ECONOMICAL SOLUTION FOR HIGH-SPEED USE

LINE CAMERAS DETECT HOLES IN WIDE PAPER WEBS

High-speed processes are usually no big deal for high-performance sensors. But when the sensor system is not used regularly and higher expenditures into technically more complex solutions are not feasible in spite of high requirements, the cost-benefit calculation becomes problematic.

The DS Smith paper mill in Witzenhausen, Hessen (Germany), produces more than 350,000 tons of paper annually from 100% wastepaper. “First, the produced paper is on a tambour with a diame-ter of about three meters and weighing approx. 50 tons. The 7.5-meter wide paper web of the tam-bour is divided into several smaller webs and then cut and rolled to widths from 0.80 to 3.30 meters for dispatching according to customer requirements,” explains Volker Klöpfel, factory manager for electrical and automation technology at the Witzenhausen plant of DS Smith.

On the rear side the faulty paper rolls are fixed in the clinic roller. DS Smith produces approximately 30.000 tons of paper a month, it is estimated that 300 tons thereof have to be forwarded to the final inspection on the clinic roller.

FINAL INSPECTION ON CLINIC ROLLER

An inspection system consisting of a high-speed camera checks the paper quality during cutting. “The system can detect one or more holes in the paper webs, among other things,” says Volker Klöpfel. If this is the case, the paper rolls in question are sorted out and brought to final inspection on the so-called clinic roller. This is where the paper rolls are re-reeled and the faulty web area is separated out.

On the so-called clinic roller, the paper rolls are re-reeled and the faulty web area is separated out.

TIME-CONSUMING VISUAL CHECK

“In the past, we performed this final inspection manually, because one employee had to be almost permanently stationed at the clinic roller,” reports Klöpfel, “Because the actual detection of holes was already performed by the high-resolution web inspection during production, we knew in which meter range or where in the paper roll the flaw was located. So one employee would start the clinic roller and slow down the unwinding speed at the appropriate meter in order to perform a visual check and identify the hole in the web. He would then remove this area and subsequently prepare the paper web for further re-reeling. This process had to be repeated over and over if there were holes in different areas of a roll.”

HIGH REQUIREMENTS FOR AUTOMATED INSPECTION SYSTEMS

This was a cumbersome and time-consuming process which was not satisfactory to the people in charge in the Witzenhausen plant of DS Smith, particularly because the maximum unwinding speed of the clinic roller of about 280m/min could not be fully utilized during manual checks.

Volker Klöpfel: “We then considered automating this process by means of a sensor solution for the detecton of holes in paper rolls. The solution had to be simple, practical, and able to reliably iden-tify holes with a size of 4cm2 over the entire web width of up to 3.30 meters at an unwinding speed of the paper web of about 180 to 200m/min. These were our specifications.”

ECONOMICAL SOLUTION SOUGHT

Systems that work quite reliably in respect to these requirements are relatively easy to find. But the factory manager adds: “Our solution also had to be very economical, as a high investment was not feasible to us.” The reason: The Witzenhausen plant produces about 1,100 tons of paper per day, which equates to about 30,000 tons a month. Only about 300 tons of the monthly output are for-warded to the final inspection on the clinic roller. “We are talking about maybe five to ten paper rolls per month. Which is why a reliable but expensive solution simply made no sense to us.”

SYSTEMS FALTER AT HIGH WEB SPEEDS

Many different optical solutions, including two camera systems and a device based on a laser light barrier, were tested during the quest for a technology that would be equally simple, reliable, and above all cost-efficient. But according to Volker Klöpfel, all systems quickly exhausted their capa-bilities when it came to the unwinding speed of the clinic roller: “While some systems managed to detect the holes in the paper, they failed to transmit a corresponding signal to the PLC to stop the paper web. As we are already in contact with ipf electronic as part of ongoing projects and familiar with the broad range of solutions offered by the sensor vendor, we inquired with them. Despite pur-veying numerous impracticable solutions at first, ipf electronic remained tenacious and finally came up with a system that worked very well during an on-site field test.“

LINE CAMERAS INSPECT THE ENTIRE WEB WIDTH

This system consists of so-called line cameras in combination with special **AO98E126** LED lights as the counterpart or transmitter. One of the unique characteristics of the line camera PYSI0317 from ipf electronic is its receiver, a CCD line detector with 512 receiving elements or pixels that are tightly arranged in a single line.

A line camera of type **PYSI0317**. A specific feature of this device is its receiver, a CCD-line detec-tor with 512 receiving elements or pixels that are stacked tightly together in one. The device also provides a frontside C-mount thread to accommodate a wide variety of standard lenses, which allow for the visual field of the line camera to be freely defined.

Another feature is the front C-mount thread that can accommodate a wide variety of standard lenses such as the **AO000542** used here, which allow for the visual field of the line camera to be freely defined. In this particular application, two LED lights were attached to the clinic roller to illuminate a paper web over its entire web from below in the shape of a line. Two line cameras were installed above the paper web in order to capture the maximum web width of 3.30 meters during inspections. As the device lenses feature a focal distance of 6mm, each line camera can cover slightly more than half the paper web as part of its inspection area. Light now penetrates trough the web wherever there might be a hole in the paper, whilst the outer edges of this imperfection are mapped on the CCD line by one of the two line cameras. If this edge distance (hole size) exceeds the preset dimension, the line camera generates a switching signal, which can be transmitted to the clinic roller’s PLC.

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100%-INSPECTION AT MAXIMUM SPEED

The system from ipf electronic has been in use at the Witzenhausen paper mill since August 2017, and it not only meets all the aforementioned requirements, but by now it has also exceeded the ex-pectations of the operating company. Now, all it takes is one employee inserting a paper roll for in-spection into the clinic roller, after which he is no longer required to attend the process. If the sys-tem from ipf electronic detects a hole in the paper web, a signal is sent to the PLC and the system stops. A signal light simultaneously indicates that a hole has been detected. The employee then separates the faulty area, positions the roll again, and starts re-reeling. “The system from ipf elec-tronic detects the holes 100% of the time, even at the maximum unwinding speed of about 280m/min. Our initial requirements for the reliable detection of defects at an unwinding speed of about 180 to 200m/min have thus been surpassed,” such is the positive conclusion of Volker Klöpfel.

The successful cooperation resulted in an optimal, automated solution for the inspection of paper webs. Ralf Henning (left), application specialist of ipf electronic, and Volker Klöpfel, workshop manager for electrical engineering and automation in the plant in Witzenhausen of DS Smith..

ⓘ High-quality from recycled paper

DS Smith PLC headquartered in England is a leading provider of corrugated board packaging and a specialist for plastic pa-ckaging. The company’s product range includes transport packaging, con-sumer goods packaging, displays and promotional packaging as well as tailor-made protective and industrial packaging. DS Smith employs approximately 27,000 people at 250 locations in 37 coun-tries worldwide. In Germany, two paper mills in Aschaffenburg and Witzenhausen produce paper from 100% wastepaper. The plant in Witzenhausen went into operation in 1975.