

Particulate Contamination in Lubricating Oil

Particulate detection in lubricating oil is one of the areas of Tribology that receives the least attention in South Africa. The detection of small particles in both new and used oils is a relatively simple task that most condition monitoring laboratories can perform. This is done using numerous techniques, the most common of which is optical particle counting. Unfortunately the majority of customers pay no attention to the laboratory results.

Particle detection, monitoring and managing can allow the oil user to save themselves a substantial amount in downtime and component repair costs.

It can't hurt?

The particles referred to are predominantly smaller than 50 microns (μm). If you have 20/20 vision in both eyes you will only be able to see particles larger than $40\mu\text{m}$. Perhaps this is why there is so little emphasis put on particle detection. What you can't see can't hurt you?

Unfortunately exactly the opposite is true: the particles that you cannot see are also the ones that are the hardest to remove from the oil.

If you have 20/20 vision in both eyes you will only be able to see particles larger than $40\mu\text{m}$

The majority of components in industry have some sort of filtration installed on them. This filtration has to take two things into consideration for it to work efficiently and effectively: the oil flow through the filter media required for the components to be adequately lubricated; and the size of the particles that the filter can trap and remove from the oil. For example, if you have a flow rate requirement of 500 L/min such as in some hydraulic systems, and you want to remove all the particles in the oil larger than $4\mu\text{m}$, as well as taking the restriction due to blockage into account, you will require a very large filter area to return the flow rate required. So the majority of filtration is a tradeoff of size over area.

Small and dangerous

Particle detection or particle counting in oil can give you valuable information surrounding the efficiency of the filtration fitted to your components. The larger the particles detected in the component's oil, the larger the particles the filtration media is allowing through.

Keeping in mind that the particles in the oil that cause wear are often not visible to the human eye, a trial was carried out to determine the detrimental effects of particles in oil.

Using calibration dust with given particle sizes and weight, numerous hydraulic pumps of the same make and size were operated with a different particle count in each of their oils. Simulating their normal operation, the flow rate was a constant 250L/min. In accordance with the ISO 4406 (1987) specifications, the particles in the oil were monitored and converted into a cleanliness rating.

The first pump with a cleanliness rating of 21/18 operated for a 2-year period before failing. The others failed in succession thereafter. The cleaner the oil was, the longer they lasted. The pump with a cleanliness rating of 14/11 was still running after a 14-year period.

Cleanliness rating

At the same time, a calculation was done as to the effects of high particle count or cleanliness ratings on the pump pumping the oil and its longevity.

The pump pumping oil with a cleanliness rating of 21/18 pumped approximately 4 tons of calibrated dust in one year, whereas the pump pumping oil with a cleanliness rating of 14/11 only pumped 25kg of calibrated dust in the same year.

Using this study, a table was created that calculates the life extension to a lubricated component by improving the oil cleanliness. For example, if the oil has a cleanliness of 21/18 and it is reduced to 14/11, the life of that component is extended by approximately 12 xs.

Not that clean

A survey was then carried out to determine the average oil cleanliness of new oil on the South African market. After testing numerous new oils out of sealed containers, it was discovered that the average new oil in South Africa has a cleanliness of 20/17, which is not that clean.

So, if lubricating oil is just kept clean, it can go a long way towards reducing operating costs and making Tribology management much easier.

Wade de Chalain, SAIT Committee Member, Email: secretary@sait.org.za