WEAR CHECK® AFRICA
A Division of the Set Point Technology Group

TECHNICAL BULLETIN

ISSUE 22

CLEAN UP YOUR ACT

by Michelle Allis,
B. Sc. Eng (Mech)

It is widely accepted that oil contamination is the one of the major causes of component failure. When practising proactive maintenance it therefore makes sense to give oil cleanliness a high priority. This technical bulletin will deal primarily with particulate contamination, the causes, and how to avoid it. By maintaining a high level of oil cleanliness, machinery failure, resultant downtime and expensive repair costs can be kept to a minimum.

There are many factors to consider when trying to *clean up your act.* The first and most important place to start is at the source: the ***new oil***. Oil could be contaminated when it leaves the refinery, during transportation or during the transfer to the end-user's or vendor's tanks. But, more often than not, it is the manner in which the oil is stored by the user that results in new oil contamination.

OIL STORAGE

Oil storage is a very important factor to consider when implementing proactive maintenance but is usually at the bottom of the list of priorities - or overlooked completely. Many times the area and manner in which the oil is stored can introduce contamination. So how does one ensure that this does not happen? Let's take a closer look at proper oil storage conditions.

The most common oil container used by the oil industry is the 210 litre drum. When filled with oil it weighs approximately 220 kg. These drums should be handled in a careful and correct manner so as not to damage the drums and cause them to puncture or burst. Containers should be immediately moved to a storage area and remain sealed until needed. Wherever possible, oil drums or containers should be stored indoors but there are times when this is not possible and one needs to utilise ***outdoor storage*** areas.

There are a number of rules to follow to avoid contamination when storing oil outdoors:

Storage drums should ideally lie on their sides.

- Do not store the drums outside indefinitely as drums can rust and contaminate oil.

- Ensure bungs are tight and that drum seams do not deteriorate. This can occur because of temperature changes resulting in expansion and contraction of the metal, causing oil leaks or contamination.

- Keep drums or containers as dry as possible and well away from water. Do not allow water to accumulate on any part of the container. This water can be drawn into the container when changing temperatures cause pressure changes within the drum or container.

- Cover the drums with a tarpaulin or some form of covering. Construction of a 'lean to' will help.

- Before removing bungs, dry and clean around the bung areas to prevent contamination with dirt and water which are the two most common and destructive contaminants in any environment.

- Ideally, lay the drums on their sides, on a specially constructed rack if possible. Make sure that the bungs are at the 3 o'clock and 9 o'clock positions. This generally ensures that the content of the drum is above the bung level. This will minimise water (and dirt) entry and stops the seal from drying out. If drums have to be stored upright without any protection from the elements, tilt them slightly and make sure the tilt is parallel to the 3 o'clock/9 o'clock bung line. This stops water from collecting around the bungs.

Even though it is best to store oil containers or drums indoors there are still a few factors to consider when utilising ***indoor storage.***

- The storage area should be a cool, dry area free from extreme temperatures.

- The storage area should be kept clean at all times, ideally with a formalised cleaning schedule.

- Presence of any contaminants should be minimised. Contaminants could result from manufacturing processes, the environment, etc.

Oils can also be stored in ***bulk storage tanks.*** It is often easier to maintain low particulate contamination levels when oils are stored in bulk tanks as they are normally closed to the atmosphere and the oil is dispensed via a pump or tap. Ensure the seals are intact and breathers are fitted. The fitting of desiccant type filters is recommended.

OIL DISPENSING

Contamination due to dirty top-up containers or ***dispensing equipment*** is a common problem. As with most of the points raised with storage, hygiene and common sense are what count. Wherever possible, dispensing equipment should be kept clean to minimise contamination of the oil. A few points to remember are:

- Make sure pumps and portable lines are stored in a clean environment and are kept clean.

- If possible avoid topping up and filling in exposed areas.

- If top-up containers have to be used, make sure they are clean and not left open to the elements. Avoid mixing different oils in these containers.

Dispensing equipment is a common problem.

- Quick coupling fillers will ensure that environmental contaminants do not enter lubrication systems.

- A number of companies produce utility cans for topping up purposes. These have lid and spout designs that keep contaminants out and some have a pressurised dispensing facility.

- Clean around filler caps before removing.

- Make sure the tops of drums are cleaned and free from dirt and water before opening.

Once sufficient, adequate oil storage has been established, the next place for oil particulate contamination to occur is once the oil is in the machine or component. This can happen in many ways. Open ***vents*** provide an easy means of dirt entering a machine. Faulty ***breathers*** are a common source of particulate contamination. ***Oil leaks or damaged seals*** are also culprits. Remember if oil is able to leak out of a system, contaminants are able to enter the system. Repair damaged seals or oil leaks as soon as possible.

INTERNAL CONTAMINATION

Now that we have considered particulate contamination via an external source let us look at particulate contamination via an internal source. Some form of internal contamination is inevitable and is worrisome as it can denote a problem with the machine/component. Internal particulate contamination is basically any particles that contaminate the oil once it has been placed in the closed lubricated system, e.g. wear particles, seal material, etc. When external particulate contamination is under control a high particle count provides an early warning for an abnormal wear situation developing.

Particles, especially catalytic metal particles like copper, iron and lead, increase the rate at which oxidation occurs. These particles also strip the oil of its anti-wear additives, extreme pressure additives, rust inhibitors and dispersants. Numerous very small particles in stable suspension can cause the oil's viscosity to increase and may promote foaming.

These particles are abrasive and, as with all particulate contaminants, once in the oil accelerate the rate of wear dramatically because abrasive wear can cause a chain reaction in lubricated machinery. The typical chain reaction is:

- Abrasive wear particles become work hardened.

- Work hardened particles produce more particles.

- New particles become work hardened.

- A chain reaction occurs until the particles are removed by filtration, or the machine fails.

It is therefore imperative that one monitors the oil cleanliness and keeps particulate contamination to a minimum. This is done by implementing a contamination control programme which needs to be looked at in three easy steps.

1. Contamination prevention

Having made sure that clean oil is just that, i.e. free from contamination, by taking heed of all that has

It is imperative to monitor oil cleanliness.

been said above about oil storage, handling and dispensing, we also need to look at the times when servicing of the machine becomes necessary. When component changes or work is carried out on the machine, ensure all new components are free from contamination and further contamination does not enter the machine during servicing. Ensure that all seals and breathers remain intact to prevent contaminant entry.

2. Contamination removal

Contamination removal deals mainly with filters and filtration systems or, if easier and cheaper, especially with small sump quantities, oil draining and discarding. Each application needs to be evaluated when deciding which option is more cost-effective. When using filters to achieve target cleanliness levels, it does not always mean that one must use the best or most expensive filter. A cheaper filter used in the correct manner may produce the desired results at a lower cost. The effectiveness of a filter or filtration system can be tested by taking representative oil samples from before and after the filter.

3. Monitoring of cleanliness levels

Monitoring does not mean monitoring of the oil only while in use in the machine. In order to implement contamination control, cleanliness levels may be checked at several points:

- New oil sources
- Bulk tanks or stored lubricants
- Oil in service in equipment

To monitor the level of contamination, one needs to test the oil and obtain a ***particle count***. Different instruments using different methods are available to test particle count but Wearcheck uses the most common type of automatic particle counter, which operates on a light blockage principle. In this particle count test, the total number of particles, irrespective of origin, are counted in a number of sizes, ranging from greater than 5 to 100 microns. The results are expressed as the total number of particles per ml of oil in the various specified size ranges. A cleanliness rating is also reported. The cleanliness rating is expressed as a two-number code X/Y, where X represents the total number of particles per ml greater then 5 microns and Y represents the total number of particles per ml greater than 15 microns.

TARGET CLEANLINESS LEVELS

'What does this mean to me?', you may ask. Well that depends on the machinery you are operating, the application, environment and the required cleanliness levels. For warranty purposes, certain manufacturers have already laid down maximum cleanliness ratings for their equipment. It is difficult to know what the optimum cleanliness level is for your machines. Each machinery class has an appropriate oil cleanliness level for that application. In general, machines with tight clearances benefit greatly from clean oil. It takes time to monitor results and choose an exact level if you have not been given one by the manufacturer. But remember, be realistic and consider what is cost-effective when setting target cleanliness levels. It makes no sense to expect such high cleanliness levels that you spend more money discarding

Sampling technique is of utmost importance.

or filtering your oil than it would cost to replace the machine in the event of a failure.

That said, once you have a target cleanliness level and you are monitoring particle counts, there are a number of things to keep in mind. Sometimes an oil may have a high particle count result but the actual oil in the machine is perfectly clean. This could be the result of two scenarios. ***Sampling technique*** is of utmost importance when monitoring cleanliness levels.

Firstly ensure that the oil sample taken is representative of the oil in the machine. The oil should be well mixed when the sample is taken and no external contamination should be introduced during sampling. This **external contamination** could be as a result of a number of things:

- A dusty environment.
- A manufacturing process that produces particulate contamination.
- The oil not being well mixed and sediment from the bottom of the tank being drained into the oil sample bottle.
- A dirty sample valve.
- Dirty sampling equipment, especially when samples are decanted from another sampling container.
- Sample bottle caps not being replaced immediately after the sample is taken.
- Dirty sample bottles.

Secondly, consider the method used by the laboratory to obtain particle count data. Wearcheck operates an optical particle counter using the light blockage technique. This involves passing a laser beam through a controlled stream of oil, measuring the amount of light blocked by individual particles as they pass through the beam. Obviously larger particles block more light than smaller ones, making size information relatively easy to obtain. This method is, however, very sensitive and has some limitations. Particle count data is inflated by the presence of water droplets or gas bubbles in the sample because these are 'seen' as particles. The laser cannot pass through very dark or extremely contaminated samples making them impossible to measure.

It is, therefore, important to look at the appearance of the oil as well as other laboratory tests, such as water concentration and any comments based upon a microscopic examination, before reacting to an abnormal particle count result. It is also very important to ensure that the sample is taken in the same manner and from the same sampling point each time a piece of equipment is sampled. This consistency allows samples to be compared with confidence (comparing apples with apples). Randomly sampling a machine from up and downstream of a filter can produce a very confusing set of laboratory results if no sampling point information is included with the sample.

To summarise, one needs to set target cleanliness levels, achieve target cleanliness levels with continuous exclusion and removal of contaminants, and monitor contamination levels regularly to assure conformance to standards.

Education is the key to contamination control.

BETTER LUBRICATION LEADS TO INCREASED PROFITS

Lubricants free from contamination provide better service to machines and, in turn, properly lubricated machines will provide better, more reliable and profitable service to the owner or operator. The question that springs to mind then is 'Why is contamination control given such a low priority in most proactive maintenance programmes?'

This is largely due to a lack of understanding of contamination, its consequences and its control. Proactive maintenance requires a long-term investment in machines and people. A small amount of particulate contamination in a machine may not lead to an instant failure or halt of operation today, but will invariably shorten the machine's life. When the machine does finally fail it is very difficult to determine or even prove loss of life due to particulate contamination.

Education is the most important ingredient on a journey of successful contamination control. All personnel must be educated as to their roles in the process and the benefits obtained in reaching the destination. Teamwork is imperative and an educated, dedicated team will result in an efficient, cost-saving contamination control programme. The general rule of thumb is that it costs ten times as much to remove the particulate contamination as to prevent it occurring in the first place.

The bottom line is: clean up your act and you will achieve greater machine availability and utilisation. Reduced operating costs and increased profits will follow naturally from this.

Michelle Allis is a technical consultant for the Wearcheck Division of Set Point Technology.

Copies of previous Technical Bulletins can be accessed on Wearcheck's web site:

www.wearcheck.co.za

Readers who would prefer to receive future issues of Wearcheck Technical Bulletin and Monitor via e-mail instead of in printed form, please e-mail a request to:

support@wearcheck.co.za

Produced by the Wearcheck Division of Set Point Technology

KWAZULU-NATAL
9 Le Mans Place, Westmead
P.O. Box 15108, Westmead, 3608.
Tel: (031) 700-5460
Fax: (031) 700-5471
E-mail: support@wearcheck.co.za

GAUTENG
25 San Croy Office Park,
Die Agora Road
(off Brabazon Road), Croydon.
P.O. Box 284, Isando, 1600
Tel: (011) 392-6322
Fax: (011) 392-6340
E-mail:
jhbsupport@wearcheck.co.za

INTERNET SITE :
http://www.wearcheck.co.za