a few weeks of operating the CJC™ VRU.



Contamination
now under Control!

Varnish
Oil degradation products – dissolved and suspended – are removed from the oil and system components

Solution
The optimized filtration and treatment in the CJC™ VRU captures the soft contaminants, which can then be removed from the system completely by replacing the CJC™ Varnish Removal insert, VRi

FACTS

The specially designed CJC™ Varnish Removal inserts VRi, used in the CJC™ Varnish Removal Unit make it possible to remove oil degradation products from oil in gas and steam turbines, up to 45,000 L (11,900 gal) – dissolved and in suspension

– even from high temperature operating turbines!

The Result

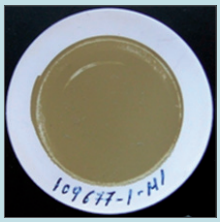
no turbine trips | no oil aging | no valve sticking | no inline filter blocking

Before and **After** installation of CJC™ VRU

Turbine oil BEFORE filtration with the VRU

Turbine oil AFTER just a few weeks of filtration with the VRU

Millipore membrane MPC>50



Millipore membrane AFTER filtration with the VRU, MPC <10

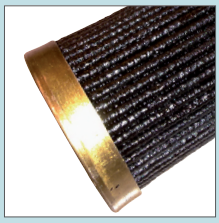
Ultra Centrifuge test, initial sample before the VRU (inlet)

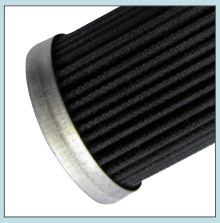
Ultra Centrifuge test, sample after a single pass through the VRU (outlet)

Clearly visible varnish at the metal surface BEFORE startup the VRU

No more varnish at the metal surface AFTER startup the VRU

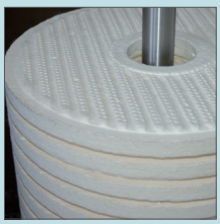
6 months WITHOUT VRU: Varnish on the inline filter

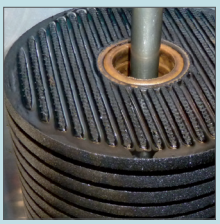




6 months WITH VRU: No varnish on the inline filter

Varnish Removal insert, VRi before startup





Varnish Removal insert, VRi, after filtration

CASE

Customer

A 95 MW Combined Cycle Power Plant in Spain. Two base loaded gas turbines each containing 6,500 L (1,700 gal) of Mobil DTE 832 oil. Varnish level measured with Membrane Patch Colorimetric was reduced from MPC 55 to MPC 15 within two weeks of operating the CJC™ VRU. By using the CJC™ VRU, a pending oil change and flushing were not necessary anymore, and turbine trips due to varnish were avoided!

The savings obtained from reduced oil purchases, flushing and oil handling, add up to approximately

$ 35,000

per gas turbine.

The Benefits

no expensive turbine trips | no uncontrolled shut downs

Benefits

- Increased system reliability and availability
- Prevent shut downs due to varnish e.g. turbine trips or fail-to-start
- Full control of governor system and smooth operating valves
- Optimum operating cooling system free from varnish
- No need for tank cleaning and system flushing
- Longer lifetime of oil and components

Savings (average)

Avoiding a turbine trip and prolonging oil life can result in huge savings – a real example:

- $ 40,000 saved by avoiding a turbine trip (not including lost revenue)
- $ 35,000 saved on oil, flushing and disposal costs
- $ 4,600 per hour penalty for not supplying energy

Total cost for a turbine trip can easily exceed $ 100,000 including down-time penalties

Environment

- With the CJC™ VRU the oil life time can be extended to **10-20 years** in operation without compromising its properties
- Less oil is consumed due to reduced top-ups
- Extend the lifetime of components

Less Maintenance

- No need for system flushing and tank cleaning
- Avoid malfunction of hydraulic valves e.g. inlet guide vane valves
- Avoid clogging inline filters
- Avoid sludge and varnish build-up in heat exchangers
- Minimal maintenance and supervision of the CJC™ VRU
- Maintenance of the CJC™ VRU does not require shutting down the main oil system

C.C.JENSEN
- all over the World

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C.C.JENSEN A/S | Ver. 001 | 06.12