Flawless Countenance

Quality Control in Cosmetic Packaging

The turnover of the German cosmetics industry exceeds € 1.5 billion. All cosmetic products are supplied in a packaging – a box, a tube, a bottle, etc. -which is generally enhanced in a particularly appealing and exclusive way. Accordingly, the manufacturer of the packaging has to meet strict requirements for quality control. In this article you find a few examples for the various applications of quality control within the cosmetic packaging industry and it shows which advantages the manufacturer has by employing image processing systems.

Cosmetic packagings are generally enhanced in a particularly appealing and exclusive way

An array camera determines the exact radial and axial position using the tube's print image

Inspection of Hot Foil Stamping on Tubes

Cosmetic tubes are optically enhanced with gold and silver foil stamping which generally represents the brand name of the product. Therefore it is crucial to ensure the quality of the stamping. Apart from the correct positioning before printing, special attention has to be drawn to defects in the foil such as holes, break-offs and dull spots.

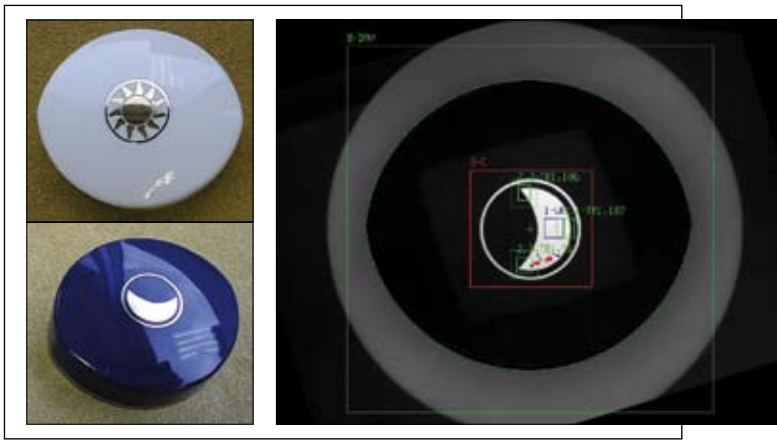
In close co-operation with Madag Printing Systems, the manufacturer of the stamping machines, Signum has developed a 100 % inspection system for this task. The machine is designed to perform 90 cycles per minute. The tubes are put onto mandrels on a turntable passing five stations. After the tubes have been placed, a registration mark sensor determines the approximate position at the second station. Subsequently, a surface camera determines the radial and axial position accurate to 0.01 mm using the tube's print image to compare the object position to the target position. The PLC corrects the position, so that in the stamping station the accurate position of the stamping in relation to the print is guaranteed.

Following the stamping, the tube is rotated under a line scan camera and the image of the circumference is compared to a reference image.

The illumination is selected in a way that the foil appears in reflection and therefore the background remains rather dark. Only in special cases the illumination is changed to dark field. Objects with a length of up to 200 mm can be inspected with a resolution of 0.1 mm/pixel. If required, the user can check also the imprint as well as the remaining surface for defects.

The innovative employment of image processing in the production machine enables the end customers to

Developed surface of the front of the tube with foil print and inspection windows



Lid of the day cream jar, lid of the night cream jar, inspection result of a defective print

produce and pack robot-aided and fully automatic. Delivering 40–50 machines with this new technology so far made the manufacturer market leader.

Control of Lid Ornaments with Hot Foil Stamping

The lids of cosmetic jars are particularly suitable for aesthetic and informative logos. For instance, the symbols sun and moon are stamped in gold foil for the day and the night cream jar.

This stamping must be inspected during the production process. The rotary position is arbitrary and the lateral position varies according to the width of the conveyor. Six stamping machines work with a number of cycles of 45/min each. At the discharge of each machine an inspection system is installed.

The lighting condition is optimized with a semi-permeable mirror in a way that despite the lens effect of the spheric surface an even illumination is ensured. The progressive scan camera triggered by a light sensor acquires an image and at first the position of the printing is determined and corrected. Subsequently, the area of interest is compared with a stored reference. The deviations are measured for their size (small marks blue, large marks red). The reject criteria are determined by the user in a parameterising process. The inspection system uses an air nozzle to reject.

The inspection systems have been in use with great success since 2002 at Weener Plastic Packaging Group. The machine operator can entirely focus on the productive capacity and can operate several machines simultaneously.

Inspection of Edges with Hot Foil Stamping

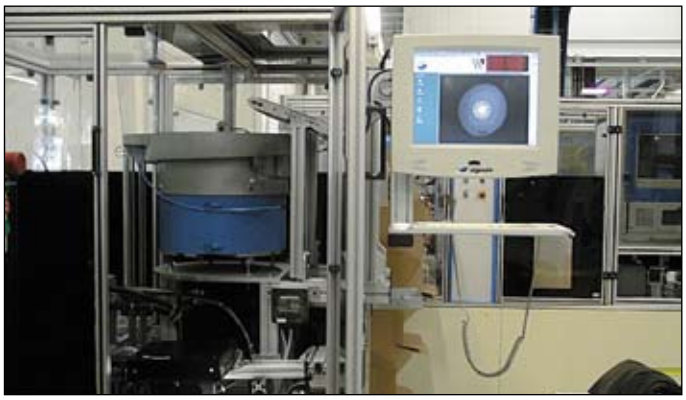
Caps and covers of cosmetic jars have frequently a hot foil stamping at the edges. The quality is to be inspected with image processing after the hot stamping process. Since the shape of these containers can vary from round to extremely oval, the image acquisition set-up has to be adapted to the different shapes as simple as possible.

The typical defects in hot stamping are:

- marks
- holes, gaps
- outline error

The time for image acquisition and evaluation is typically 1 second.

In the example shown the contour is printed with a foil that is approx. 2 mm wide. Afterwards, the unit under test is put on a rotation device and is rotated 360 degrees. A progressive scan camera, which can be triggered asynchronously, takes 10 images while the object is



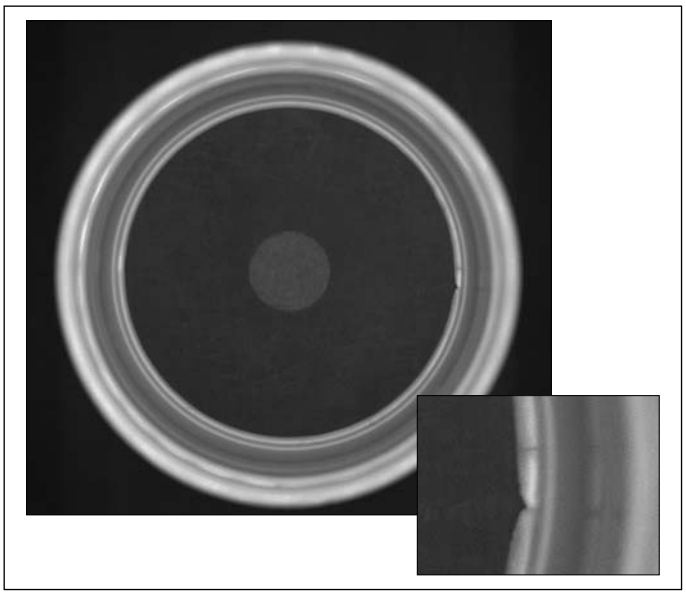
At the discharge of each machine an inspection system is installed

Oval Cap with hot foil print, image sequence of half a revolution, the second half is symmetric

25 Years of Signum Computer

In November 1982, Dr. Hayo Giebel established in co-operation with three colleagues Signum Computer for Signal Processing and Pattern Recognition. What was then pattern recognition became over the years today's industrial image processing / machine vision.
Apart from the field of interactive image processing with the product INCOS (some might recall this name), from the beginning also high-level projects for the industry were in the focus of the company's activities. Already in 1982 a 100 % inspection sytem for cigarettes was built with an efficiency of 7,500 pieces per minute. For this purpose VME bus computers with special hardware, high performance illumination and the line scan camera technology were developed.
In 1996, Signum was divided into Signum Bildtechnik GmbH (Managing Director: Dr. Hayo Giebel) with systems for television studios and crash test plants and Signum Computer GmbH (Managing Director: Dr. Alfred Vogel) with the focus on industrial print and surface inspection. Today, Signum Computer is the technology partner for machine builders who want to ensure their leading position in the international markets by integrating vision systems in their machines.

Position of the side wall inspection



Sealing ring for the roller ball (left), Image detail showing a defect with a depth of 0.25 mm (right)

rotated one full circle, so that the stamped edge can be completely examined. The lighting is arranged in a way that for each point of view a diffuse reflexion is created for the area to be inspected. Since the reflexion angle varies strongly due to the curvature of the object, the light source must be rather large and positioned close to the object.

In order to start the image acquisition at the correct time, a trigger device is fastened on the rotation axis. This trigger device has to be changed whenever a part with a different shape is produced. Depending on the shape of the product, the image sequence on the monitor looks different. For the extreme case of a round part all the images of a sequence look alike. The trigger distance of the rotation device may not be faster than 60 ms. Beyond that no demand is made against the uniformity of the rotation.

Since these caps are mass products, one of the customers operates eight of these stamping machines with inspection in 3 shifts 24 hours a day, another customer operates four of these machines. Now not only the manual offline inspection can be saved, but it is also possible to connect the machines to the final assembly.

Quality Control on Cosmetic Jars

Cosmetic plastic containers are to be inspected for moulding errors before they are packed. Typical errors are bubbles and inclusions, as well as break-offs during the assembly of the interior container.

On a top plate four containers are mounted in a row and inspected in the next cycle. The cycle time is approx. 4 seconds, 3 seconds of which is standstill time. In these 3 seconds all four jars are turned around once and eight images per revolution are acquired – altogether 32 images. The four progressive scan cameras are triggered by a light sensor arrangement. As soon as the group of four objects arrives in the next station for packing, the result has to be present and the grip arm rejects the bad parts. The sidewall inspection is supplemented by an inspection of the bottom of the containers, which is carried out on each jar on the conveyor before the final assembly.

Peter Gluth, project engineer at Weener Plastic Packaging Group: „Since the installation of this testing equipment and with a rejection rate less than 1 %, we have had no complaints by any customer."

Control of Sealing Rings for Roll-On Deodorants

The ball of a roll-on deodorant runs in a plastic ring to protect the bottle from leaking. On one hand, the sealing lip must ensure the passage for the deodorant liquid, on the other hand it has to fit evenly in order to prevent any leakage.

The sealing rings are moulded from one piece with the thin sealing lip. A small gap can remain opposite the injection point, if the material does not flow together correctly. This gap can cause a leakage. Therefore the sealing lip passes a 100 % inspection with a throughput of 100 pieces per minute before the assembly is carried out. The retaining rings are passed under a camera triggered asynchronously with 1,000 x 1,000 pixels and are illuminated with a ring light from above. An inductive sensor supplies a trigger signal when the ring is centrically positioned under the camera. The resolution of the image acquired is 0.05 mm/pixel. After the image acquisition, the exact position of the object is determined as well as the inner diameter of the sealing lip. Then the outline of the sealing rim is inspected. Parts with gaps exceeding a certain depth or size (which can be parameterised), are rejected as bad parts as well as rings with a large deviation from the target diameter. Bad parts are blown out with an air nozzle. A manual optical inspection would have required at least five people per shift to inspect this throughput with magnifying glasses.

The examples above show which benefits are brought to the manufacturers of cosmetic packaging by image processing. Due to strict requirements regarding the performance of the inspection system and the large variety of the packaging, the decision to work with Signum was made mainly because of Signum's creativity in providing solutions combined with the reliability of the systems installed.

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