Monitoring and control at the hot end to reduce costs

Xpar Vision, a specialist in the development and implementation of hot end sensor technology for the container glass industry, explains how its various inspection systems can help manufacturers achieve significant cost savings through the early detection of defects and the reduction of variation.

Xpar Vision is dedicated to the development and implementation of hot end sensor technology for the global container glass industry. The application of its technologies can create significant saving potential.

Infra-red dual camera system

For almost 10 years container glassmakers around the world have been using Xpar Vision's infra-red (IR) camera system at the hot end for inspection and process control. When this technology is properly applied, glassmakers can increase the effectiveness of inspection and gain more knowledge of the glass forming process, thus allowing them to better control it.

Infra-red technology can be used for all types of forming processes: Blow & blow, press & blow and narrow neck press & blow (NNPB); and for every glass colour and form.

Inspection

With the use of the infra-red camera system, defects can be detected from the thermal image of each bottle. Detecting faulty bottles at the hot end ensures a smooth process at coating hood, annealing lehr and cold end, and dramatically increases the total effectiveness of inspection.

So far, this dual camera system has shown to be effective in detecting and rejecting critical defects including: Birdswings; fins; choked neck; stuck ware; fallen ware; offset finish; leaners; shape; thin bottoms; hollow neck; body thickness; and inclusions.

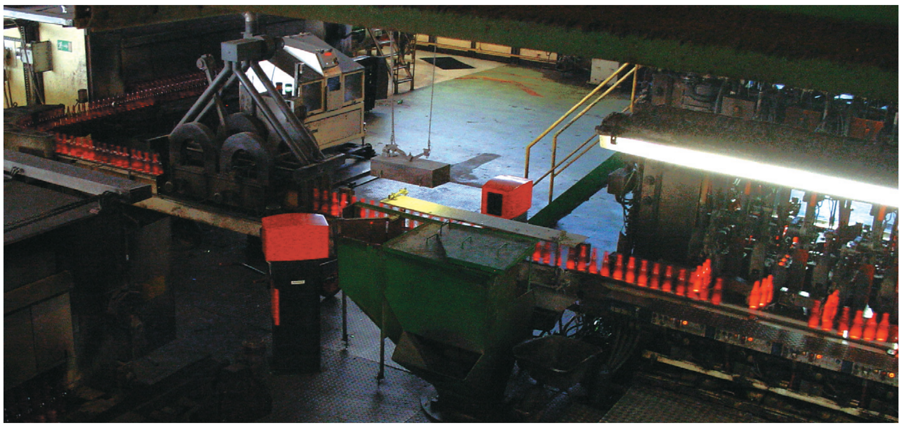

Fig 1. Xpar Vision's hot end infra-red camera system for inspection and process monitoring and control.

Process monitoring and control

In terms of minimising the risk of customer complaints, detecting and rejecting faulty bottles at the hot end is extremely important. One step further is to execute root cause analysis on faulty bottles and try to understand where the problem comes from, as well as what can be done to prevent this faulty bottle being produced in future.

As the IR information is real-time and cavity-related, it is relatively easy to execute root cause analysis to any defect. The IR information represents a fingerprint of the process failure and provides direct information on which process variables have failed (such as thermal condition, human interaction, IS machine, etc).

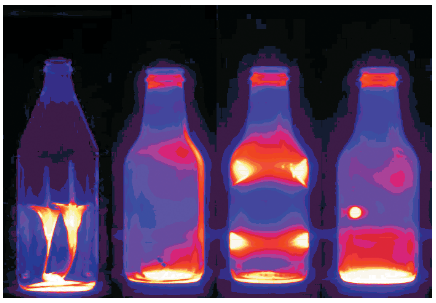

Fig 2. Examples of defects: Birdswings, blisters and inclusions.

Monitoring the forming process with IR technology, even without a focus on inspection, shows the process behaviour in terms of variations in intensity, asymmetry, shape, verticality and transport. IR information for each individual cavity is compared with the correlation of the total IS machine and, as a result, differences between sections and cavities are visualised, providing direct input for any process improvement.

Xpar Vision's infra-red dual camera system can monitor and reduce these

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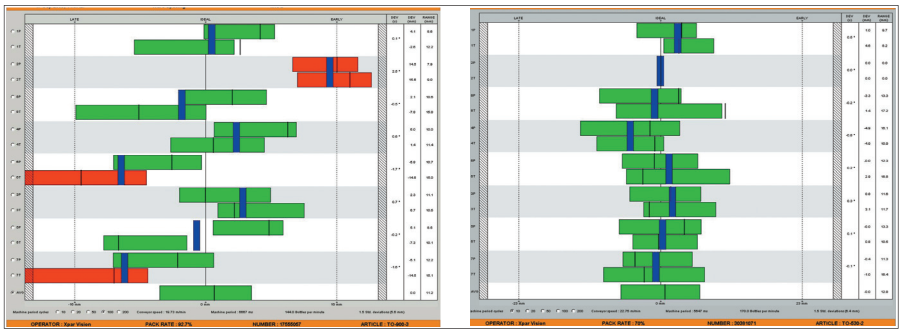


Fig 3. Example of monitoring transport (left = more variation; right = less variation).

variations by means of improved swabbing, transport, weight control and gob loading.

Gob monitoring technology

Minimising forming process variation should be the focus on the way to improved efficiency and better quality, and thus gaining a competitive advantage and making money.

Xpar Vision specialises in creating sensor technologies for this purpose. To this end, it offers two technologies.

IR gob weight control

The Infra-red Gobweight Control (IGC) system monitors the weight of the products and automatically corrects the weight by adjusting the tube height. The IGC is an add-on to an infra-red camera system and as such forms an integrated system (see ***fig 4***).

The intensity of the total amount of emitted infra-red light as measured by the infra-red camera system is an important factor, as it tells us everything about the mass of the product. In theory, the total intensity has a linear relationship to the total mass.

When, for example, the mass of the products rises over time, the measured intensity will also rise. This information forms the input to a control loop, which calculates the ideal position of the tube for that moment. The control loop forms a robust and reactive concept that can recognise weight deviations of less than 0.5 %.

The self-regulating capabilities of the system reduce the operator's workload, while reducing variance in the weight of the individual gobs over time. Low variance in the weight of the gobs leads to less glass usage, fewer defects and a more stable production process.

Through many customer installations the IGC has proven to be very effective in automatically controlling weight and reducing weight deviations. As such the IGC has a fast pay back.

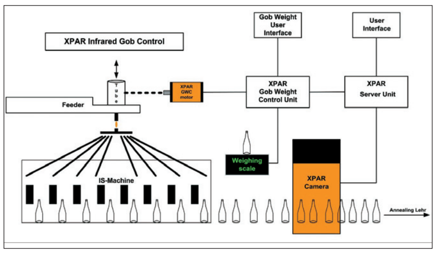


Fig 4. Xpar camera and Infra-red Gobweight Control integrated in the forming process.

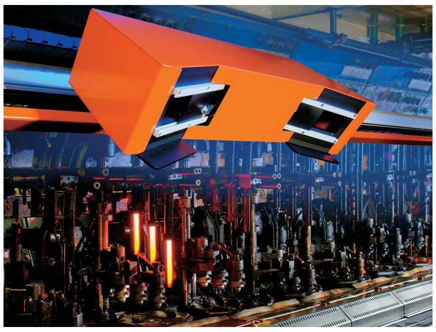
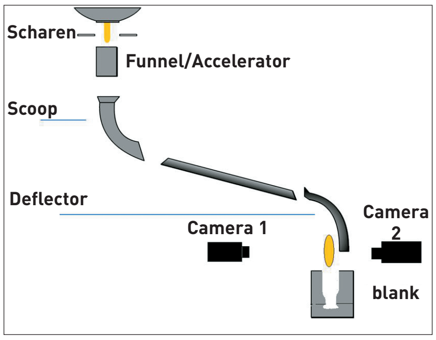


Fig 5. The camera module glides along the rail and takes images at a speed of 500 per second.



Controlling gob loading

The Gob Assist (GA) monitors the speed, length, position, shape, orientation, time of arrival and trajectory of the gobs falling into the blank moulds, without coming in contact with them. With this information it is possible to easily find and maintain optimal gob loading and to retrieve optimal gob loading after equipment and/or job change. As with the IGC, the GA is an add-on to an infra-red camera system.

The Gob Assist comprises a camera module that glides along a rail system, which is strongly attached to the IS machine and enables the camera module to move to all different sections. The cameras take images at a speed of 500 frames per second. Both cameras start taking images when the gob is leaving the deflector and stop when the gob has fallen completely into the blank mould. In this way, the whole trajectory is imaged.

Xpar Vision software then processes this sequence of images in near real-time. The images from both cameras are combined to reconstruct a three dimensional image of the gob, thus giving information about the real three dimensional shape, as well as the trajectory of the gob.

Clear information

The 3D image of the gob is used to calculate different properties of the gob such as length, diameter and shape. For the trajectory, several calculations are also made, such as speed of the falling gob and the exact position (in x- and y-direction) where the gob enters the blank mould.

All the information is presented in clear graphs, which is accessible through the user interface. These graphs give the operator all necessary information about the gob loading process and therefore help to improve it.

With the Gob Assist it is possible to find, maintain and retrieve optimum gob loading within seconds, thus eliminating a significant source of process variation. The result is a much more stable and predictable forming process, with fewer inefficiencies (eg downtime of the IS machine, poor job changes, damaged moulds, losses due to blank swabbing) and fewer quality issues (eg thin ware, blisters, poor glass distribution, loading marks, finish defects, poor baffle marks, bird swings). As a result, the glass manufacturer can see lower costs, more throughput and higher profits.

Currently, the Gob Assist is in the final stage of development. The results of the prototypes in operation at Wiegand Glas Steinbach, Ardagh Glass Nienburg and Ardagh Glass Dongen are promising and the system is showing to be effective in reducing deviations due to gob loading. As such, the product is expected to offer a fast return-on-investment. ■

Xpar Vision, The Netherlands.
Email: contact@xparvision.com
Website: www.xparvision.com