BRIGHT SPOT FOR QUALITY

COLOR SENSOR DETECTS WELD SEAM IN ANNEALED PIPES

What supplier does not have to contend with rising cost pressure and increasing quality requirements from its customers? Those who understand how to use intelligent sensor technology where it brings true advantages can, however, master this balancing act and likely be a step ahead of the competition.

One example of this is a company that specializes in forming and cold forming technology and produces, among other things, screws and pressure lines as well as media-carrying pipes for the automotive industry, the household appliance industry and the wind power industry.

PRECISE ALIGNMENT OF THE WELD SEAM REQUIRED

In a specific case, the company is to use welded and annealed pipes with a length of approximately 600mm and a diameter of about 20mm to produce bent pipe parts for the automotive industry. During the production process, in which the workpieces are first bent and then pressed, the weld seam on the inside of the pipes must be precisely aligned. „The position of the pipe weld seam in the final product is defined by the customer with tight tolerances. During the bending process, it must never be located in the bending radius, since – particularly during the subsequent pressing – cracks could form in the workpiece," emphasized the technical director of the company. On account of these concrete specifications, the company sought out a sensor technology that was capable of reliably identifying the position of the weld seam, which is located inside of the pipe, prior to bending.

MANUAL POSITIONING FASTER THAN AUTOMATION

The first solution considered was a magnetic-resonance eddy current test, because a supplier to the company for forming and cold forming technology had already achieved very good results for identifying pipe weld seams with this method. „The reliable recognition of the seam is the timecritical factor in the entire production process," points out the technical director. The magneticresonance eddy current test requires machine-positioning of the workpiece, since the weld seam must pass the detection range of a sensor a total of four times to be able to clearly identify it.

„In spite of the automated positioning, this procedure would take longer than correctly positioning it by hand with the help of one of the other methods for weld seam detection for the subsequent processing. Since the eddy-current test would have required additional attachments to our production system that we simply had no space for, we rejected this suggestion."
Thus, the desired solution needed to be compact, capable of being integrated in the production process without a great deal of installation effort, and enable both a fast and extremely reliable identification of the weld seam.

TRUE CHALLENGES FOR THE SENSORS

A promising alternative to the magnetic-resonance eddy current test ultimately came from ipf electronic, which recommended a color sensor of the **OF50** series, the **OF500180** to be precise. „The solution, consisting of color sensor, fiber optics with linear light exit and magnification optics, instantly convinced us on account of its compact design and simple mounting. It was still necessary to test the performance capability of the sensor with regard to the reliable detection of the weld seam - and with annealed pipes, that is no easy task," knows the technical director. With workpieces that are not annealed, a very clear heat-affected zone can be seen adjacent to both sides of the weld seam that differs in color from the background. „With annealed pipes, such annealing colors have either completely disappeared or are only slightly visible due to the ‚normalization.'" (Fig. 1)

For the **OF500180** to be able to clearly recognize a weld seam inside of the pipe in spite of these challenges, ipf electronic extended the hardware with additional intelligence in the form of a configuration software program. Using this software, specially developed for color sensors, reliable color evaluation of objects can be performed even under extremely difficult conditions.

USE GROUPS INSTEAD OF GUESSWORK

In this context, users of the system solutions from ipf electronic benefit from a „specialty“ of the software, by means of which multiple taught-in values of an object or object area can be grouped into color groups or reference groups for OK or NOK states. For the application described thus far, this meant teaching-in multiple weld seams with a wide range of characteristics and storing them in a group for the state „weld seam present“ in the reference/teach table of the software. In addition, many other values on the surfaces on the inside of the pipe were taught-in: areas without weld seams or areas with stripes, streaks and discolorations that appear to be very similar to weld seams, but can form, in among other ways, during annealing of the pipes. These values were stored in a second group in the reference/teach table for the state „weld seam not present.“

In this way, there are two „color and reference groups“ available to the sensor for the evaluation of the inside of the pipes, whereby one group contains all values that represent the presence of a weld seam, while the other groups together all references that indicate an NOK state of the detection area, i.e., „no weld seam present.“

CLEAR DISTINCTION THROUGH LINEAR LIGHT SPOT

The sensor was mounted at an operating distance of about 80mm to the detection area to the side of the bending and pressing tool in such a way that it does not impair handling of the workpieces in the production process (fig. 2). For the detection of the weld seam, the focusing lens of the **OF500180** in combination with the fiber optics form a linear light spot at an angle of incidence of about 50 degrees to the test area. This light spot ensures that the sensor has a sufficiently „long“ detection range to be able to clearly distinguish between a weld seam and, e.g., remnants of annealing processes (such as dark lines or streaks).

CORRECT POSITIONING OF THE WORKPIECE

For the processing procedure, the pipe is first inserted in the bending tool and turned by hand until the sensor detects the weld seam. For this purpose, the device compares the currently recorded values with the entries in the two groups in the reference/teach table. If matches occur in the group for the OK state, a weld seam has been detected (fig. 3). The sensor then transmits a signal to the PLC of the machine which then outputs a switching signal to a pneumatic cylinder that secures the pipe in the tool. As the weld seam is now properly aligned for processing, the workpiece can be bent and, in a subsequent step, be pressed.

A MATTER OF A FEW SECONDS

The system from ipf electronic has been in use in the company for cold and forming technology since March of 2014 and has thus far convinced the technical director of the company with respect to process reliability: „The complete processing of a workpiece, which includes the detection of the weld seam for correct positioning of the pipe for the bending process, takes just a few seconds, allowing us to produce an estimated several hundred bent pipe parts per hour.“

ipf electronic gmbh | Rosmarter Allee 14 • 58762 Altena • Germany | Tel +49 2351 9365-0 • info@ipf-electronic.com • **www.ipf-electronic.com**

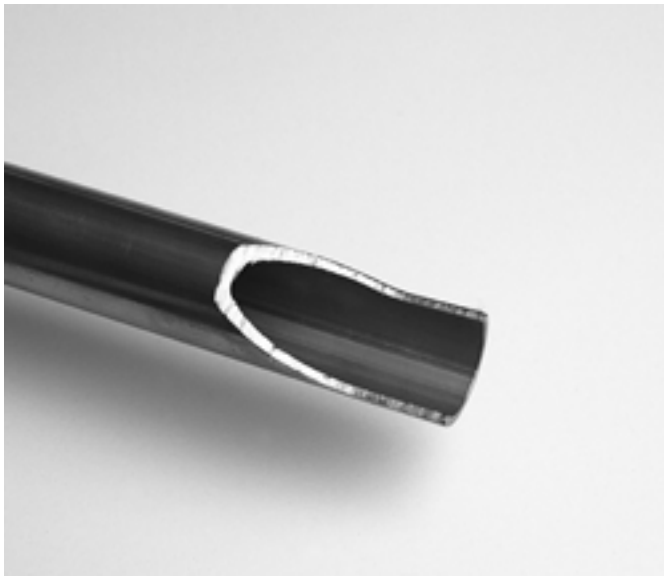

Figure 1

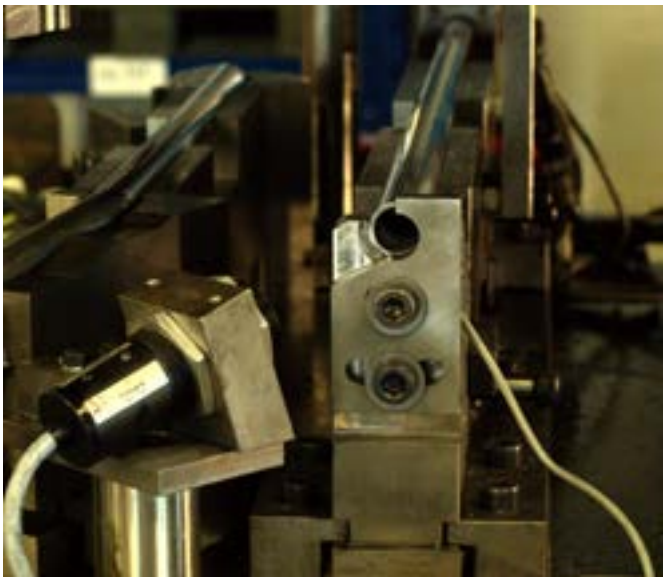

Figure 2

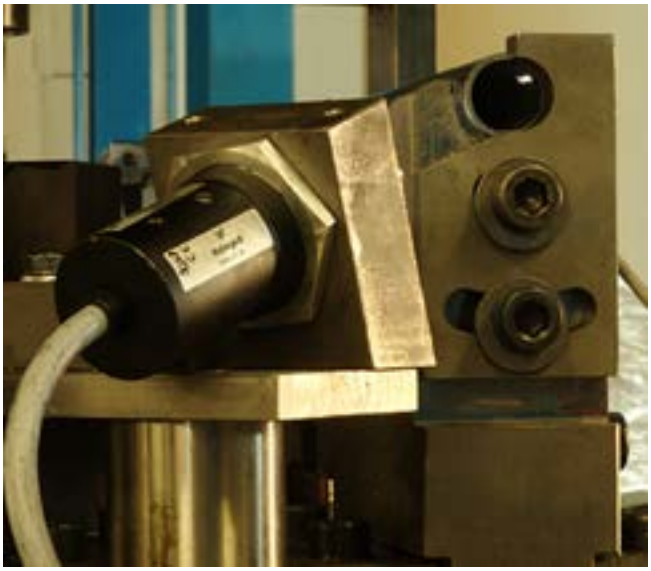

Figure 3