FASTER, MORE EFFICIENT, MORE ECONOMICAL

A MODULAR SENSOR SYSTEM AVOIDS LONG PLANT STANDSTILLS

A leading car manufacturer used elaborate sensor technology in its factory to monitor the complex cooling system of a cathodic dip coating plant for "turbid flow". During the modernization of the entire cooling circuit, the existing all-in-one sensor system was replaced with a modular solution from ipf electronic.

The entire CDC process requires 12 individual process steps and consists of multiple large baths arranged one after another. (All images: ipf electronic gmbh)

The factory produces a variety of different vehicle components, including front and rear axles. Most of these axles are treated in a plant for cathodic dip coating (CDC) (see the gray box). First, the components are cleaned and degreased to prepare them for application of the actual corrosion protection. This happens during the "phosphating" process, when a zinc-phosphate layer is applied as corrosion protection. After further process baths, the actual dip coating takes place, which protects the corrosion protection from later mechanical damage. "The entire plant comprises multiple large baths arranged one after another. The dip degreasing bath alone has a capacity of around 80 cubic meters. The entire CDC process requires 12 individual process steps, which include two baths for the dip coating, with which we can coat around 36 vehicle components in four minutes in dual cycle operation," explains the head of maintenance.

FLOW TURBIDITY MONITORING AT 156 MEASURING POINTS

In the two baths for dip coating, there are a total of 156 individual round cells that are supplied with DC voltage and heat up due to the flow of electricity. They are therefore cooled using a special system. The head of maintenance explains: "Each cell has its own supply and return flow. In addition to cooling, this system simultaneously controls the acidity in the baths, which are filled with a mixture of fully demineralized water and formic acid. The cells consist of a membrane and a titanium anode that is subject to a natural aging process. A round cell can also be damaged by external influences, as a result of which the membrane becomes permeable and ruptures." The cooling medium fed through the cell then becomes contaminated by the permeating black paint and can also contaminate all of the other cells. Therefore, each round cell has a glass tube on the return flow with a measuring system based on a light barrier to monitor flow turbidity. Put simply, the system detects when the medium in the tube becomes cloudy as the result of a cell rupturing, and the cooling circuit is then switched off and the contaminated coolant can be fed out of the defective cell into the drainage system.

INFLEXIBLE TECHNOLOGY REQUIRING A LOT OF EFFORT

"In the course of modernizing the entire cooling system, we wanted to also replace the whole measuring system with a more economical solution," says the head of maintenance.

The existing sensor system consisted of an optical fiber optic amplifier in combination with plastic fiber optics, with transmitter, receiver and evaluation unit installed in the amplifier. The plastic fiber optics in particular were subject to a high degree of wear caused by the acid and had to be replaced regularly. Sometimes it was also necessary to replace the whole evaluation unit, for example due to functioning errors on the sensor or receiver. This resulted in high costs as well as considerable effort, since the fiber optic amplifier was not pluggable, meaning that it 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 REQUESTED

The new solution for monitoring flow turbidity therefore had to have a modular structure so that all of the important system components could be replaced individually as easily as possible. "We were already using an ipf electronic solution with similar properties, but only at one measuring point. It therefore seemed obvious that we should work together with the sensor provider to specify a multi-channel solution that would suit our needs. An important requirement was also that the future components would not contain silicone, since this would alter the consistency of the paint and prevent it from adhering to the treated component," says the head of maintenance.

HIGH-PERFORMANCE LIGHT BARRIERS WITH CENTRAL EVALUATION

The solution for monitoring flow turbidity separately at 156 individual measuring points ultimately consisted of a high-performance light barrier with an **OS126020** optical transmitter and an **OE126020** optical receiver in combination with an 8-channel **OV650840** evaluation unit and glass fiber optics. The evaluation unit with integrated electronics for the sensor technology controls the power of the pulsed infrared light. 312 glass fiber optics encased in metal were installed on the glass tubes on the return flow of the cooling system and connected to the individual transmitters and receivers. The pluggable transmitter and receiver elements were then connected via conventional sensor lines to 20 evaluation units located in a separate switching cabinet. Each pair of sensors and each light barrier work autonomously and are evaluated independently at the connection unit.

A total of 312 glass fiber optics encased in metal had to be installed on the glass tubes on the return flow of the CDC cooling system and fitted onto the individual transmitters and receivers.

FAST SIGNAL TRANSMISSION TO THE PLC

The evaluation devices allow the transmitting power to be adjusted both manually and automatically (for a high level of soiling compensation). Since this application requires highly sensitive sensor technology for monitoring flow turbidity, a manually adjustable transmitting power was chosen. Regarding this decision, the head of maintenance says: "The light output of the transmitter is set to 10 percent of the maximum transmitting power. If the infrared light beam of the light barrier is interrupted due to the coolant in a glass tube becoming cloudy, the relevant evaluation channel of the connection unit generates a switching signal that is transmitted to the plant PLC and visualized as plain text in the control station of the CDC plant. In this way, the specific defective cell in one of the baths is identified."

Each of the individual measuring points features an integrated high-performance light barrier consisting of a fully compound-filled **OS126020** optical transmitter and **OE126020** optical receiver.

Each pair of sensors and each light barrier work autonomously and are evaluated independently. The sensors, which are equipped with conventional M12-connectors, can be replaced without the need for time-consuming wiring.

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NO POSSIBILITY OF CONTAMINATION

At the same time as the message is sent, the respective cooling system of the CDC switches off immediately to shut off the cell belonging to the measuring point. "The return flows of the cells have flaps that close in the event of the flow becoming turbid so that the contaminated medium can be fed directly into the drainage system. The cell supply flow is also then closed, so that the fluid in the reservoir for the cooling system does not get contaminated," explains the head of maintenance, adding: "As well as offering significant economical advantages, the modular sensor system also brings practical benefits for our day-to-day work, since the individual components can be replaced separately in the event of a fault, which also results in more cost-effective stocking of spare parts."

If the infrared light beam of the light barrier, which consists of an **OS126020** optical transmitter and an **OE126020** optical receiver, is interrupted due to the coolant in a glass tube becoming cloudy (second tube from the left), the relevant evaluation channel of the connection unit generates a switching signal.

TARGETED ERROR ANALYSIS, FAST RESPONSES

The evaluation units of the system solution also support some processes and workflows that are relevant for troubleshooting, since they check whether the transmitters and receivers are in good working order by querying the sensors individually. In the event of a malfunction, the amplifier display instantly shows which sensor is affected. In addition, the fault is signaled via a diode on the corresponding sensor channel. As a result, time-consuming troubleshooting of the sensors is avoided.

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

The pluggable transmitter and receiver elements were connected via conventional sensor lines to 20 evaluation units located in a separate switching cabinet. The amplifiers allow the transmitting power to be adjusted both manually and automatically (for a high level of soiling compensation).

ⓘ Opposites attract

Cathodic dip coating is an electro-chemical process for painting bodywork or other metal parts. The physical principle is based on the fact that materials with opposite charges attract. This is realized by an electric current flow from an external electrode (anode) through a conductive paint to the component that needs painting (cathode). The paint particles attracted by the component form a homogeneous paint film over the entire surface, whereby the paint not only adheres to the metal extremely well because of the electrical attraction, but penetrates into cavities, corners and edges during immersion.