

Even tougher in the face

Special sensor technology for special requirements

The attribute "robust" can mean a lot for sensors with regard to environmental conditions. The following application in an automated continuous pickling line for copper sheets shows the extremely high demands that such devices are actually confronted with in practical use.

CSN Carl Schreiber GmbH processes sheet metal according to customer specifications. "Our core business is the production of plates, sheets, circular blanks, rings, blanks and machined parts made of copper and copper alloys. We also process brass, bronze, copper-nickel and aluminum. Our products are used in apparatus engineering, in heat exchangers, in the chemical industry, in electrical engineering and in seawater desalination, among other things," says Stefan Schnock, plant electrician at CSN Carl Schreiber, describing the production spectrum. As a specialist in the processing of copper, the medium-sized company based in Neunkirchen has developed a fully automatic continuous pickling line. "When copper sheets are rolled, an oxide layer forms on the surface of the material, which we remove with a sulphuric acid solution before further processing the sheets in our system," says Schnock.

Automated material handling

After rolling, the sheets, some of which are up to 500° C hot, are transported via a roller conveyor to a straightening machine that removes the surface waviness. This machine is followed by a device that is used to lift the individual sheets from a roller conveyor in order to position them correctly aligned in two buffer zones in front of the pickling chamber. After a sheet has been treated on both sides in the pickling chamber, it is conveyed to one of three buffers, which act as a kind of intermediate storage area. "If no sheet comes out of the roller, a finished pickled sheet can be removed from this buffer zone via a roller conveyor for further processing. The pickling line is arranged in a U-shape around the straightening machine. The buffered sheets therefore always pass through the straightener before being removed, but do not necessarily have to be straightened," explains the plant electrician.

Sensors with very special properties wanted

In order to ensure a safe process flow in the fully automated continuous pickling line, CSN Carl Schreiber required sensor solutions that were not only precise and reliable, but also extremely robust. Specifically, suitable devices were sought for the two buffer zones before pickling, for the pickling chamber itself and for the three downstream material buffers in order to ensure safe automated handling of the sheets in the system. Stefan Schnock specifies some of the requirements: "One of the problems was that the copper plates, which are up to 6 meters wide but only 8 to 160 mm thick, do not always lie straight on the roller conveyor in front of the pickling chamber and can be slightly curved due to the low sheet thickness. In addition, the pickling process consists of a solution containing 15 to 20 percent sulphuric acid, which can cause massive damage to the sensor system. The sensor solution for the two buffer zones directly behind each other in front of the pickling chamber should nevertheless be able to reliably detect the front position of a sheet and inquire the entire area just above the roller conveyor via the entire width of the material."

Precise laser light barrier for long ranges

As the solution therefore had to be via a very precise, small measuring point with a large range and also withstand very adverse environmental conditions, an application specialist from ipf electronic recommended a laser light barrier. The through-beam sensor consisting of a transmitter **PS180024** and a receiver **PE180424** in metal housing (protection class IP67) has a large switching distance of 0 to a maximum of 60m, is suitable for ambient temperatures of up to +50° C, and can be adjusted very well due to the visible laser light in the area above the roller conveyor.

The very small and therefore precise measuring point makes it possible to reliably detect the front position of the thin sheets in the two buffer zones in front of the pickling chamber via the entire width of the material. Stefan Schnock explains: "The sensors are linked to the PLC (programmable logic controller) of the continuous pickling line and signal to the control (unit) that a sheet is in the respective buffer zone. Once the treatment of a copper plate with acid solution is complete and the sheet has left the pickling chamber, the sheet located in the zone in front of the pickling chamber can be transported into the chamber. The next sheet is then transported from the second buffer into the buffer zone in front of the pickling chamber."

Robust solution for extreme conditions

In the pickling chamber, the panels are sprayed with pickling agent from above and below on roller conveyors in reversing operation. Here too, the position of the sheet to be treated must be inquired in conjunction with the sensors in the buffer zones. However, an optical solution was out of the question, as the sensors in the pickling chamber are permanently exposed to a spray mist containing sulphuric acid.

For this reason, the decision was made to use the inductive sensors **IO300106** from ipf electronic with an active surface made of stainless steel. These particularly robust devices are designed for ambient temperatures of up to +70° C and have protection class **IP68**. Three inductive sensors operated in parallel were installed at the input and output of the pickling chamber so that they can detect the copper plates from below. "The arrangement of the sensors was chosen deliberately, as the plate in the chamber can move slightly in the longitudinal direction. This ensures that we can inquire a larger area of the plate from the underside and that at least one sensor always responds. If the material position were only inquired in the middle, a displaced plate could also reach the area of the chamber door, which would then sometimes open a little, leading to error messages from the control (unit)," reports Schnock. If one of the inductive sensors at the chamber exit detects the underside of the plate end when a copper plate is fed into the pickling chamber, the doors close and the spraying process begins.

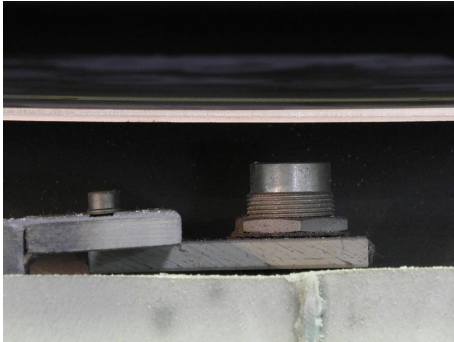
After surface treatment, the copper sheets are transported to the three downstream buffer zones, which are also monitored by the laser light barriers. **PS180024/ PE180424** are also equipped with laser light barriers. The sensors report to the PLC (programmable logic controller) of the continuous pickling line when the buffers are fully assigned so that the control (unit) can stop the system to avoid material jams.



The one-way barrier consisting of the transmitter **PS180024** (top) and the receiver **PE180424** proved to be the right choice for the demanding application in the pickling line.



The inductive sensors have an active surface made of stainless steel and are therefore very robust (protection class IP68) and designed for ambient temperatures up to +70° C.



The IO300106 inductive sensors were installed in such a way that they can detect the copper plates from below.



Three parallel-operated inductive sensors are positioned at the input and output of the pickling chamber. The special arrangement ensures that a larger area of the copper plate can be inquired from the underside and thus at least one sensor responds.

Challenges overcome

In view of the many challenges that had to be overcome for this special application, plant electrician Stefan Schnock is extremely satisfied with the solutions from ipf electronic: "The sensors in the buffer zones and especially in the pickling chamber itself are not given a second thought. The pickling solution is very aggressive due to the acid content and is therefore extremely hard on the devices. Despite these very adverse environmental conditions, they have proven themselves in our automated system."



The acidic stain is extremely hard on the laser light barriers in the buffer zones, as can be clearly seen, but the sensors, which were installed just above the roller conveyors, still work reliably.

