Preventive maintenance through particle analysis

An online particle counter helped a Finnish paper mill discover impurities in its process fluids and avoid expensive damage and downtime

Lubricating oil systems rely on clean operating fluids, and are subject to failures due to contamination. Particles in lubricating oil systems might lead to system failures or machine downtime. The sources for such contaminations are various, as particles can enter the system either from outside or can originate from the system itself.

Contaminants may enter the system from outside through badly covered patches (e.g. particles in environmental air or sediments on piston rods). Incorporated dirt particles derive from the manufacturing process, and stay in the system unless they are carefully removed (e.g. casting sand of core manufacturing, scales, rust, welding sputter, or textile fibre). Finally, metallic or non-metallic pieces of abrasion may enter the liquid during machine operation due to ageing processes (e.g. wear material or abrasive particles). All these contaminants may cause severe problems for the lubricating oil system. It is therefore essential to continuously monitor the condition and cleanliness of the operating fluid.

Equipped with eight or more size channels, automatic particle counters are able to detect bearing failures in lubricating oil systems at an early stage

Automatic particle counting

Automatic particle counting helps to prevent contamination-related damage. With the aid of an online particle counter, the operating fluid can be permanently monitored. The fluid particle counter detects particle number and the size of each individual particle via an optical measuring technique. As soon as a pre-defined limit is exceeded, the online particle counter instantaneously raises an alarm.

In case of an extraordinary number of large particles, it is likely that wear and abrasion have occurred. Abrasive particles often derive from defective components, which must be exchanged or repaired to prevent machine failures or complete downtime. Large abrasive particles, however, can be detected only with specially equipped monitoring instruments.

Defective roller bearing in a Finnish paper mill

Unlike standard contamination monitoring devices, the integrated sensor of an automatic particle counter is equipped with more than three size channels. With at least eight integrated size channels, a particle counter provides much more detailed information on the particle size distribution than a contamination monitor could do. Larger particle sizes >70µm(c) can be distinguished from smaller or medium particle sizes.

The following application example shows that the knowledge on larger particle sizes and their size distribution is of paramount importance in lubricating oil systems. An above average particle population of large particles casts light on abrasion issues in the application.

Eight take on three

In a Finnish paper mill, the operating fluid of a roller bearing was monitored simultaneously with two measuring instruments for four months. On one side, the monitoring was performed on a contamination monitor comprising three size channels, and on the other side on a particle counter equipped with eight size channels. As per ISO 4406, the contamination monitor provided information on the particles in the sizes of >4µm(c), >6µm(c), and >14µm(c), whereas the automatic particle counters reported on the contamination level in eight size channels between >4 and >70µm(c).

Abrasive particles often derive from defective components, which must be exchanged or repaired to prevent machine failures or complete downtime

The comparison of measuring results showed that the triple channel monitor did not suffice to identify the quality of the lubricating oil sample. During the complete measuring interval, the contamination monitor declared the oil to be clean with low triple codes as per ISO 4406. The automatic particle counter with its eight size channels, however, reported alarmingly high particle numbers in the size channel >70µm(c). A further examination revealed that mechanical components of the roller bearing had been badly damaged, resulting in the bearing having to be exchanged. If the machine abrasion had not been detected on time, a severe and costly machine failure or complete downtime would have been the consequence.

The use of an automatic particle counter was therefore crucial in this application example. Only thanks to the differentiation of particle numbers in eight size channels, and in particular in the channel >70µm(c), was it possible to clearly show the real degree of contamination. The high number of larger particles highlighted an abrasion issue and provided insight on a failure in the system (i.e. a defective bearing in this case). If such abrasive particles are detected on time, proactive and preventive maintenance operations can be undertaken to repair the failure and to limit downtime.

Conclusion

Condition monitoring of lubricating oil systems requires an early detection of failures, so that they can be quickly repaired and consequential damages can be prevented. The application example proved that a differentiated particle analysis of at least eight size channels is required to detect abrasive particles. A contamination monitor reporting triple codes as per ISO 4406 does not provide any information on the real size distribution of larger particle sizes.

Contamination monitors cannot detect these large particles and hence are not adequate for condition monitoring of lubricating oil systems. An online particle counter with eight or more size channels is more suitable for early detection of bearing failures, as it provides information on the particle size distribution also for larger particle sizes.

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