Fluid condition monitoring of lubricating oil

Preventive maintenance through particle analysis

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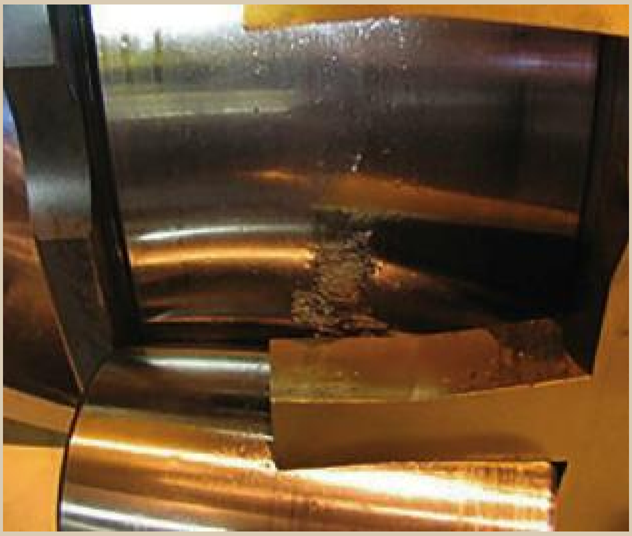
Lubricating oil systems are relying on clean operating fluids, and they are subject to failures due to contamination. Particles in lubricating oil systems might lead to system failures or machine down times. The sources for such contaminations are various, as particles can enter the system either from outside or can originate from the system itself. 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 of environmental air or sediments on piston rods). Incorporate dirt particles derive from the manufacturing process, and stay in the system unless they are accurately 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 aging 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.

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; these parts must be exchanged or repaired to prevent machine failures or complete down times. Large abrasive particles however can be detected only with specially equipped monitoring instruments. Unlike standard contamination monitoring devices, the integrated sensor of an automatic particle counter is equipped with more than 3 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 > 70 µm(c) can be distinguished from smaller or medium particle sizes.

The following application example from real life shows that the knowledge on larger particle sizes and their size distribution is of paramount importance in lubricating oil systems. A particle population of larger particles above average casted light on abrasion.

Application example: Eight-channel particle counter vs. Triple code contamination monitor

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 a contamination monitor comprising 3 size channels and on the other side a particle counter equipped with 8 size channels. As per ISO 4406, the contamination monitor provided information on the particles in the 3 size channels > 4 μm(c), > 6 μm(c) and > 14 μm(c), whereas the automatic particle counters reported on the contamination level in 8 size channels between > 4 and > 70 μm(c).



Unlike a contamination monitor, an automatic particle counter is able to provide information on abrasive particles. In a Finnish paper mill, the use of an automatic particle counter with 8 size channels revealed that mechanical components of the roller bearing were badly damaged. An exchange of the roller bearing limited further losses. (Picture: PAMAS)

The comparison of measuring results showed that the triple code as per ISO 4406 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 8 size channels however reported alarmingly high particle numbers in the size channel > 70 μm(c). A further examination revealed that mechanical components of the roller bearing had been badly damaged. The bearing had to be exchanged. If the machine abrasion had not been detected on time, a severe and costly machine failure or complete down times would have been the consequence.

The use of an automatic particle counter hence had been crucial in this application example. Only because of the differentiation of particle numbers in eight size channels and in particular in the channel > 70 μm(c) was it possible to clearly show the real degree of contamination. The high number of larger particles casted light on abrasion 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 the down times.

Condition monitoring of lubricating oil systems requires an early detection of failures, so that they can be quickly repaired and so that consequential damages can be prevented. The application example from real life proved that a differentiated particle analysis of at least 8 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 the condition monitoring of lubricating oil systems. A real online particle counter with 8 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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Equipped with 8 or more size channels, automatic particle counters are able to detect bearing failures in lubricating oil systems at an early stage. With the aid of particle counting, contamination-related damages can be prevented. (Picture: PAMAS)