

e-connect.monitor enables predictive, condition-based maintenance with the aim of avoiding unplanned plant downtime and optimally leveraging the service life of critical machine components

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So that the Heart of the Machine Beats Longer

Avoid Standstills by Permanently Monitoring Hydraulic Pumps and Hydraulic Oil

Unplanned production downtime can have far-reaching consequences in an injection molding company until delays in delivery. In the form of e-connect.monitor, Engel offers a solution for analyzing the condition of critical machine components, which avoids unanticipated downtime. Following the introduction of two modules for monitoring plasticizing screws and ball screws, the company is now presenting further e-connect.monitor modules for condition monitoring of hydraulic pumps and hydraulic oil.

Even experienced machine operators and maintenance personnel find it very difficult to assess the condition of an injection molding machine during ongoing production. In order to avoid unplanned production downtime, wear-prone components are replaced at fixed intervals in some operations as a precau-

tionary measure. In this way, unplanned plant downtime can be avoided, collateral damage to other components ruled out and the downtime necessary for the planned installation of spare parts minimized. However, this maintenance strategy means that parts subject to wear are replaced earlier than actually necessary,

and thus too often. Rising maintenance costs and falling plant availability are the consequences.

With the increasing networking of production systems and the systematic utilization of machine data, Industry 4.0 opens up new opportunities for injection molding companies through con-

dition-based, predictive maintenance. At K2016, Engel Austria GmbH, Schwertberg, Austria, presented the first two modules of the new e-connect.monitor condition monitoring solution: for monitoring plasticizing screws and online monitoring of ball screws [1]. The demand for these solutions has been growing steadily ever since. The system provider is therefore successively expanding the number of machine components that can be monitored. Engel will be presenting two new modules for continuous monitoring of hydraulic pumps and hydraulic oil at Fakuma 2018 (Title figure).

Three Factors as the Cause of Decreasing Oil Quality

Injection molders commonly refer to the hydraulic pump as the heart and the hydraulic oil as the blood of a hydraulic injection molding machine. This comparison with a living being is appropriate in that if the pump fails, the machine stops and that the machine can no longer offer 100% performance with aged hydraulic oil.

With increasing operating time, the water content and the particle concentration in the hydraulic oil increase (Fig. 1). As hydraulic systems operate with very small gaps for high energy efficiency and precision, particles in the oil can lead to wear or failure of the hydraulic components. Such impurities cause up to 80% of all failures in hydraulic systems.

Friction of existing particles with the metal surfaces of components such as cylinders or valves releases increasing numbers of particles; the water in the oil

also contributes to this. On evaporating, the microscopically small water vapor bubbles implode under the high pressure and cause pressure peaks which tear further particles off the surfaces. All told, the water causes a significant deterioration in the system's friction properties and also leads to corrosion (Fig. 2).

In addition to contamination by particles and water, chemical oil aging is a third factor that makes it necessary to regularly check the hydraulic oil. In chemical aging, oxidation processes decompose the basic components and additives and change the composition of the hydraulic oil. High oil temperatures accelerate this process.

Three Oil Monitoring Strategies

Injection molding companies have three different strategies for monitoring hydraulic oil: no monitoring at all (if one can call this a strategy), manual or automatic oil control. The strategy of not carrying out any monitoring at all means that a check only occurs if there is a problem. This often results in increased, highly advanced wear.

The majority of companies carry out manual checks. Oil samples are regularly sent to a laboratory. Depending on the result, the processor then filters the oil manually or replaces it completely. The third strategy, automatic oil maintenance, involves stationary filter systems keeping particle contamination, and thus wear, low. Automatic filtering can slow down the chemical aging of the oil, but not completely prevent it, so that the oil needs to be changed at certain intervals, even in this case. »

Central Information Platform

The new e-connect customer portal supports all service products from Engel's inject 4.0 program. e-connect is thus the central information platform for all e-connect.monitor solutions. The state-of-art IT security architecture ensures that the required data is transmitted securely between Engel and its customers. On the dashboard, the users can see all their machines at a glance. Traffic light colors indicate the current aggregated status of the machines. The worst value applies to the entire machine and indicates whether or not action is required.

For the best possible overview, users can reproduce the structure of their individual machinery in the system and even assign production lines to different halls or departments online. When the customer selects a machine, they can see all monitored machine components and their conditions. Each component is shown individually so that the user can quickly identify which component is approaching its wear limit. When the user selects a component, a graphical trend curve appears with the limit values drawn in. This makes the condition of the monitored machine component easily visible.

The user can define the limit values for the warning light, that is, when it changes to yellow or red. Customers can also define whether they want to receive warnings as text messages or e-mail so that they do not have to visit the portal as often.

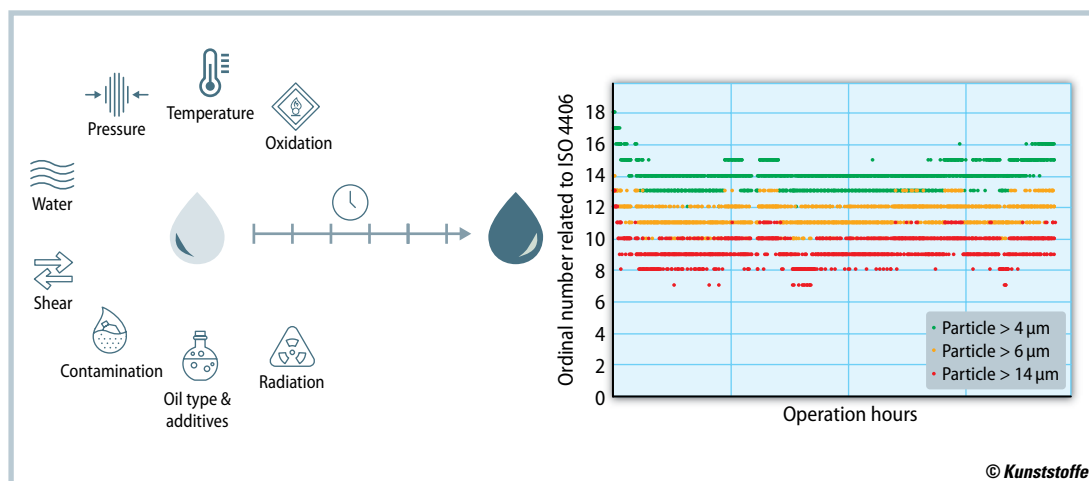


Fig. 1. A wide variety of factors influence oil quality. As the hydraulic oil ages, the particulate content increases, especially in the range $> 4\mu\text{m}$, thus changing the oil properties (source: Engel)

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Service

References & Digital Version

- You can find the list of references and a PDF file of the article at www.kunststoffe-international.com/6893834

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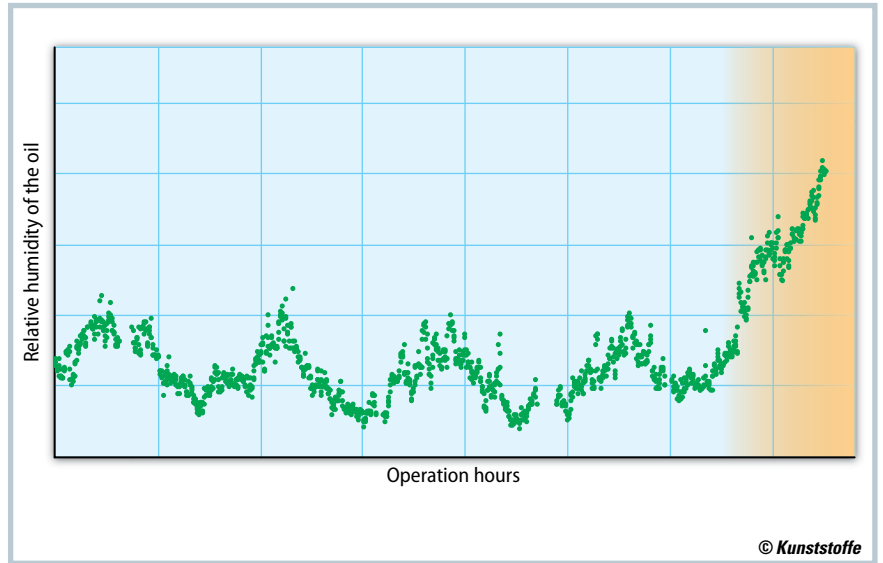


Fig. 2. Over the service life, the water content in the hydraulic system increases. This deteriorates the friction properties and also leads to corrosion (source: Engel)

What all established strategies have in common, however, is the lack of transparency in terms of oil quality. On top of this, none of the three strategies supports the goal of optimally leveraging the service life of the oil. Either the oil remains in the system for too long, which can lead to damage and even a breakdown of the machine, or the oil is changed at too short an interval, and thus too often, as a precaution.

Thanks to special sensors in the oil circuit, Engel now supports online monitoring of the hydraulic oil quality. The benefits of permanent oil monitoring: no longer any need for manual and time-consuming oil checks, the user receives recommendations on filtration time and duration and, in addition, the injection molder is able to precisely plan the oil change based on the predicted condition. Monitoring the oil quality also en-



Fig. 3. The condition of the hydraulic oil and the pumps (shown in the screenshot) is clearly displayed on the e-connect customer portal. The system can automatically send status messages and warning messages (© Engel)

sures early detection of critical conditions and thus averts damage and unplanned failures.

The relevant measurement data is recorded during ongoing production without negatively affecting it. The data is transmitted to Engel via a secure data connection, and automatically evaluated and interpreted there using specially developed mathematical models. The results are immediately visible on the Engel customer portal e-connect (Fig. 3), where they are displayed in a clear-cut view. If desired, the system can automatically send notifications or warnings.

Wear Values from Monitoring of Fixed Displacement Pumps

Not only the hydraulic oil can now be monitored using e-connect.monitor, but also the fixed displacement pumps in servohydraulic injection molding machines. As a rule, and unfortunately, plastics processors only notice a critical pump condition when the machine cycle changes significantly or – in the worst case – when the machine fails.

The pump – the heart of the machine – is a part subject to wear; it reaches its end of life after a certain time, depending on the load spectrum. Over the service

life of the pump, its efficiency decreases continuously due to wear and tear; energy consumption increases as a result. Engel therefore began at an early stage to build up its own in-house pump expertise. Pump test beds and monitoring of various pumps in ongoing production provide the data from which the machine manufacturer experts model the algorithms that precisely and conveniently show the customer the condition of their pump.

With the help of condition-based monitoring, the pump data is automatically recorded and analyzed without affecting the production process. The results are not only intended as information, but instead to give the user a basis for deciding whether or not they want to

replace the pump and, if so, when. For this reason, e-connect does not simply display the measured value, but an easily understandable wear value.

Outlook

The e-connect.monitor condition monitoring solution by Engel, now consisting of four modules, is the first system on the market that allows condition-based and predictive maintenance of injection molding machine components. As a first step, the two new modules for monitoring hydraulic oil and pumps will be offered for injection molding machines of the current CC300 control generation. Retrofit solutions for older control generations are in preparation. ■

A Plus for Productivity and Quality

The goal of Industry 4.0 is the smart factory in which all production machines and their components communicate with each other and continuously optimize themselves. With the result that productivity, efficiency, quality, and flexibility in manufacturing improve significantly. The focus is on three areas: smart machine, smart production and smart service. Under the name inject 4.0, Engel already has a broad spectrum of products and solutions for all three areas in its portfolio today and is continuously developing them further, as the example e-connect.monitor condition shows.

➤ www.engelglobal.com/inject-4-0