100% quality for can bodies and ends

The legislation on disposable packaging will be changing with effect from May 1, 2006: Retailers that sell beverage cans or disposable bottles will be obliged to take back all empty disposable beverage containers. Consequently, experts are expecting the beverage can to make a comeback. High-speed image processing systems are used in the manufacture of these cans to ensure 100% quality.

The US group Ball Packaging Europe is the world’s largest manufacturer of beverage cans. In Europe the company has twelve factories that produce can bodies and two further factories that produce up to 7 billion can ends a year. One of these two can-end factories is in Braunschweig, Germany. The quality of the aluminum can ends produced there is ensured by TCVision, a high-speed image processing system from Puchheim-based company QUISS, which uses image processing components from STEMMER IMAGING.

Each machine in the production hall in Braunschweig churns out 2400 aluminum can ends a minute. The can ends are produced in a process that involves several steps. First, the blanks are punched from an aluminum sheet. The can end is then molded into shape in successive steps, and the tab, which is molded simultaneously, is then attached to it to get the finished article.

Random sampling is not enough

Before they are packaged, every can end is inspected using the TCVision image processing system. "Random samples used to be taken to check the quality of the can ends," says Helmut Gruber, the sales and marketing director of QUISS’s Packaging division. "However, because of the products’ field of application, that is no longer enough, not by a long way: The quality of metal packaging must be extremely high. The economic conditions and high inspection speeds required made it almost inevitable that high-speed image processing systems would have to be used."

QUISS has years of experience in the development of inspection systems for can ends. The TCVision system used at Ball Packaging in Braunschweig is the latest QUISS system: It checks the can ends for problems such as malformation, scratches, impurities, forming errors, burring, edges or other flaws. In addition, the position of the tab, the overall diameter and the rivet diameter are checked. "There is a combination of checks involving contour and surface analysis and presence and position monitoring," continues Gruber. "The demands are considerable: The can ends run past the inspection station on three parallel lines at a speed of around 800 can ends a minute. For some criteria the detectable tolerances are a mere 15 µm."

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Well-conceived combination

To meet such demanding technical requirements on the image processing side, a well-conceived combination of suitable and well-coordinated image processing components were required, in addition to software that had to be specially developed for this application. Parts of the TCVision system were supplied by STEMMER IMAGING, a company that is also based in Puchheim near Munich.

The progressive-scan CCD cameras M10 and M4+CL of the Danish company JAI were used, and PC-Vision and PC-CamLink frame grabbers from DALSA were used for rapid image capture. The cameras work under a movable cover with application-specific lighting consisting of standard LEDs with flash control developed by QUISS to meet the requirements of high-speed inspection.

In addition to the technical suitability of the components used, there were a number of other reasons that led QUISS to work with STEMMER IMAGING: "The comprehensive support and technical expertise of STEMMER's staff were decisive factors in our decision to use this reliable supplier," explains QUISS sales and marketing director Gruber. "We even benefited from the experience of STEMMER IMAGING for feasibility studies during the preparatory stage when we were in the process of developing the best possible system for Ball Packaging Europe."

Inspection procedure

The result of the close collaboration between QUISS and Ball Packaging Europe was the modular TCVision system. "The system can be adapted for different requirements and checking operations," explains Gruber. The system can detect a number of different flaws on the can ends, reject flawed parts and shut the press down immediately when certain defined types of flaw occur. The system is fully configurable: It is possible to control its behavior to suit the type of flaw detected and, in the case of slight flaws, for example, to permit five flawed parts per thousand. Serious flaws, on the other hand, can be defined as criteria for an immediate shutdown. Defective parts are always rejected.

The TCVision analysis software checks the test object on the basis of a contour model that can be compared with a CAD drawing. Deviations from the required contour and flaws in the surface can be detected repeatably even in the sub-pixel range. Consequently, not only can a wide variety of checks of dimensional and positional accuracy of contours and surfaces of all shapes be carried out; it is also possible to check for malformation, dents, cracks, impurities and completeness. This new type of analysis permits the robust and repeatable detection of defects that image processing systems have previously failed to detect. This makes it possible, for example, to check other designs such as gold-colored can ends or other variants with different surfaces.

The mature application software also allows the user to create new product types or alter the inspection parameters: The contours are detected by the system in advance, and the user simply has to select the contours to be inspected. The user can assign them go/no-go criteria such as the maximum size of crack that can be tolerated or the maximum and minimum rivet diameter. "It is thus possible for the system to learn arbitrary free-form areas and curve geometries within a short space of time," stresses Gruber.
Numerous analysis options

TCVision offers numerous analysis parameters. The analysis algorithms used were developed for the fully automatic visual inspection of products in the metal packaging industry. No special image processing hardware is required for analysis.

With a network connection it is possible to load parameter sets and images from the production level and analyze and optimize them offline. The updated software can then be transferred back to the production system without interrupting production. All the computers in a TCVision image processing system are integrated in a network. Consequently, the system can be operated and monitored entirely from the office or by means of a teleservice or remote control. Thus, even details like camera settings can easily be transferred to all lines in this way.

In addition, the production process can be optimized and documented on the basis of the data obtained. The system also offers various statistical functions for the visualization and data analysis of the results obtained in the inspection process, as Gruber explains: "The results of the analysis over time can be displayed in a bar chart, for example. The trend view allows the proportion of faults and fault classes occurring in the analyses to be displayed. In addition, markers indicate the time and date of system interventions so as to show, for example, the effects of changing the parameters on the results of the checks."

The statistical functions are assigned filter criteria. It is thus possible, for example, with a mouse click to extract and display line-related, station-related or fault type-related data. You can also set warning thresholds and display them in the statistics. "By issuing an increasing number of these warnings, TCVision provides timely notification of changes that occur in the process and advises the user to take a close look at production before it gets to the point where rejects are produced," explains Gruber, highlighting another benefit of the system.

The Braunschweig-based can-end manufacturer Ball Packaging Europe is highly satisfied with the results of this powerful and flexible inspection station. "In addition to providing 100%, documented quality, the detailed analysis and visualization functions of TCVision allow changes that take place in the process to be detected quickly and in good time," says Gruber. "You get not just quality control but also the opportunity to improve the whole process and dramatically reduce the reject rate."

On the basis of its positive experience with the system in Braunschweig, Ball Packaging Europe has decided to use TCVision in its other factories as well. Companies such as Crown Bevcan UK and Lotte in South Korea also have successful QUISS inspection systems in operation.