

Optimisation by automation

A strategic partnership between XPAR Vision and Bottero aims to control and optimise the forming process by automation. Using their respective systems as a basis, automated control loops with different functionalities are formed. Marketed under the name BoX, these automated control loops are discussed by Paul Schreuders and Gianclaudio Borsarelli.

BoX is represented as a black box; the automated control loops are intelligent software that is complex in itself but easy to use. Because many automated control loops can be considered, the BoX is set up as a modular system and thus, is designed for the future. Each module optimises and automates a specific sub-process of the glass forming process. With the modular approach, a customer can make a choice for only those modules that have relevance to specific glass forming processes.

The philosophy behind the BoX is that automatic control is much faster, repeatable and accurate than manual control. Besides, an operator hardly has the time or the knowhow to adjust the settings of the IS machine (up to 48 cavities) to optimise the glass forming process. The BoX calculates optimal settings every minute and performs optimised corrective actions

against every disturbance due to changes in the forming process, for example ambient temperature, glass temperature, IS machine wear etc. In many cases, manual control is simply impossible and/or certainly not as effective.

In the first phase, two different BoX modules have been developed and tested and both are now ready to present to the market at glasstec 2012 exhibition in Düsseldorf this October.

MODULE 1: WARE SPACING

Ware spacing is the distance between bottles on the conveyer belt. The more even this distance, the better the transport on the conveyer belt. Better, stable transport means less fallen and stuck ware on the belt, less coating hood jams and reduced levels of fallen ware in the annealing Lehr. Properly organised transportation is also

a precondition for speed increases.

Even more importantly, with properly organised transport, the shop floor remains free from glass and is therefore safer. Furthermore, the operator's workload reduces significantly, allowing him to focus on other forming process parameters.

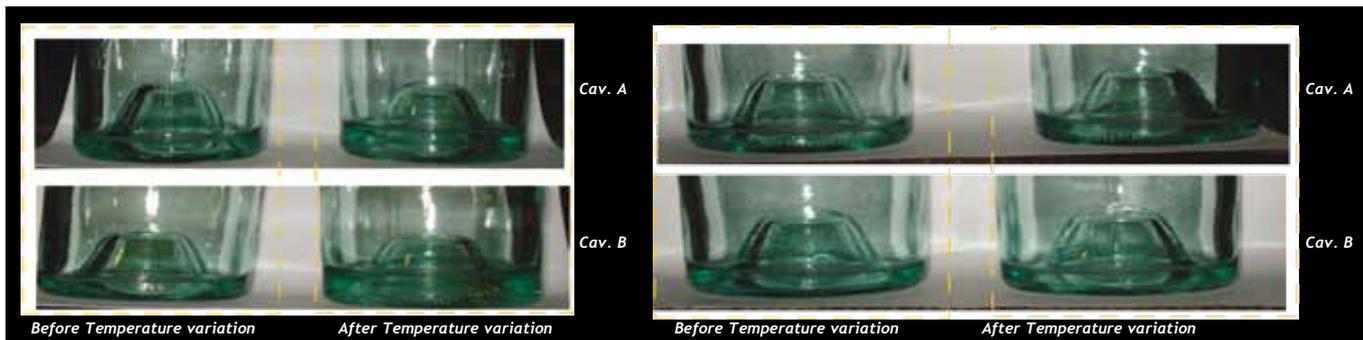
The BoX automatically controls and optimises ware spacing. The result is stable ware spacing between all sections/cavities. After a job change, the ware spacing module takes control and ware spacing is optimised automatically. No time is wasted transferring faulty bottles into the Lehr. Simply press the start button and the BoX takes control.

As proved by several customer trials, the accuracy of this automated control loop goes beyond what the best operator/specialist is capable of achieving. Figure 1 presents the mean squared error of the ware spacing in time. It is obvious that manual control leads to a much higher mean squared error than automatic control.

In this example, the bottles were positioned on the conveyor with a distance variation between the bottles of less than 0.3°! This distance variation is automatically kept low, because the automatic feedback corrects the ware spacing continuously and takes the correct corrective actions every minute against changes in temperature, speed fluctuations etc. >



Figure 1: Ware spacing overview.



Effects on glass.

MODULE 2: VERTICAL GLASS DISTRIBUTION

Vertical glass distribution is the distribution of glass from top to bottom. It tends to drift over time, for example due to fluctuating ambient temperatures (day and night rhythms) and fast changes in the cooling capacity of IS machines due to weather changes. In addition, unwanted changes in the forehearth are common causes of change in vertical glass distribution.

Less variation in vertical glass distribution means less quality problems related to glass distribution, as there are thick/thin bases, thin spots, thin necks etc. Also, the IS machine will run more smoothly, as the number of outliers reduces due to stable glass distribution.

The aim of this control loop is to achieve a stable and repeatable vertical glass distribution across all cavities and to make vertical glass distribution independent from ambient temperature fluctuations (day/night) and from feeder (glass) temperature fluctuations, whereby human interaction is excluded.

Unlike the ware spacing module, controlling vertical glass distribution goes beyond current operator and specialist capability. This control loop brings controlling functionality to the glass forming process, which brings the forming process as a whole to a higher level of control. As such, this control loop is the key towards the future of operating an IS machine.

Figure 2 shows the effects of the vertical distribution module on

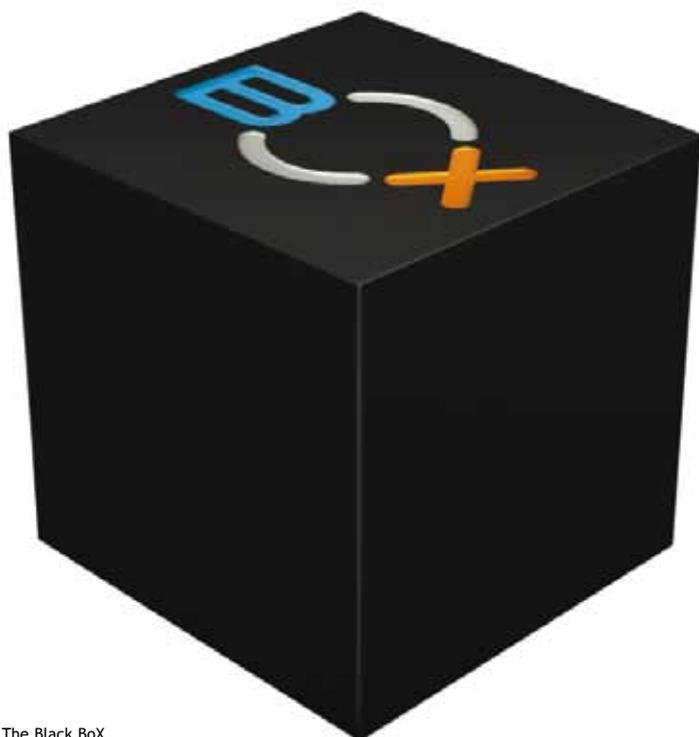
glass. Shown at left is the situation without BoX control, where it can be seen that a variation in gob temperature leads to a thick base. In the right-hand image, the gob temperature also changed but due to BoX control, there is no difference in glass distribution at the base.

With these automated control loop systems, forming process variation and thus forming process performance can be improved dramatically. As a result, the number of so-called outliers will reduce and thus, fewer critical defects will be produced. A leap in improvement is within reach with regard to pack-to-melt, weight/volume ratio, speed of production, customer complaints and resorting. A better future is gaining shape!

THE FUTURE

The question arises what this future will look like. Without doubt, BoX automation has started and the next innovative step in the glass container industry has been taken. From what has been learned so far, the attainment of equal bottles from all different cavities seems to be within reach! This means that the control level of the forming process goes up and the variation in the forming process is minimised. Consequently, lighter and stronger bottles, produced at higher speed, are within reach. Moreover, dependence on machine operators and/or specialists is reduced, thereby refocusing their work priorities.

In the knowledge that the market requires greater flexibility, higher quality and lower costs, the BoX is a necessity; fulfilling customer demands is only feasible when the glass forming process can be automated and continuously optimised against external disturbances. ■



The Black BoX.

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