Case study: **Continuous monitoring of pumps in heat-transfer systems**

Condition monitoring systems provide early leak detection and allow users to optimize their heat-transfer pumps.

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Many production processes depend on pumps for the movement of heat-transfer oils. When selecting a pump, operator safety and system stability are top considerations, followed by maximum uptime and low operating costs.

Demanding requirements in heat-transfer applications

Heat-transfer pumps must operate safely and reliably to ensure a high level of quality in production processes. Such pumps are frequently subject to high loads, and their failure can have serious consequences, especially if hot oil can escape. Therefore, operators of heat-transfer systems are sensitive to leaks. While hot water normally escapes through the seal in the form of steam — and usually does not cause major damage — any escaping heat-transfer oil rapidly disperses across a wide area and has a high potential for serious damage. Any leaks from thermal oil pumps represent a precarious situation that requires a rapid, effective response. And elevated liquid temperature makes this a challenging task. The solution is to monitor the rate of leakage to detect the early stages of seal wear. That way, pump operators immediately know when a leak starts.

Pumps used in heat-transfer systems are subject to high loads induced by elevated temperatures and large temperature differentials. What's more, chemical decomposition reactions often occur in the pumped liquid whenever the heat carrier is under high thermal loads. In particular, the chain-like hydrocarbons decompose over time into "low boilers" and "high boilers." When the proportion of low boilers becomes too high, there is a risk of pump cavitation. High boilers, on the other hand, accelerate pump wear and occur in numerous forms, from a bituminous-like consistency to highly carbonized products. Both represent a threat to the bearing and shaft seal of the pump. The use of synthetic heat-transfer oil reduces the appearance of low and high boilers, but the low viscosity and lubricity of these materials have other drawbacks. The tribological loads working on the sliding components of mechanical seals are extremely high.

Application example

German-based Odenwald Faserplattenwerk GmbH (OWA), a manufacturer of acoustic panels, uses heat-transfer pumps to move mineral oil at temperatures of approximately 270°C.

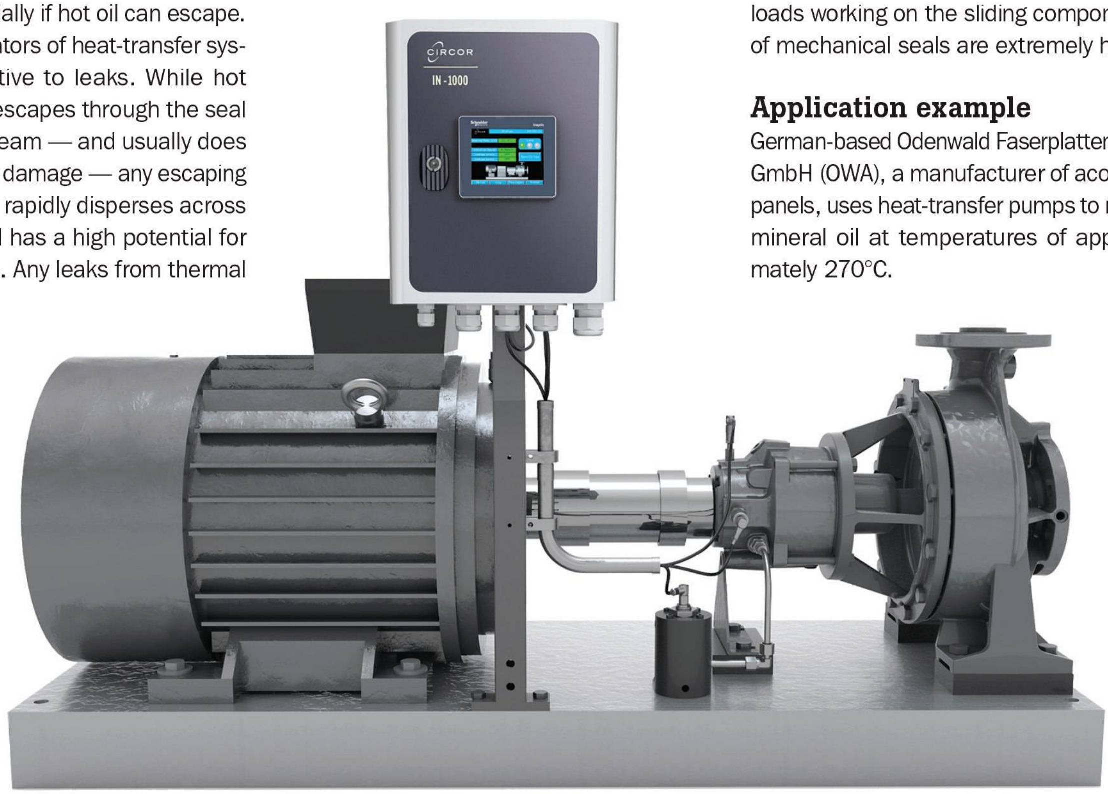

Figure 1. The Allweiler IN-1000 system from CIRCOR can be added to Allweiler ALLHEAT and NTT pumps, as well as compatible pumps from other manufacturers if they are equipped with standardized sensors (analog and digital).

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The most important elements of any dryer are the heating register and the heating coils. They impinge heat onto the mineral fiber panels in a highly uniform manner. Doing so requires pumps that move the heat carrier (petroleum-based or synthetic thermal oil) to the dryer both uniformly and reliably. Maintaining the temperatures required of the process is essential for achieving high product quality as well as ensuring reliable, continuous functionality.

As part of OWA's in-house engineering, the pumps are in continuous operation in the heat-transfer systems.

"We often think of the provision of heat to our production lines as a self-evident fact," said Jan Herrschaft with the technology and process engineering department at OWA. "Our employees in the production area are focused each day on maintaining the premium quality of our ceiling panels. The special challenge they face is to have a system that is extremely reliable and allows for preventive maintenance and a sufficient level of digitization."

The system monitors the functionality of the mechanical seal, the temperature of the bearing and oscillations in the pump.

In the past, OWA relied on leak detectors in the collection pans of the thermal oil pumps. Unfortunately, this method detected leaks only when they were already advanced. Preventive maintenance options were also limited. In 2017, OWA deployed their first Allweiler IN-1000 condition monitoring system from CIRCOR and added additional systems near the end of 2018.

The condition monitoring system monitors the functionality of the mechanical seal, the temperature of the bearing and oscillations in the pump. If one of the monitored parameters exceeds the primary or secondary thresholds, the system reacts with the appropriate warning or alarm messages. The status of each of the pumps can be read directly from the display on the master unit, giving maintenance personnel the opportunity to respond quickly to disturbances. The signal can also be optionally transmitted across an Ethernet to a control panel or sent wirelessly to mobile devices. A green light indicates normal operation. In most cases, a yellow light draws attention to the need for pump maintenance. Once the light switches to red, immediate intervention is usually required. In some cases, production must be stopped.

If significant leaks or high bearing temperatures are detected, the system indicates that the seal is worn or that the bearing must be replaced. Large oscillations indicate that the pump is out of alignment or the coupling is damaged. When the appearance of such irregular operating conditions is monitored comprehensively, the operator has the opportunity to plan for replacement or repair in a timely manner on scheduled maintenance days, thereby avoiding unanticipated production downtime. Early detection of disturbances and wear saves money by minimizing service and repair costs.

"For us, disturbance-free operation is the most important aspect and the greatest advantage of monitoring our systems with IN-1000," said Herrschaft. "In addition, we can detect upcoming wear early and plan for countermeasures."

The condition monitoring system is also modularly constructed, which makes it possible to adapt the module to the system being monitored. The master/satellite combination of the system handles a variety of monitoring requirements, from straightforward monitoring of a single condition to complex situations with multiple pumps. The master module is equipped with a web server that enables remote access to the master module through a web browser or the application-specific interface of an existing process monitoring system via Ethernet connection. At OWA, the system is integrated into a larger control system so pump conditions can be retrieved directly, providing implementation into existing IT structures.

Figure 2. Warnings and alarms for disturbances and irregular operating conditions can be retrieved wirelessly on mobile devices.

Cost savings with continuous monitoring

Condition monitoring systems allow users to optimize their pumps from the time of installation. Therefore, an investment can quickly pay for itself. For example, when existing installations were monitored with IN-1000, it was discovered that up to 75 percent of the pumps were not properly aligned, which would have resulted in high oscillations and ultimately bearing damage and premature failure. These cases can avoid costly damages.

Also, integrated data recording enables precise, daily determination of pump performance, giving users additional ways to optimize their pumps, such as speed control or hydraulic optimization.

There are also long-term advantages of continuous monitoring. Since condition monitoring systems detect critical levels of seal wear, the need for preventive maintenance is reduced. This allows operators to exploit the long service life of high-quality pumps. As a result, typical maintenance costs for pumps in heat-transfer systems are reduced, while providing operators the peace of mind in knowing that everything is under control. FC

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