

CJC® Varnish Removal Unit, VRU

CJC® Fine Filter for Gas & Steam Turbines

APPLICATION

The CJC® Varnish Removal Unit, VRU has an unheard high efficiency in removing soft contaminants from oil - dissolved and suspended – even from hot operating gas and steam turbines.

Oxidation and varnish are known to cause problems in many industries, resulting in very costly production stops, turbine trips, loss in revenue etc.

BENEFITS

- Less varnish related turbine trips
- Lower maintenance costs
- Extends the lifetime of both oil and components
- No need for system flushing and tank cleaning
- Avoid temperature increase – no varnish in the cooling system

APPLICATIONS

Designed for efficient removal of soluble varnish from any size turbine:

- Gas and steam turbines with combined or separate lube and control oil system
- Base or peak loaded gas or steam turbines operating at low, medium or high oil temperatures
- Also for highly stressed and high temperature oil systems in general.

FUNCTION

The VRU is designed to remove dissolved and suspended soft contaminants by polar attraction in the optimized cellulose based 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 being treated and filtered in the VRU before sent back to the system tank as varnish free oil.

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

The VRU is prepared for online data logging via CJC® Trender Tool.



The CJC® Varnish Removal Unit
VRU 27/108

TECHNICAL DATA

		VRU 27/108
Varnish Removal Unit		380 - 420V @ 50 Hz & 440 - 480V @ 60 Hz
Pump inlet pressure, max.	bar/psi	0.5/7
Power consumption, aver.	kW	2
Full load current, max.	A	4
Filter Insert VRi 27/27	pcs.	4
Oil reservoir volume, max. *)	ltr/gal	45,000/11,900
Oil viscosity **)		<ISO VG68
Oil temperature, max *)	°C/°F	105/221
Varnish holding capacity, up to	kg/lb	8/18
Total weight	kg/lb	290/640
Design pressure, filter	bar/psi	4/58
Dimensions LxWxH incl. + free height	mm inches	1600x650x1598+575 63x25.6x62.9+22.6

*) For more than 45,000 L or higher temperatures, please contact us

**) For viscosities higher than ISO VG68, please contact us

APPLICABLE FILTER INSERTS

Type	Application for
Varnish Removal insert, VRi	Gas and steam turbines, large compressors and hydraulic oil systems



The CJC® Varnish Removal Unit, VRU 27/108 is only functional, if used in conjunction with the CJC® VRI 27/27 Filter Insert.

(Please ask for Product Sheet ID nr. PSFI3214)

CJC® Filter Insert, type VRi

Specially designed for removal of dissolved varnish in hydraulic and turbine oils

CJC® VRi FILTER INSERTS

The CJC® Varnish Removal insert, VRi 27/27, is used in the CJC® Varnish Removal Unit, VRU. The VRU contains 4 x VRi 27/27 Filter Inserts, which are specially designed for efficient removal of dissolved and suspended soft contaminants from turbine lube and hydraulic oils that operate at continuously high temperatures.

Used for the maintenance of the below applications:

- Gas turbines
- Steam turbines
- Compressors
- Hydraulic systems
- Generators
- Gearboxes



CJC® Filter Insert VRi 27/27



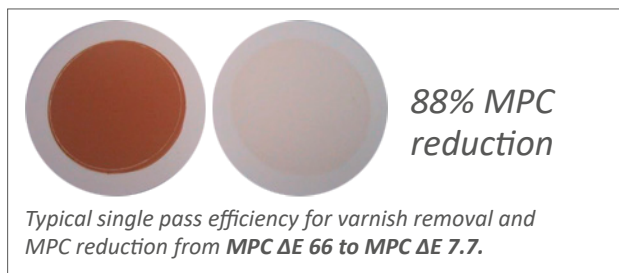
The CJC® Filter Insert VRi 27/27 is only functional when used in conjunction with the CJC® Varnish Removal Unit, VRU 27/108. Only the distinctive oil treatment and flow characteristic of the CJC® VRU ensures precipitation and polymerisation of dissolved varnish in the oil.

CONTAMINATION CAPACITY

Based on field experience we have observed that the total Dirt Holding Capacity (DHC) is dependent on the shape and density of particles and other variables within an oil system.

Contamination Capacities	Size
	27/27
Solids, kg (lb)	4 (8.8)
Water, ltr (gal)	2 (0.53)
Varnish, kg (lb)	4 (8.8)

Documented cases have shown the removal of 4 kg (4,000 g)/8 lb of solid contaminants and oil degradation products per filter insert with one VRU Filter Insert change (4 x VRi 27/27 16 kg/32 lb). Single-pass efficiency for varnish removal and MPC reduction of up to 99 percent. An Ultra-Centrifuge test can also be used to detect varnish.



COMPONENTS

CJC® Filter Inserts consist of cellulose bonded discs **made of 100% natural cellulose fibres from sustainable resources; no plastic, no metal, no chemicals.**



DISPOSAL OF USED CJC® FILTER INSERTS

CJC® Oil Filters are green solutions, and at C.C.JENSEN one of our objectives is caring for the environment. Therefore, please arrange for proper disposal of used filter inserts in accordance with your own local legislation.

IDENTIFICATION

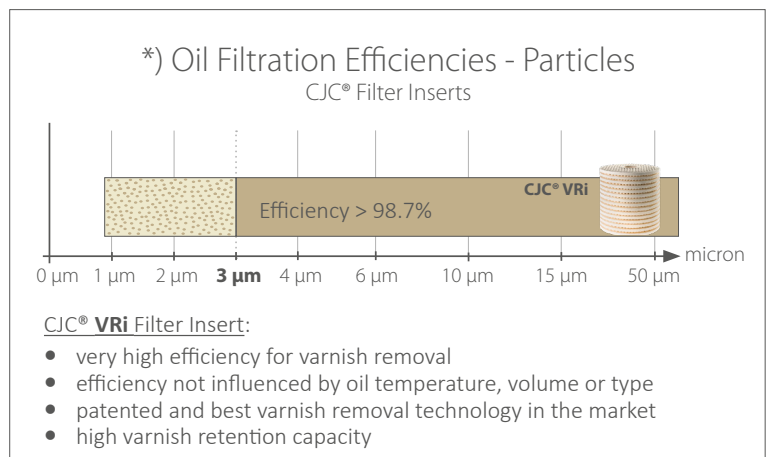
To order the VRi Filter Inserts, please use:

Article No.:

- 1 x VRi 27/27: PA5601370

FILTRATION TECHNOLOGIES

- ▶ **Oxidation and oil degradation products**
The CJC® Filter Insert VRi removes all phases of oil degradation; oxidation/resin/sludge/varnish, which are retained by the special cellulose material using adsorption and absorption forces.
- ▶ **Oil filtration degree**
*Particles can be removed as shown in the illustration below *)*
For offline oil filtration, the dirt holding capacity is paramount because the offline process will have time to remove contaminants, unlike in-line filtration. Our focus is on removing the smallest and most harmful particles.
- ▶ **Water removal**
VRi Filter Inserts will typically be able to keep the water in oil below saturation point (mineral/synthetic oils). All three phases of water (dissolved, emulsions and free) will be absorbed by the cellulose fibres.
- ▶ **Acidity stabilisation**
Acidity is a natural part of the oil degradation process and will be retained by the CJC® Filter Insert using absorption technology. The VRi 27/27 Filter Insert is documented not to affect the functional phenolic and amine anti-oxidant additive package of the oil. (Please request the CJC® VRU Product Sheet, ID no. PSST1109).



BENEFITS in general

C.C.JENSEN DEPTH FILTER EFFICIENCY TEST

CJC® Filter Inserts are designed to last for one year, therefore testing of a high density depth filter for a few hours does not make sense. The C.C.JENSEN test is inspired by a modified ISO 16889, using finer test dust (UFTD), which resembles real dust and wear particles better than the coarse MTD test dust used in the standard Multi-pass test - designed for thin pleated filter media. The test modification also includes a much longer test time to get close to a real-life application scenario. The main advantage of CJC® Filter Inserts is the huge surface area, which distributes the oil flow and particles evenly and ensures stable low velocity for optimum retention of contamination. The large filter mass makes this unmatched high dirt holding capacity possible.

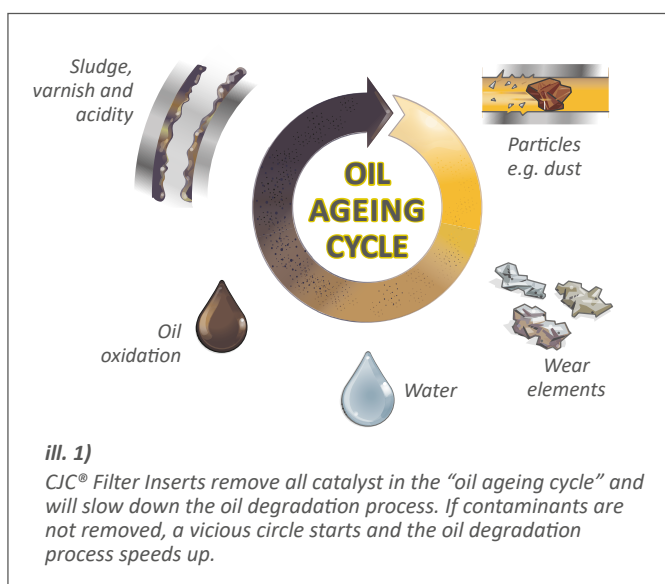
DIRT HOLDING CAPACITY CREATES VALUE

Competitive Filter Insert costs divided by dirt holding in kg:

3-micron filtration	Example 1	Example 2
Filter Insert type	Competitive pleated filter	CJC® cellulose depth media
Cost of element vs. Filter Insert	1 x €	4 x €
Dirt holding capacity	0.100 kg	4 kg
Cost per kg removed contamination	10 x € per kg	1 x € per kg

SLOW DOWN OIL AGEING

By removing all four contamination types (particles, water, acidity, and varnish), the CJC® Filter Inserts can slow down the oil ageing process and prolong the oil lifetime (see ill. 1). CJC® often results in 2-5 times longer oil lifetime, leading to considerable savings and reduction of CO₂ emissions. Field experiences show that removing particles of 3 µm and below with CJC® Filter Inserts has a significant effect on oil and component lifetime.



YOUR BENEFITS WITH CJC®

CJC® Filter Inserts have the highest dirt holding capacity on the market due to special cellulose-based material. Furthermore, the unique construction of the bonded discs, creates a large filtration area (see ill. 2) resulting in reduced costs of ownership. The CJC® Filter Inserts are a modular design, which allows them to fit any applications and requirements.

1. The CJC® Filter Insert features:

- a. Depth media of moulded cellulose.
- b. Highest Dirt Holding Capacities (DHC).
- c. **100% natural cellulose fibres from sustainable resources; no plastic, no metal, no chemicals.**



2. Removal of contaminants, 4-in-1:

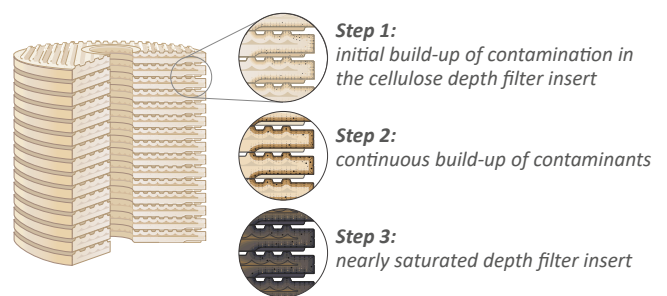
- a. **Particles:**
Lifetime of both oil and component are increased considerably.
- b. **Oil degradation products:**
Avoid sticking valves, lacquering, and varnish on metal surfaces.
- c. **Water:**
Reduce the risk of micro-pitting, bacterial growth, sludge etc.
- d. **Acidity/TAN:**
Reduce oil ageing and wear on equipment.

3. OEM requirements

Experience and application knowledge of C.C.JENSEN ensure that CJC® solutions can meet specifications from OEMs on oil cleanliness.

All helping to minimise further degradation of the oil.

CJC® DEPTH FILTRATION EFFICIENCY



ill. 2)

This graphic describes the technology and the efficiency of depth Filter Inserts removing contaminants by adsorption & absorption.

MAINTENANCE RECOMMENDATIONS

To achieve the highest possible oil cleanliness level, the CJC® Filter Inserts need to be changed at least once a year. Because of accumulated oil degradation products (oxidation, acids, and varnish) no matter what the pressure gauge indicates the used Filter Inserts should be replaced annually. Leaving filter media in service for longer than one year will result in decreased oil filtration efficiency and increased risk of breakdowns and component wear.





CJC[®] Oil Filtration presents

CJC[®] Varnish Removal Unit

Solution for removal of dissolved and suspended soft contaminants from oil in
Gas & Steam Turbines



Avoid varnish related turbine trips,
downtime & expensive repairs.

Prevent oil change & reduce CO₂ footprint.



Your challenges

turbine trips | oil aging | valve sticking | in-line filter blocking



- send us your oil sample
- contact your nearest CCJ Distributor

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 40°C (100 °F), 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 cold and hot surfaces, e.g. journal bearings.



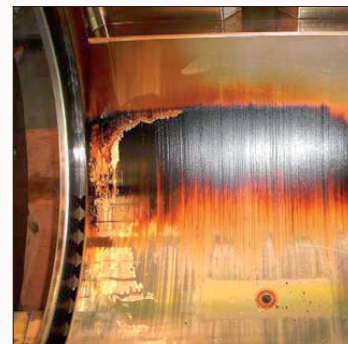
Varnish coated in-line filter of IGV servo valve hydraulics



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

Your solution

high efficiency | low maintenance | reliable | easy to install

3 in 1 Solution

use the CJC® VRU and remove
varnish, particles & water - in one single pass

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.

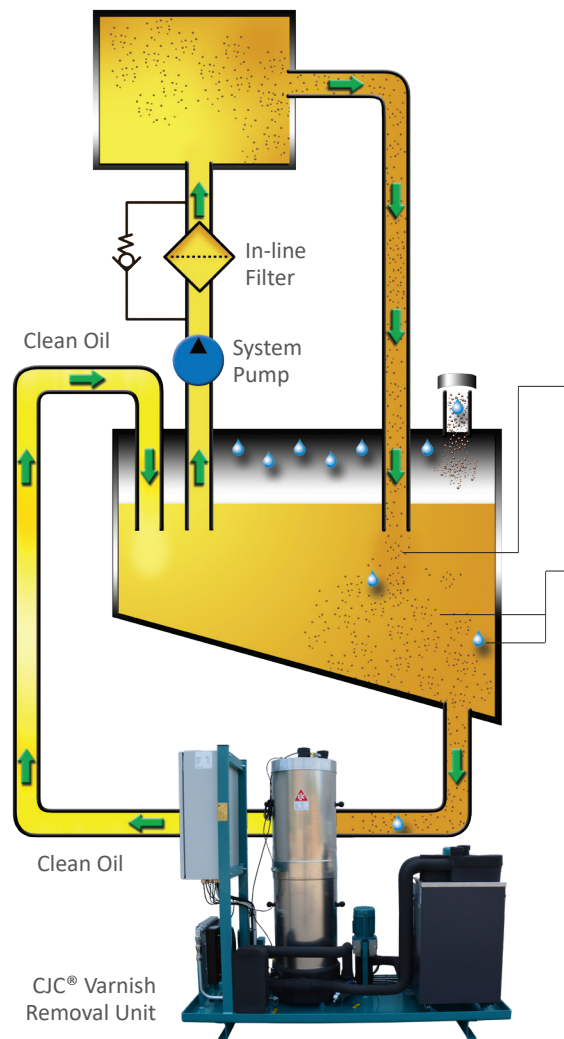
The CJC® VRU is designed to remove dissolved and suspended soft contaminants by polar attraction in the optimized, cellulose based CJC® Varnish Removal inserts, VRi. It does this without any additional power, chemicals or beads which may be harmful to the oil's additive package.

The hot oil is drawn from the lowest point of the system tank to the CJC® Varnish Removal Unit by means of the transfer pump on the unit. The process inside the unit includes passing the oil through the efficient CJC® Varnish Removal insert, VRi 27/27 specially designed for varnish removal in combination with the CJC® Varnish Removal Unit. After cleaning, the oil is returned to your system.

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.

Oil System

- Turbine lube and control oil
- Hydraulic oil
- Compressor oil



Contamination

now under Control!

3 in 1 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

Varnish

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

Particles & Water

Not only varnish is removed, also particles and water is retained in the inserts and removed from the oil.

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!

Our result

no turbine trips | no oil aging | no valve sticking | no in-line filter blocking

Before and After installation of CJC® VRU

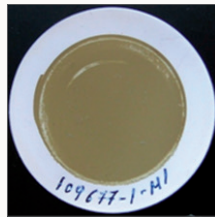
Turbine oil BEFORE filtration with the VRU



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)



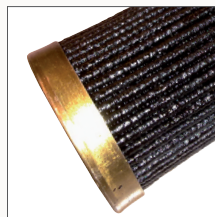
Clearly visible varnish at the metal surface BEFORE startup the VRU



No more varnish at the metal surface AFTER startup the VRU



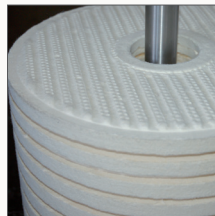
6 months WITHOUT VRU: Varnish on the in-line filter



6 months WITH VRU: No varnish on the in-line filter



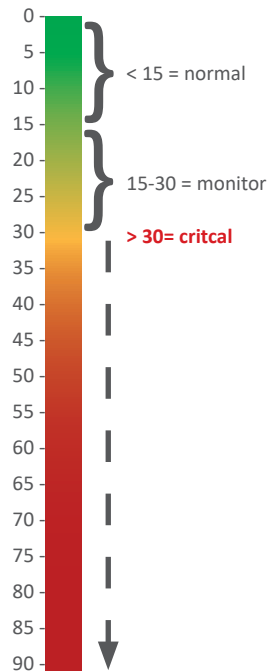
Varnish Removal insert, VRi before startup



Varnish Removal insert, VRi, after filtration



MPC Safe Level



CASE

Customer

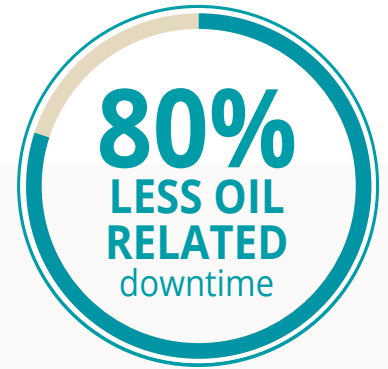
A 95 MW Combined Cycle Power Plant in Spain. Two base loaded gas turbines each containing 6,500 L (1,700 gal) of Mobil DTE 832 oil. Varnish level measured with Membrane Patch Colorimetric was reduced from MPC 55 to MPC 15 within two weeks of operating the CJC® VRU. By using the CJC® VRU, a pending oil 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.

Your benefits

no expensive turbine trips | no uncontrolled shut downs



Benefits

- **80% drop in oil-related turbine trips**
- **MPC of <15 guaranteed**
- Increased system reliability and availability
- No turbine trips or sticking valves due to varnish
- Prevent uncontrolled shutdowns and reduces maintenance costs
- Extends the lifetime of both oil, additives, and components, e.g. bearings, valves, seals etc.
- No need for system flushing and tank cleaning
- Improved lifting oil pressure
- More stable bearing temperature
- Less vibrations due to varnish in bearings



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 downtime penalties.



Environment

- **75% reduction in oil consumption**
- With the CJC® VRU the oil lifetime can be extended to **10-20 years** in operation without compromising its properties
- Extend the lifetime of components
- No use of ion exchange resin
- Prolonged oil and additive lifetime
- CJC® VRi Varnish Removal insert is made of 100% natural cellulose



Less Maintenance

- **50% shorter oil service time during outage**
- No need for system flushing and tank cleaning
- Avoid malfunction of hydraulic valves e.g. inlet guide vane valves
- Reduced consumption of in-line 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 - contact us today!



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