ENVIROSEP® VARNISH CONTROL
WITH MULTISTAGE ADSORBENT TECHNOLOGY

VARNISH MITIGATION

FOR LUBRICATION AND HYDRAULIC SYSTEMS

The ENVIROSEP® Varnish Control Technology utilizes advanced adsorption and filtration technology to stop varnish formation – at ambient or elevated temperatures - while delivering high oil circulation rates.

MODERN HIGH EFFICIENCY TECHNOLOGIES

Modern high-efficiency turbines operate at high firing temperatures and increased power output. These extreme operating conditions eventually consume protective oil additives resulting in the formation of costly lubricant varnish.

THE VARNISH PROBLEM

Lubricant varnish (also known as lacquer, sludge or tar), is a by-product of oxidation, additive drop-out, and thermal degradation. Varnish can 'plate out' on metal surfaces, build-up on valves, and other critical components.

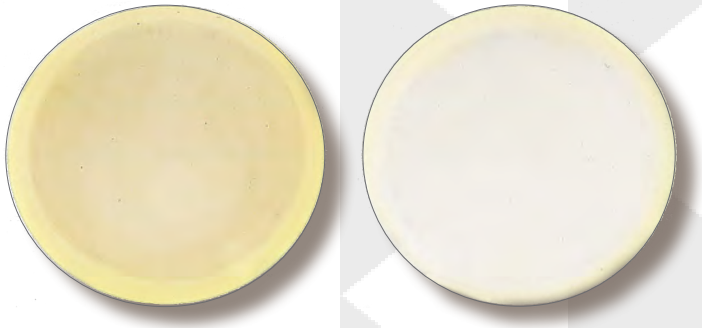
Low temperature conditions, such as shut downs, and extremely high or low turbulence conditions, such as bends and orifices, can help accelerate the formation of tar or sludge. These deposits tend to form a sticky, gummy layer that collects rust, mineral, and other particles.

On heat transfer surfaces, these deposits tend to dry into a hard to clean film. This film acts as an insulator lowering the heat transfer efficiency as compared to clean tubes and plates. Varnish deposits can adversely impact reliability as these deposits can cause a catastrophic failure by shutting down a turbine and can cause costly clean-ups. Varnish deposits are also responsible for the sticking and seizing of servo valves, frequent filter change-outs, and plugged or restricted oil flow through orifices.

The ENVIROSEP® Varnish Control Technology disrupts the varnish formation process.

VARNISH MITIGATION

Membrane Patch Colorimetry (MPC) testing (ASTM D7843) visually quantifies the potential for varnish formation; a high degree of discoloration is indicative of impending varnish problems. Patch sample field testing results are shown below. The patch on the left represents unconditioned oil with an MPC rating of 15.9. The patch on the right is the result of oil conditioning using the ENVIROSEP® Technology. Notice that the patch is brighter and has an MPC rating of only 7.1. These results demonstrate that the ENVIROSEP® Technology effectively reduced the varnish potential of the oil.



Unconditioned Oil (MPC 15.9)

After Oil Conditioning with ENVIROSEP® (MPC 7.1)

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DISRUPTING VARNISH FORMATION

Effective varnish control involves disrupting the varnish formation process. This process consists of three phases.

Phase 1 - Decline of Lubricant Solvency

Varnish formation begins when the lubricant is supersaturated with oxidized and degraded oil. The varnish potential (VP) begins to increase as the solubility of agglomerated by-products decreases.

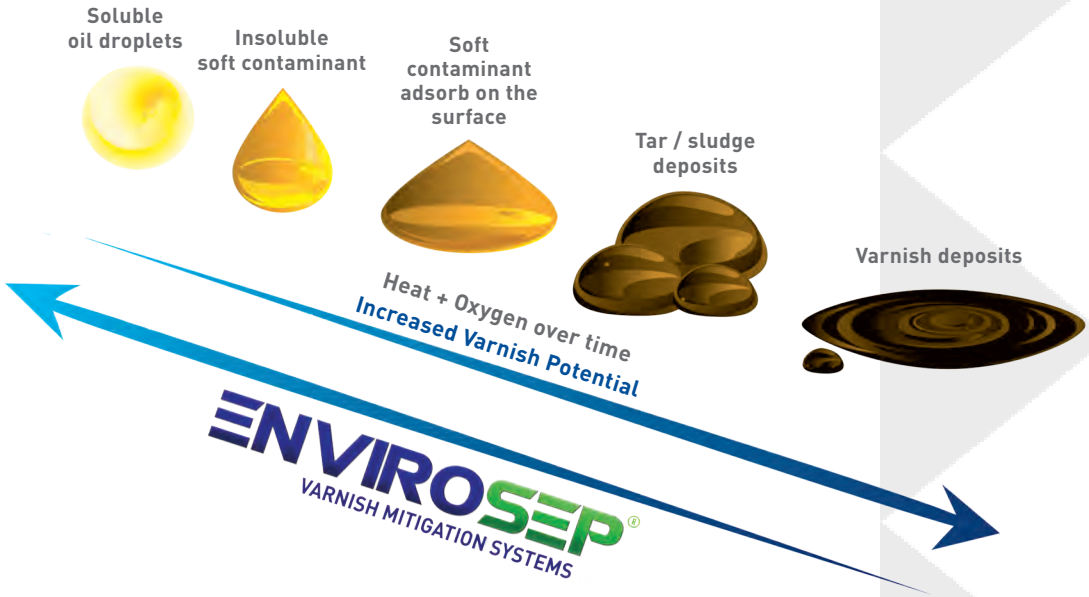
Phase 2 - Formation of Soft Contaminants

A decrease in oil solubility leads to the creation of insoluble, gel-like by-products called soft contaminants. These soft contaminants are easily deformed and will tend to extrude through conventional filter media.

Phase 3 - Generation of Sludge and Varnish Deposits

Soft contaminants can build up in a Technology and agglomerate, causing sludge and sticky deposits. Likewise, as partially soluble varnish precursors grow in molecular size, concentration, and polarity, they can adsorb directly onto metallic surfaces forming hard varnish deposits.

The ENVIROSEP® Technology uses multistage adsorbent technology to collect partially soluble gels, soft contaminants, and insoluble particles to reduce the varnish potential. High circulation rates treat the entire reservoir quickly and effectively using radial flow technology. This varnish prevention Technology helps to restore the oil package enabling long term improvement in both the oil quality and the equipment reliability.



Varnish formation is a process that evolves from the oversaturation of soluble oil products to form soft contaminants and finally varnish deposits. The ENVIROSEP® Technology effectively controls varnish formation by addressing them all.

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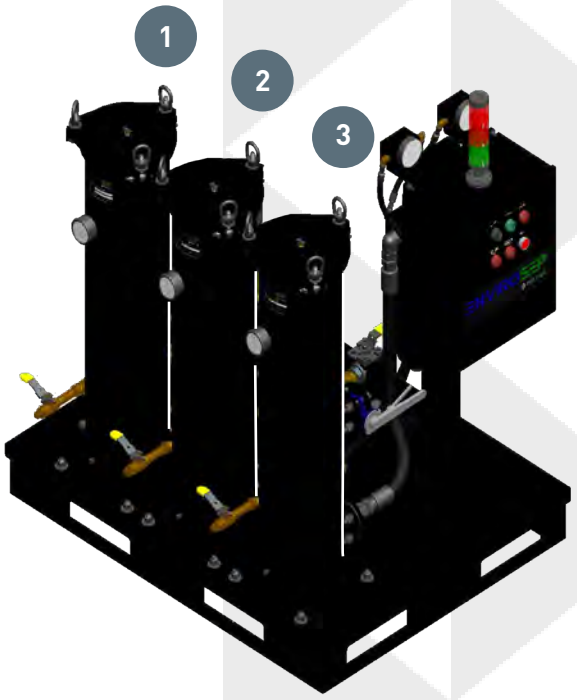
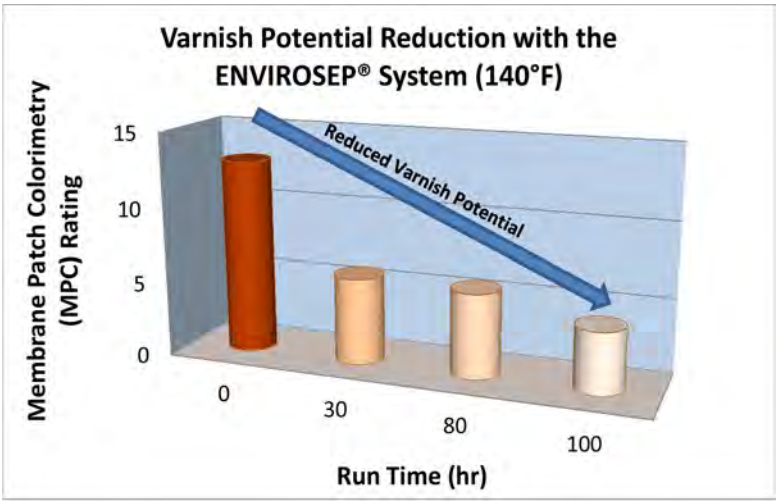
HOW IT WORKS

1. **STAGE 0 PRE-FILTER – Fine Particulate Removal** - The first stage of the ENVIROSEP® incorporates very fine filtration (as fine as one micron) to remove these hard to capture contaminants.
2. **STAGE 1 ADSORBER – Non-Soluble Varnish & Gels Adsorption** - Soft contaminants are easily deformed and tend to extrude through conventional filter media. The ENVIROSEP® proprietary Technology uses a varnish adsorption media that has a high affinity for large, sludge-causing oxidative by-products. This unique media also provides a large surface area for maximum effectiveness.
3. **STAGE 2 ADSORBER – Soluble Varnish Precursor Adsorption** – Next, fine and oil soluble varnish compounds are absorbed using a specialized polar adsorbent in a high performance depth bed specifically for the removal of hard to capture varnish compounds.



The ENVIROSEP® Technology uses a multistage adsorptive varnish removal process to effectively remove both dissolved and suspended oil degradation products that can lead to varnish formation.



Laboratory test result which show the reduction in MPC over the course of four days at 140 °F (MPC: Membrane Patch Colorimetry), July 2014.

ENVIROSEP® VARNISH CONTROL
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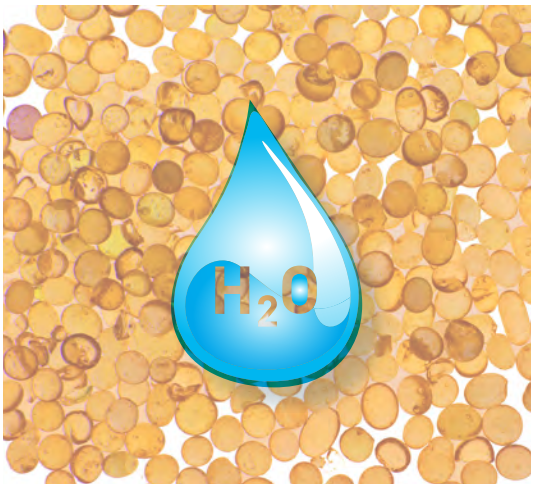
The ENVIROSEP® Varnish Removal Technology utilizes a multistage process to effectively remove both dissolved and suspended oil degradation products that can lead to varnish formation.

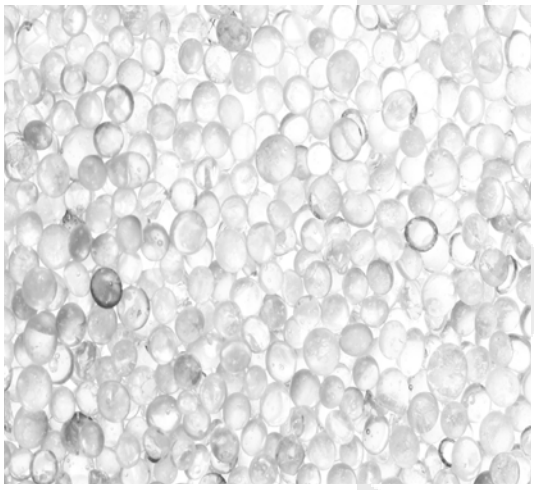
KEY BENEFITS

- **Removes Soluble and Insoluble Varnish Precursors, as well as, Particulates**, from petroleum-based and synthetic oils
- **Helps to Improve Technology Reliability and to Prolong Time Between Oil Changes**
- **Helps to Restore the Entire Oil Technology** enabling long term improvement in both the oil quality and the equipment reliability
- **Requires No ion exchange resins** – No moisture required
- **Flows at High Circulation Rates** (up to 16 gpm) treat the entire reservoir quickly and effectively
- **Operates at Normal Oil Temperatures** – No cooling required
- **Easy to Install, Simple to Operate**
- **Requires only Minimal, Periodic Operator Intervention**
- **Will Not Deplete Anti-Oxidant Additives** – Anti-oxidant compounds remain in the oil to help maximize oil life

THE ENVIROSEP® RESIN TECHNOLOGY ADVANTAGE



Ion exchange resin Technologys require water.



The ENVIROSEP® Technology uses proprietary adsorbent technology that does not require water.

ENVIROSEP® VARNISH CONTROL
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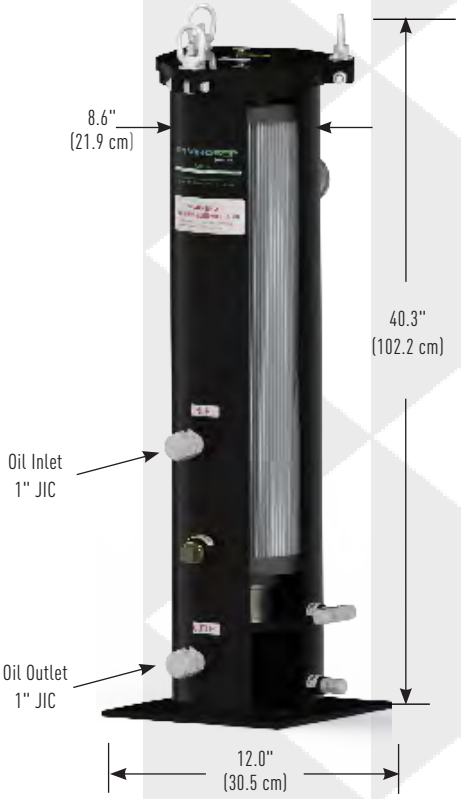
STAGE 0 PRE-FILTER
Fine Particulate Removal

The first stage of the ENVIROSEP® incorporates very fine filtration (as fine as one micron) to remove hard to capture contaminants.

DESCRIPTION	PART NUMBER
EnviroSep® Varnish Control Technology, Stage 0 Pre-filter Housing Assembly	ENV-STAGE0-JIC
Replacement Prefilter, Stage 0 (1 micron)	LGU6427HSAB

MATERIALS OF CONSTRUCTION	
Wetted Materials	Steel / Aluminum / Brass
Seal	Buna - N
Treatment Vessels	Epoxy Painted Steel
CONNECTIONS	
Oil Inlet	1" JIC
Oil Outlet	1" JIC
DESIGN RATINGS	
Maximum Operating Pressure	150 psig (10.3 barg)
Maximum Operating Temperature	140 ºF (60 ºC)
Minimum Operating Temperature	32 ˚F (0 ˚C)
Maximimum Flow Rate	16 gpm (61 lpm)



EnviroSep® Varnish Control Technology, Stage 0 Adsorber
(cutaway shown to illustrate pre-filter inside)

ENVIROSEP® VARNISH CONTROL
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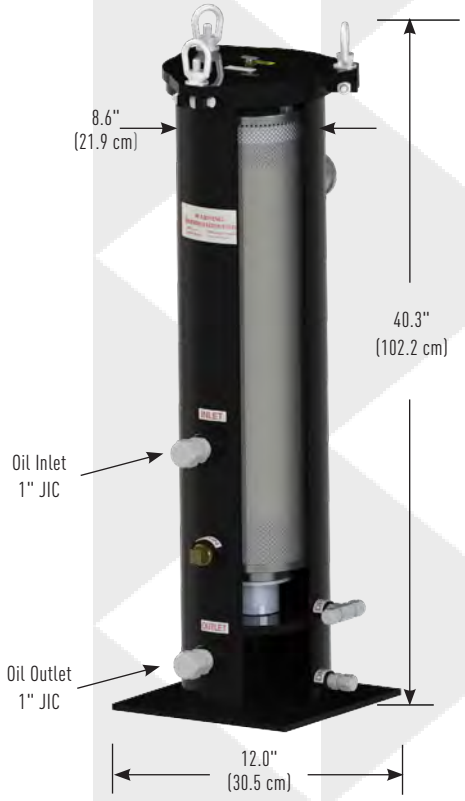
STAGE 1 ADSORBER
Non-Soluble Varnish & Gels Adsorption

Soft contaminants are easily deformed and tend to extrude through conventional filter media. The EnviroSep® proprietary Technology uses a varnish adsorption media that has a high affinity for large, sludge-causing oxidative by-products. This unique media also provides a large surface area for maximum effectiveness.

DESCRIPTION	PART NUMBER
EnviroSep® Varnish Control Technology, Stage 1 Adsorber Housing Assembly	ENV-STAGE1-JIC
Replacement Canister, Stage 1	LEADS-S1-SHC

MATERIALS OF CONSTRUCTION	
Wetted Materials	Steel / Aluminum / Brass
Seal	Buna - N
Treatment Vessels	Epoxy Painted Steel
Plumbing Fittings	Brass & Plated Steel
CONNECTIONS	
Oil Inlet	1" JIC
Oil Outlet	1" JIC
DESIGN RATINGS	
Maximum Operating Pressure	150 psig (10.3 barg)
Maximum Operating Temperature	140 ºF (60 ºC)
Minimum Operating Temperature	32 ˚F (0 ˚C)
Maximimum Flow Rate	16 gpm (61 lpm)



EnviroSep® Varnish Control Technology, Stage 1 Adsorber
(cutaway shown to illustrate canister inside)

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STAGE 2 ADSORBER
Soluble Varnish Precursor Adsorption

Fine and oil soluble varnish compounds are absorbed using a specialized polar adsorbent in a high performance depth bed specifically for the removal of hard to capture varnish compounds.

DESCRIPTION	PART NUMBER
EnviroSep® Varnish Control Technology, Stage 2 Adsorber Housing Assembly	ENV-STAGE2-JIC
Replacement Canister, Stage 2	LEADS-S2-SHC
Adsorbent refill for canister	LEADS-RF28L

MATERIALS OF CONSTRUCTION	
Wetted Materials	Steel / Aluminum / Brass
Seal	Buna - N
Treatment Vessels	Epoxy Painted Steel
Plumbing Fittings	Brass & Plated Steel
CONNECTIONS	
Oil Inlet	1" JIC
Oil Outlet	1" JIC
DESIGN RATINGS	
Maximum Operating Pressure	150 psig (10.3 barg)
Maximum Operating Temperature	140 ºF (60 ºC)
Minimum Operating Temperature	32 ˚F (0 ˚C)
Maximimum Flow Rate	16 gpm (61 lpm)

EnviroSep® Varnish Control Technology, Stage 2 Adsorber
(cutaway shown to illustrate canister inside)

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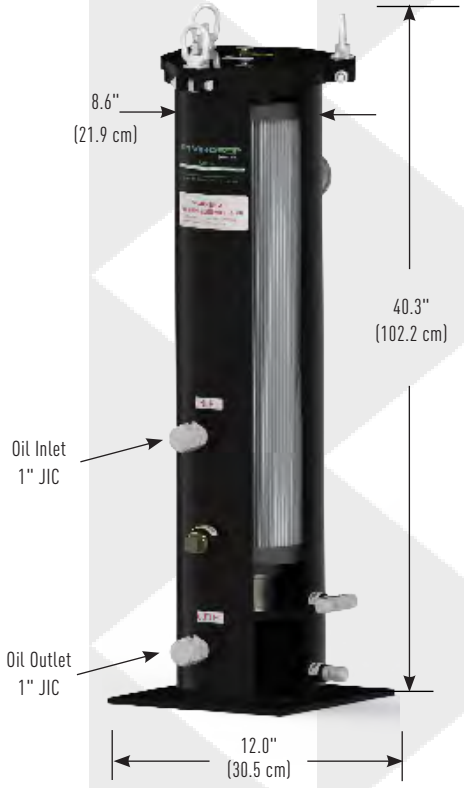
POST-FILTER

The ENVIROSEP® post-filter acts as a system failsafe.

DESCRIPTION	PART NUMBER
EnviroSep® Varnish Control Technology, Post-filter Housing Assembly	ENV-POSTFILTER-JIC
Replacement Post-filter, 3 microns	LGU6439HSBB

MATERIALS OF CONSTRUCTION	
Wetted Materials	Steel / Aluminum / Brass
Seal	Buna - N
Treatment Vessels	Epoxy Painted Steel
CONNECTIONS	
Oil Inlet	1" JIC
Oil Outlet	1" JIC
DESIGN RATINGS	
Maximum Operating Pressure	150 psig (10.3 barg)
Maximum Operating Temperature	140 ºF (60 ºC)
Minimum Operating Temperature	32 ˚F (0 ˚C)
Maximum Flow Rate	16 gpm (61 lpm)



EnviroSep® Varnish Control Technology, Post-filter
(cutaway shown to illustrate post-filter inside)

For more information on Pentair Engineered Filtration, please contact us at EFCustomerService@pentair.com.

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