Identifying And Tackling Oil Contamination

demp
danish engineering & marine power

WELCOME

Oil is said to be the lifeblood of any machine. Properly lubricated machines will give a better, more reliable and more profitable service to the operator. Why is it then that oil testing and contamination control is such a low priority? We believe this is mainly due to a lack of understanding of the consequences of contaminated oil and how to avoid them.

Oil is prone to contamination both whilst being stored and during service. Water and solid particles are just two of oil's enemies. A build-up of contamination can block filters and can result in areas of the engine not receiving adequate lubrication. Downtime on equipment due to engine failure is expensive and a waste of valuable operation time.

Education is the most important step in preventing oil contamination. This handbook has been written to guide you through good oil husbandry.

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HOW MUCH OF A PROBLEM IS OIL CONTAMINATION?

Clean oil is the key to an efficient, healthy running engine. However, oil is under constant attack from contamination which can be disastrous for equipment reliability and performance.

According to Noria (the industry body that promotes better lubrication practises), 80% of engine failures can be attributed to contaminated oils. This can reach 90% in hydraulic systems.

To put the problem into focus:

- 85% of lubrication professionals state particle contamination has caused problems for their plant's equipment
- 82% of mechanical failures are said to be caused by particle contamination
- 70% of instances of 'loss of usefulness' of equipment is caused by oil degradation

Not only that, but oil contamination can cause damage to engines in many different forms, including blocked filters and injectors and damaged bearings and gears - all of which require expensive replacements.

HOW MUCH OF A PROBLEM IS OIL CONTAMINATION?

Such a high level of breakdowns is not good for business and cannot be ignored. Damaged engine components and regular oil changes rack up costs.

But what is the likely cost of oil contamination? This cost breakdown came from an existing customer, TDL. It shows how much they were spending on just ***one*** dump truck due to oil contamination, and how much they saved with improved oil conditioning.

Without OilLife

	Year 1	Year 2	Year 3	Year 4	Year 5	
Services per year	12	12	12	12	12	
Oil cost per service	£224	£224	£224	£224	£224	
Filter cost per service	£60	£60	£60	£60	£60	
Labour cost per service	£200	£200	£200	£200	£200	
Oil Analysis cost per service	£10	£10	£10	£10	£10	
Cost per service	£494	£494	£494	£494	£494	
Cost per year	£5,928	£5,928	£5,928	£5,928	£5,928	**£29,640**

With OilLife

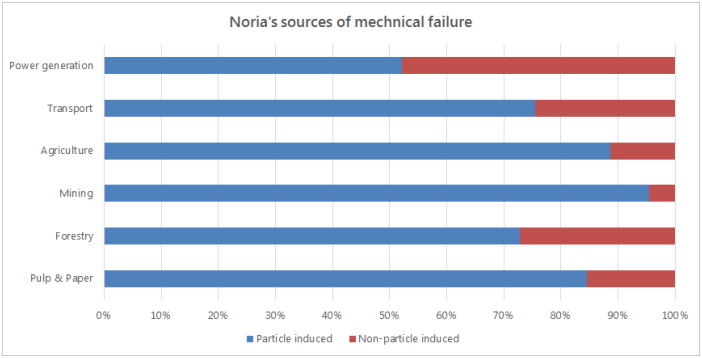
	Year 1	Year 2	Year 3	Year 4	Year 5	
OilLife Unit (incl. fitting)	£1,050	£0	£0	£0	£0	
Services per year	3	3	3	3	3	
Oil cost per service	£238	£238	£238	£238	£238	
Filter cost per service	£60	£60	£60	£60	£60	
Labour cost per service	£204	£204	£204	£204	£204	
Oil Analysis cost per service	£10	£10	£10	£10	£10	
OilLife Unit replacement filter	£95	£95	£95	£95	£95	
Cost per service	£607	£607	£607	£607	£607	
Cost per year	£2,872	£1,822	£1,822	£1,822	£1,822	**£10,158**

Total Saving	**£19,482**
Total Saving	**66%**

WHO IS AFFECTED BY OIL CONTAMINATION?

If you're in a business that relies heavily on mechanical equipment – mining, quarrying, transport, manufacturing, agriculture and shipping – oil contamination can cause major disruption by means of mechanical breakdowns.

This makes the problem of oil contamination one that cannot be ignored. It is particularly prevalent in the mining and quarrying industries. After all, these represent some of the dirtiest commercial environments on the planet; the air is full of abrasive particles. Up to 95% of mechanical failures are caused by particle contamination within these industries.



TYPES AND CAUSES OF OIL CONTAMINATION

There are many types of contamination that can affect oil including water, fuel, particles, detergents and air. The two most commonly found are water and particle contaminants including soot and glycol (the key component of anti-freeze).

EXTERNAL CONTAMINATION: WATER

Water is one of the most destructive contaminants in lubrication. It will deplete additives and will interfere with oil thickness production. Water vapour is a by-product of the combustion process and should cause no immediate problems. However, high water levels demand attention and can only be temporarily corrected with an oil change.

Water combines with combustion by-products such as sulphur dioxide and trioxide to cause the formation of commonly found acids in oil such as sulphuric acid. The presence of acid will cause a rapid drop in the oil's alkalinity (its TBN or Total Base Number), resulting in a corrosive environment.

Free and emulsified water can flash-vaporise under extreme temperatures and pressures resulting in cavitation wear to bearings and other components.

Emulsified water also binds easily with particulate contamination causing a bigger obstruction and increasing the likelihood of blocked filters.

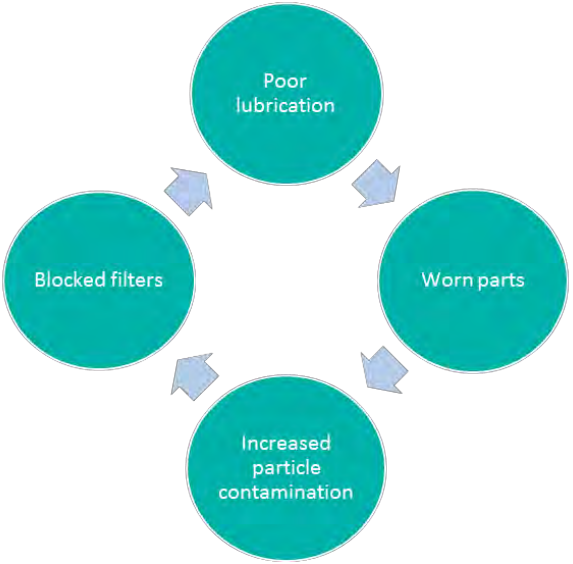
EXTERNAL CONTAMINATION: SOLID PARTICLES

A common type of particle contamination is soot. Soot is a by-product of combustion and will be found in all operating diesel engines and most petrol engines. It reaches the engine oil via blow-by during the engine's normal operation.

Historically, soot formation is more common in diesel than in petrol engines because of the way that diesel fuel is injected and ignited. Petrol engines ignite the fuel/air mixture with a spark. Diesel engines use the high temperature in the combustion chamber. The fuel and air in earlier models of diesel engines generally do not mix as thoroughly as they do in petrol engines. This results in fuel-dense pockets that produce soot when ignited. While the majority of soot exits through the exhaust, some gets past the piston rings and ends up in the oil. If soot particles build up in the oil it is likely an oil change will be required. This means costly downtime for important equipment. Poor ignition timing, excessive ring clearance and restricted air filters are likely causes of high levels of soot contamination .

All types of particulate contamination are a distinct problem for modern common rail diesel engines. They are more sensitive to abrasive wear than older diesel technologies because of their extremely high injection pressures – up to 35,000psi.

Particulate contamination causes a vicious circle unless it is tackled directly:

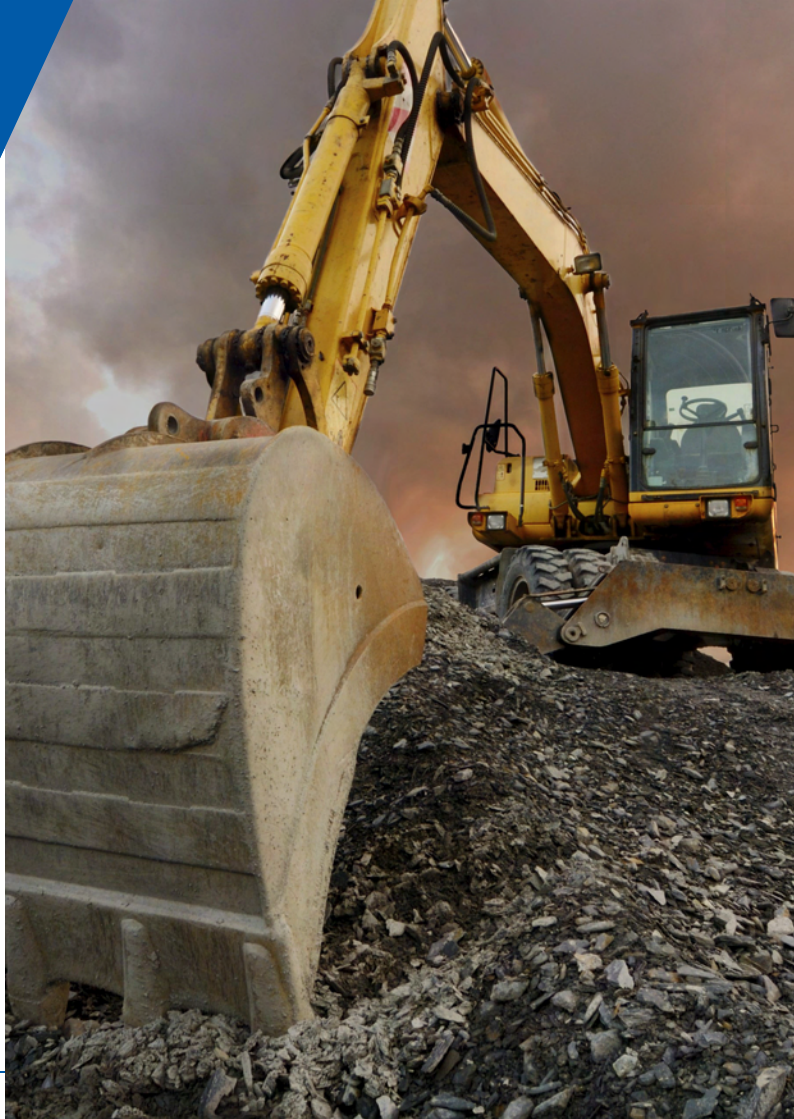


Addressing contamination is a more cost-effective solution in the long-term than changing the oil with ever-increasing frequency.

EXTERNAL CONTAMINATION: GLYCOL

Glycol, a key component found in anti-freeze, is a common contaminant in engine oils. It can weaken a lubricant's properties. Anti-freeze changes the viscosity of the oil, thickening it, meaning it will not flow and shear as readily as before. This could be damaging to parts of the engine that require a less viscous lubricant to properly protect them. Oil contaminated with glycol is likely to block filters more frequently. If they become completely blocked, oil will no longer be filtered. Without sufficient filtration taking place, harmful particles remain in the system further contaminating the lubricant and resulting in surface damage to components . A contamination level of just 0.4% glycol in oil is enough to coagulate soot and cause oil flow restrictions and filter blockage .

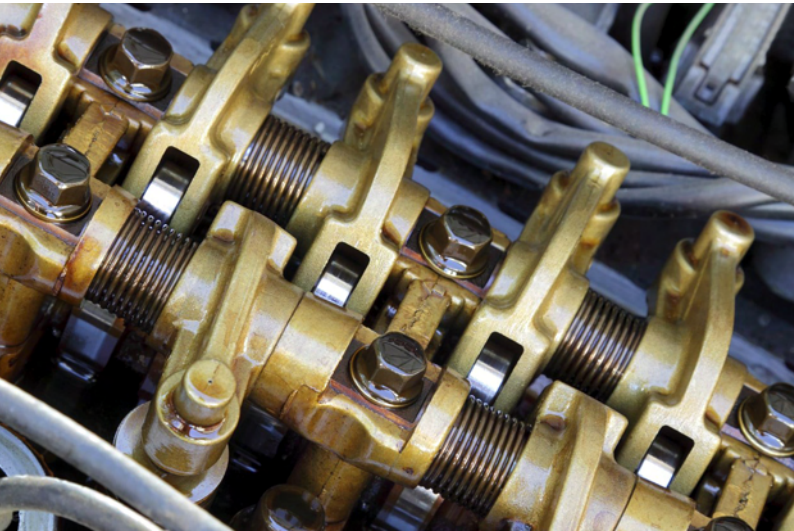
Anti-freeze, as well as altering viscosity, also mixes with oil to form globules called oil balls. Although small (usually between 5 and 40 microns in size) they can cause big problems. They are extremely abrasive and cause surface erosion, gouging and cutting into the walls of the engine.



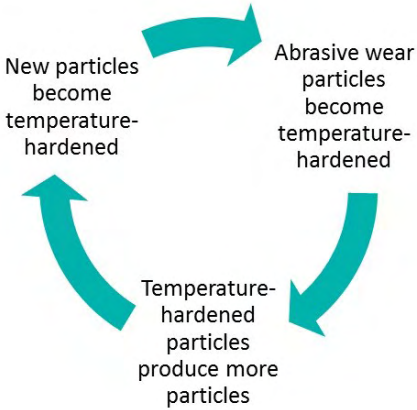
INTERNAL CONTAMINATION

Some forms of particle contamination are inevitable. Internal particles come from inside the engine and can be formed through general wear. If lubricants are stored correctly and external contamination is under control but high levels of contamination are still evident, this could suggest abnormal wear and damage to components.

Particles - particularly those made from catalytic metal particles such as copper, lead and iron - will increase a lubricant's oxidisation rate. They will also strip the oil of its anti-wear additives and rust inhibitors. Numerous small particles in stable suspension can cause the oil's viscosity to increase and may promote foaming.



These particles are abrasive. Once in the oil, they accelerate the wear rate dramatically due to a chain reaction :



This vicious circle will continue until the particles are removed by filtration, the engine fails or the oil is changed.

PREVENTING OIL CONTAMINATION

The first step in preventing oil contamination is to store it properly before use. Many people are unaware that lubricants have a shelf life. The area and the manner in which oil is stored can introduce contamination. How do you prevent this?

- Oil drums should be stored indoors wherever possible as drums can rust if stored outside
- Ensure bungs are tight and that seals are not perished. This can occur when temperature changes lead to expansion and contraction of the metal
- Keep drums as dry as possible and away from water. Do not allow water to accumulate on any part of the drum. Protect drums under a roof, a lean-to or with a tarpaulin
- Before removing bungs, clean and dry the surrounding areas to prevent water and dirt entering the oil
- Lay the drums on their sides if possible. This will help ensure the oil level is above the bung level, minimising the possibility of water and dirt entering the lubricant
- Make sure pumps and portable lines are kept clean and stored in a clean environment

- Avoid topping up and emptying drums in exposed areas
- Ensure pumps are fitted with desiccant (recommended) breathers. Desiccant breathers use a replaceable filter to remove particles greater than three microns and to remove moisture from the air entering the oil. These are slightly different from deliquescent breathers which remove moisture from the air during the inhale phase and purge it during the exhale phase, drying the filter.
- Ensure all components for an oil change are clean and free from contamination and ensure all seals and breathers are intact to prevent the entry of contamination. This will help keep contamination levels low.

Even if all of these tips are followed, oil should still be tested before use if it has been stored for a long time.

HOW OFTEN SHOULD OIL BE TESTED?

According to Noria, oil should be sampled at every oil drain as a minimum. Several factors should be considered when determining oil analysis frequency such as:

- the age of the equipment,
- the age of the lubricant and
- how critical the equipment is to operations.

A good rule of thumb is this: test the oil in critical equipment on a monthly basis and less critical equipment on a 3-monthly basis.

Oil often suffers from contamination due to cost-saving measures. Reducing the frequency of oil testing may save money, for example, but it will save less than having healthy oil and longer oil changing intervals .

TDL is a good example. TDL are the UK distributor for Terex mining equipment. They took the step to add an OilLife extended oil life system (see later pages) to each of their vehicles. By doing this, oil drain intervals were dramatically extended from 500 hours to 2,000. Instead of 12 oil changes a year, the trucks could now operate safely with just 4. Even after the cost of the OilLife systems was taken into account, TDL could show a saving of over £19,000 per truck over a 5 year period.

LUBRICANT TESTING .v. REAL TIME MONITORING

The traditional way to have oil analysed is to take a sample, send it to a lab and review the report that's returned. Recently, we have released a system that can continually analyse oil while the equipment or vehicle is running. This has several advantages:

- Off-site testing is slow – it can take a week to get results back by which time a mechanical failure may have happened. Real-time monitoring is instant and potential failures can be detected before they occur.
- Testing using samples only shows you a snapshot of oil quality at a specific time. Real-time monitoring gives you up to the minute information.
- The length of time between off-site tests makes accurate predictions difficult. Real-time monitoring allows you to record data over time for trend analysis. It's not just numbers at one time that are important – trends identify problems areas.
- Lab-style testing is only possible if trained staff are available to take valid samples. Real-time monitoring uses a permanently-fitted sensor that can be monitored by any authorised member of staff.

A landfill, gas and power generation company in the UK found that their off-site oil condition testing was too slow and too expensive. They needed something instant to avoid costly repairs. By installing an OilAlert real-time sensor (see later pages) they were made instantly aware of dangerous levels of contamination. OilAlert gave the company a potential saving of 73% repair costs by avoiding engine failures. This could mean a saving of £450,000 over a 5 year period (depending on actual repair costs).

OUR SOLUTIONS

Our range of OilAlert packages provide real-time monitoring of lubricant quality in off road equipment, ships, gen-sets, wind turbines, compressors and many other types of mechanical devices. Unlike off-site lubricant testing, OilAlert sensors constantly monitor the condition of your oils. If an engine or hydraulic system is running, its oil is being checked. With some OilAlert packages the results can even be broadcast back to your service depot in real-time and alarms raised automatically if problems are detected.

OilAlert is the perfect partner for all hard-working machinery. The more severe the conditions, the heavier the workload, the more critical the application, the more essential OilAlert becomes:

- Mining equipment
- Construction and earth-moving equipment
- Commercial and military shipping
- Passenger transport
- Haulage
- Landfill power generation
- Renewable power generation
- Prime power generation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OUR SOLUTIONS

OilLife
EXTENDED OIL LIFE SYSTEM

Our OilLife system is a low-flow filtration and evaporation system that offers an effective alternative to traditional oil filters. When installed in parallel with an existing filtration system, the OilLife unit uses the dual action of filtration and evaporation to remove particles and non-particulate contaminants from oil. The filtration system removes particulates as small as 1 micron. The thin-film evaporation process removes damaging gases and liquids from oil. This improves overall oil condition and prevents further oil contamination.

Our OilLife system is suitable for engine, hydraulic, transmission and compressor oils. The results and benefits are impressive:

- Oil drain intervals extended by at least 4 times
- Reduced wear and damage to the engine
- Reduced oil usage and disposal cost
- Minimised filter replacement and ongoing consumable costs
- Reduced likelihood of unpredictable maintenance

Our state of the art low-flow filtration and thin film evaporation method combines to remove all oil based contaminants. OilLife removes at least 98.4% of solid contaminants down to 1 micron in a single pass through the use of its innovative dual filtration process.

Extended oil life is one part of our services to help industries that rely on heavy capital equipment – especially if that equipment operates in remote locations.

Below is a cost analysis to highlight the savings that can be made by efficient contamination control.

This is based on an example 1000kva generator with the assumption that it runs 3,000 hours a year and has a 180L oil capacity, and taking into account the industry average labour, oil and filter prices.

Engine oil and filter maintenance costs before Oil-Life extender fitted (with standard service interval of 500 hours)	£3,200.00
Engine oil and filter costs after OilLife extender fitted (with extended service interval of 2,000 hours)	£1,108.00
Operational savings per year:	**£2,092.00 per generator**

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