Predicting oil changes in industrial applications without interrupting operations

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Changing the oil in hard-to-access industrial equipment, such as offshore wind turbines, is complex and costly. But by using an in-built measurement system developed by researchers at Saarland University together with partners from academia and industry, the optimum time for the oil change can now be predicted even for such remote industrial installations. Professor Andreas Schütze (left) and graduate engineer Eliseo Pignanelli (right) will be exhibiting the portable version of their measurement system at HANNOVER MESSE, with which they can perform local on-site testing to detect signs of oil aging and degradation. The oil flows through the measuring cell (center) where it is irradiated with a laser and with infrared light. Credit: Oliver Dietze

Predictive maintenance of hard-to-access plants, no unnecessary oil changes, no unnecessary laboratory costs and less environmental impact. These are just some of the benefits offered by a new system that can monitor the condition of lubricating oils, hydraulic oils and other fluids in industrial installations without interrupting ongoing operations. The method was developed by engineers from Saarbrücken in collaboration with project partners. The compact sensor system is available as a portable unit or can be built into industrial plants, wind turbines and other machinery. The system, which uses optical methods to measure the oil's chemical makeup and the degree of particle loading, can also predict the best time for an oil change.

The team of engineers led by Professor Andreas Schütze from Saarland University and ZeMA, the Centre for Mechatronics and Automation Technology in Saarbrücken, will be showcasing their work from April 7th to April 11th at the Saarland Research and Innovation Stand at HANNOVER MESSE (Hall 2, Stand C 48).

Failing to change the oil at the right time can cause serious damage to machinery and equipment. A fact that is just as true for cars as it is for large industrial installations. Over time, a lubricating oil used to minimize friction, reduce wear and prevent overheating will become contaminated with fine metal dust and particles from abrasive processes. The oil will also gradually oxidize. And the additives that help to optimize the oil's properties also have only a finite lifetime. At some point, the oil will no longer be able to act as an effective lubricant. According to Professor Andreas Schütze, the key problem is that it is not obvious when exactly the oil needs changing. In the case of plants or installations that are difficult to reach – such as offshore wind turbines – the method adopted up to now has been either to take oil samples and have them examined in costly laboratory analyses or to simply change the oil at some regular interval. "As a result, a great deal of effort is expended in changing oil that is still actually useable, which is costly for both the operator and the environment," explains Professor Schütze.

In collaboration with partners from other universities and industry, Schütze's team at the Lab for Measurement Technology and at ZeMA have developed a measurement system that can be integrated directly into industrial installations where it continuously measures and monitors oil ageing and degradation while the installation continues to operate. The data from the measurement system are currently transmitted by mobile radio communication so that analysis and assessment can be performed off-site. A portable version of the system also exists. At HANNOVER MESSE, the engineers will be exhibiting a small case that contains all the equipment needed (from the measuring cell to the display unit) for on-site testing of the oil's quality. "Our system allows us to identify and avert potential damage early on. We can predict when maintenance work will be needed and plant operators can plan accordingly," explains Schütze. The method is also suitable for use with hydraulic systems. And the measurement system can test not only oils, but can also be used to monitor the condition of other fluids.

The methods developed by the engineers in Saarbrücken involve shining light into the liquid being monitored. In one case, light from a laser diode is scattered by any particles present in the oil or fluid. "Each different type of particle scatters the light in a particular way, causing more or less light to be measured in the various spatial directions. The scattered light is then recorded by photodiodes and the signals analysed. The system allows us to distinguish between metal dust, other solid particles and air bubbles and to determine the concentration of each," explains engineer Eliseo Pignanelli, who has been involved in refining the system. The second optical technique measures the absorption of infrared light by the fluid at specific wavelengths as it flows through the measurement system. "This permits us to draw conclusions about the chemical state of the oil, because chemical changes to the oil will cause changes in the light spectrum that we record," says Pignanelli. This spectroscopic analysis also enables the presence of water in the oil to be detected.

The team of engineers at Saarbrücken have been developing the system in a number of research projects, including the "FluidSens" and "NaMiFlu" projects that are collaborative efforts involving partners from academic institutions and from industry. Industrial partners include HYDAC Electronic GmbH in Gersweiler and EADS Deutschland GmbH (Innovation Works). One of the main areas of research concerned optimizing the optical and mechanical properties of the nanostructured layers used in the microsensors and adapting them for use at high pressures. Working with ZeMA in Saarbrücken, the technology is now being developed into a market-ready product.

Provided by Saarland University

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