

SERVICE DESCRIPTION:

Prevent Varnish Formation and Avoid Production Loss

A newly patented method from Ocean Team saves customers for huge amounts of money by eliminating and preventing varnish formation without any system shutdown.

Varnish formation is a huge problem in areas with high temperatures combined with high moisture, as for example in the Middle East, South Asia and South America. The combination of water, particles and high temperatures increase the risk of varnish generation, which can cause interruptions of the production such as tripping system and production loss. Once varnish deposits are generated in your system, it is very difficult to eliminate it.

What causes Varnish Formation?

Varnish is caused by oil degradation. In time oil degradation will result in, what people refer to as, insolubles in the oil, which is the initial stage of varnish formation. If this development is left unattended, the insolubles will react with solid wear particles in the system and generate varnish.

The main causes of oil degradation are oxidation (oxygen), hydrolysis (water) and thermal degradation (high temperature). In many cases it is a combination of all three together with internal or external contamination, which cause oil degradation.

- **Oxidation:** Oxidation is the reaction of materials with oxygen. It leads to insoluble products (sludge) that may precipitate as a thin film, forming lacquers or varnish deposits on hot or cold metal surfaces.
- **Hydrolysis:** Hydrolysis is the reaction of materials with water. Water in the oil can be generated as condensed water from the atmosphere.
- **Thermal degradation:** Thermal degradation is breakdown of the oil activated by heat/high temperatures. Typically thermal degradation occurs in hot spots of the system.
- **Internal or external contamination:** The presence of foreign substances in the oil has a great influence on oil degradation. Metals such as copper and iron are catalysts to the degradation process.



Are you aware of...

...that varnish only can be seen with the naked eye, when the oil temperature gets below approximately 45°C?

Additives Can Cause Creation of Varnish

Oil degradation is accelerated in areas with:

1. High moisture leading to ingress of water in the lubricant system,
2. High operating temperatures of the oil, and/or
3. Big temperature differences causing condensing problems.

To prevent or postpone oil degradation under such tough conditions, the oil will often be supplemented with special additive packages consisting of a high level of phosphor, calcium and zinc. These additive packages are extremely effective in preventing degradation processes of oil, but unfortunately nothing last forever.

In due time, it is unavoidable that the additives will get worn out, which especially can be caused by contact with water and contamination of solid particles in the oil.

The worn out additives are falling out as microscopic particles with a size below 1 micron.



Picture 1 - Example of soft varnish.

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Symptoms of Oil Degradation

An oil degradation process can be identified by the following symptoms:

- **Increased viscosity:** Increased viscosity of the oil will result in friction, wear and loss in system efficiency.
- **Decrease of flash point:** Fresh oil has a flash point at 202°C, which will decrease in case of degradation. A flash point lower than 180°C can pose a safety risk and require immediate action.
- **Change in the acid (TAN) neutralization value:**
Oil degradation will result in formation of acidic compounds, which promotes corrosion, for example pitting. This leads to increased wear in the internal surfaces of the attacked system.
- **Decreased additive performance:** Additives react with the degrading products such as water and solid particles, which lead the additives to lose their effect.
- **Varnish formation:** Varnish deposits are "sticky" and will trap hard contaminants and create a "sandpaper surface", which will accelerate component wear. In addition, varnish can result in blocking filters and valves and clogging orifices. Varnish does act as an insulator, reducing the effect of heat exchangers, resulting in higher temperatures and accelerated reaction speeds.
- **Increased contamination level:** Presence of unwanted particles and/or fluids in the oil.

**Consequences of Varnish and Oil Degradation**

The consequences of varnish formation and oil degradation are many - below are some of the most severe mentioned:

- **Shorter lifetime of the oil**
- **Reduced oil performance** - loss of lubricity, valve failure and restricted oil flow.
- **Reduced productivity** - Monday-morning problems/ slow start-ups, increased downtime and reduces system performance.
- **Higher energy consumption** - friction and wear.
- **Increased maintenance costs** - increased filter change frequency, increased wear on components, acidic corrosion at metallic components, component failures and cleaning of oxidation deposits.
- **Environmental pollution consequences** - leakages and greater disposal costs of oil and filter changes.

Known Actions toward Varnish Elimination

A known method to eliminate varnish is to establish a kidney loop and hereby perform electrostatic filtration, electro physical bonding or offline filtration of the infected system.

Unfortunately, these methods are limited by low flow conditions at less than 50 litres/minute, which will not always be effective enough to eliminate varnish at the same rate as it is generated in the system. In such cases, the normal procedure is to shut down the whole system and clean it manually in order to eliminate the varnish formation. Such a cleaning process will involve the following steps:

1. Shutdown of the infected system.
2. Draining of the system for all infected oil.
3. Mechanical cleaning of the oil tank.
4. Filling and filtering of new oil to the system.
5. Conduction of a full system flushing.

All together this is a very expensive and time-consuming procedure, which will result in huge production losses at the infected system.

Source Treatment rather than Symptom Treatment

Instead of waiting to take action until the varnish is causing problems in the system, Ocean Team focuses on eliminating the catalysts for varnish formation before they start causing interruptions of the general production. On the basis of oil analyses, we are able to monitor the oil degradation process.

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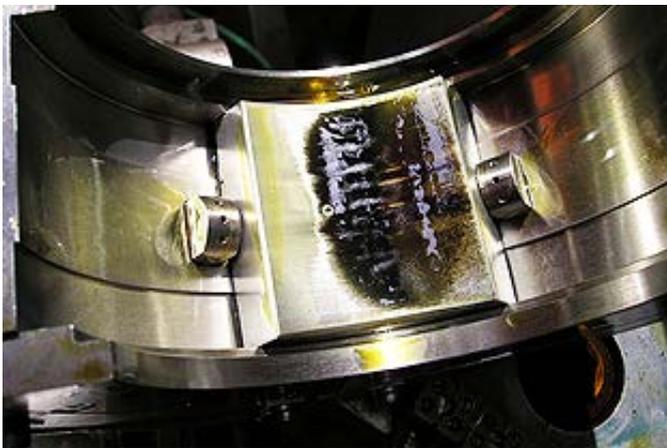
This gives us the possibility to take action at an earlier stage and eliminate the catalysts for varnish formation before the formation of varnish starts to escalate and cause interruptions.

Remove All Catalysts in ONE Step

By means of Ocean Team's developed and patented method - "In-depth Oil Conditioning" - we are able to remove all the catalysts to oil degradation - and hereby prevent varnish formation. The outstanding technology makes us able to effectively eliminate the following catalysts in one single step:

- **Foreign substances** - internal and external particles in the oil.
- **Moisture** - water mixed in the oil.
- **Gases and air bubbles.**

If the oil degradation already has caused formation of varnish in the system, our method is further developed with a special filter, which will eliminate the varnish from the infected oil.



Picture 3 - Example of varnish.

Avoid Production Loss with ONLINE Cleaning

Beside the benefits of eliminating the catalysts to oil degradation and preventing varnish formation, one of the most considerable benefits by our method is, that the whole cleaning process can be performed without shutting down the system.

Our In-depth Oil Conditioner is mounted to the oil reservoir of the infected oil system and the oil is herewith cleaned during full operation, which saves the customer for huge amounts of money and production loss.

The method has a capacity of more than 150 litres/minute, which gives a much faster cleaning compared to other known methods within varnish elimination. The high flow rates make the method especially suitable for cleaning of medium and large-sized oil systems.

ATEX Approved Method

The "In-depth Oil Conditioner" represents a new way of thinking degassing and dehydration of oil. Water and gas are removed from the oil without use of traditional vacuum pumps. This improvement has enabled us to build an ATEX approved unit, which can be operated in potential explosive atmospheres, for example at on- and offshore oil and gas extraction, gas as well as power plants.

The Result: Huge Cost Savings

Ocean Team's patented In-depth Oil Conditioning method represents an effective preventive weapon against varnish formation. The purpose is to eliminate the catalysts to varnish formation even before varnish is generated in your system. This saves you as the customer for huge amounts of money as to reduced costs for maintenance, minimized risks of interruptions and breakdowns as well as increased system efficiency.

Further advantages of our varnish prevention program:

- **Increased safety** – degassing will result in an improved flash point of the oil and therefore increased operation safety.
- **Longer lifetime of the oil** - cleaning the oil rather changing it will result in eliminated costs for disposal of the old oil as well as costs for new oil. Further this is a more environmentally preferable solution.
- **Less operation downtime** - as to increased system reliability and efficiency.
- **Online cleaning = No production loss** – no shut-down of the infected system during cleaning saves the customer for expensive production loss.
- **ATEX approved system** – the method is approved for operation in potentially explosive atmospheres.
- **High flow capacity** – ensure a fast cleaning of medium and large-sized oil systems.