FASTER, MORE EFFICIENT, MORE ECONOMICAL

Modular sensor system avoids long plant downtimes

A leading car manufacturer uses sophisticated sensor technology to monitor a complex cooling system in one of its plants for so-called "clouding" in a cathodic dip coating system. With the modernization of the entire cooling circuit, the existing "all-in-one" sensor system was replaced by a modular solution from ipf electronic.

The plant produces a large number of different vehicle components, including front and rear axles. The majority of these axles are treated in a cathodic dip painting (CDP) system (see gray box). The components are first cleaned and degreased in order to pre-treat them for the self-test preservation process. This is done in the "phosphating" process by applying a zinc-phosphate layer as corrosion protection. Further process tanks are followed by the actual dip coating, which protects the corrosion protection from subsequent mechanical damage. "The entire system comprises several large-volume and consecutive tanks. The immersion degreasing alone has a capacity of around 80 cubic meters. The entire cathodic dip coating process requires 12 individual process steps, with two tanks available for dip coating, among other things, which means we can paint around 36 vehicle components within four minutes in two-cycle operation," explains the Head of Maintenance.

The entire cathodic dip coating process requires a total of 12 individual process steps and consists of several large-volume tanks arranged one behind the other. (All images: ipf electronic gmbh

Opposites energize each other

Cathodic dip painting (CDP) is an electrochemical process for painting bodywork or other metal parts. The physical principle is based on the fact that materials with opposite charges energize each other. This is realized by an electrical current flow from an external electrode (anode) via a conductive paint to the component to be painted (cathode). The paint particles energized by the component form a uniform paint film via the entire surface, whereby the paint not only adheres extremely strongly to the metal due to the electrical attraction, but also penetrates into cavities corners and edges during immersion.

Turbidity monitoring at 156 measuring points

The two tanks for dip coating contain a total of 156 individual round cells supplied with DC voltage, which are warmed by the current flow and are therefore cooled via a special system. The maintenance manager explains: "Each cell has its own flow and return. Along with cooling, this system also regulates the acidity in the tanks, which are filled with a mixture of demineralized water and formic acid. The cells consist of a membrane and a titanium anode, which is subject to a natural ageing process. In addition, a round cell can be damaged by external influences, causing the membrane to become permeable and a breakthrough to occur." The cooling medium passing through the cell is then contaminated by the penetrating black paint and can also contaminate all other cells. For this reason, each round cell has a glass tube on the return line with a measuring system based on a light barrier for turbidity monitoring. In simple terms, the system recognizes the clouding of the medium in the tube in the event of a cell breakage, whereupon the cooling circuit can be switched off and the contaminated cooling liquid can be discharged from the defective cell into the waste water system.

High costs due to inflexible technology

"As part of the modernization of the entire cooling system, we also wanted to replace the entire measuring system with a more economical solution," says the maintenance manager.

The existing sensor system consisted of an optical fiber amplifier in combination with a plastic fiber optic cable, with the transmitter, receiver and evaluation unit installed in the amplifier. The plastic optical fiber in particular was subject to increased wear due to the effects of acid and had to be replaced regularly. Sometimes it was also necessary to replace the entire evaluation unit, e.g. due to functional faults in the sensor or receiver. This resulted in high costs and considerable effort, as the non-pluggable fiber optic amplifier had to be replaced by an electrician and the wiring in the switching cabinet had to be disconnected and the new unit connected.

Modular, easy-to-use solution required

The new solution for turbidity monitoring should therefore have a modular design so that all key system components can be replaced individually as easily as possible. "We were already using a solution from ipf electronic with similar properties, but only at one measuring point. It therefore made sense to work with the sensor supplier to specify a suitable solution for us in a multi-channel version. Another decisive requirement was that the future components could not contain silicone, as this would destroy the consistency of the paint and it would no longer adhere to the treated component," says the maintenance manager.

High-performance light barriers with straight evaluation

The solution for separate turbidity monitoring at 156 individual measuring points ultimately consisted of a high-performance photoelectric sensor with an optical transmitter **OS126020** and an optical receiver **OE126020** in combination with an 8-channel evaluation unit **OV650840** and fiber optic light guides. The evaluation unit with integrated electronics for the sensors regulates the power of the pulsed infrared light. A total of 312 metal-clad fiber optic light guides were installed on the glass tubes at the return of the cooling system and connected to the individual transmitters and receivers. The pluggable transmitters and receivers were then connected via conventional sensor cables to 20 evaluation units located in a separate switching cabinet. Each sensor pair or light barrier works independently and has its own evaluation via the connection unit.

A total of 312 metal-clad fiber optic light guides had to be installed on the glass tubes at the return of the KTL, which were attached to the individual transmitters and receivers.

Fast signal transmission to the PLC (programmable logic controller)

The evaluation devices allow both manual and automatic setting (for high contamination compensation) of the transmitting power. As this application required a very high sensitivity of the sensors for turbidity monitoring, a manually adjustable transmitting power was chosen. The maintenance manager explains: "The light output of the transmitters is set to 10 percent of their maximum transmitting power. If the infrared light beam of the light barrier is interrupted due to clouding of the coolant in one of the glass tubes, the relevant evaluation channel of the connection unit generates a switching signal that is transmitted to the system PLC (programmable logic controller) and visualized in plain text in the control station of the cathodic dip painting system. This specifically identifies the defective cell in one of the tanks."

Each sensor pair or light barrier works independently and therefore has its own evaluation. The sensors equipped with conventional M12-connectors can be replaced without time-consuming wiring work.

Each of the individual measuring points integrates a high-performance photoelectric sensor consisting of a fully compound-filled optical transmitter **OS126020** and receiver **OE126020.**

Targeted error analysis, fast reactions

The evaluation units of the system solution also support some relevant processes and workflows during troubleshooting, as they check whether the transmitters and receivers are intact during the individual sensor queries. If there is a malfunction, the amplifier's display provides an instant indication of which sensor is involved. In addition, the defect is signaled via a diode on the corresponding sensor channel. This eliminates the need for time-consuming troubleshooting on the sensor side.

The solution from ipf electronic has been in use for several years and has already proven its worth. "The system has already reliably detected several cell failures," says the maintenance manager.

No chance for contamination

Parallel to the message, the respective cooling system of the KTL is switched off instantaneously in order to discharge the cell belonging to the measuring point. "The return lines of the cells have flaps that close in the event of a cloudy run in order to direct the contaminated medium directly into the wastewater system. The cell feed is then also closed so that the liquid in the storage tank for the cooling system is not contaminated," explains the maintenance manager and emphasizes: "The modular probe system not only leads to significant economic but also practical advantages in daily work, as the individual components can be replaced separately in the event of a defect, which also has an impact on a more cost-efficient spare parts inventory."

If the infrared light beam of the light barrier, consisting of an optical transmitter **OS126020** and an optical receiver **OE126020is** interrupted due to clouding of the coolant in one of the glass tubes (second tube from the left), the relevant evaluation channel of the connection unit generates a switching signal.

The pluggable transmitter and receiver elements were connected via conventional sensor cables to 20 evaluation units, which are located in a separate switching cabinet. The amplifiers allow both manual and automatic setting (for high contamination compensation) of the transmitting power.