

Bridging hot and cold end productivity goals

Emhart Glass sees a future where glass container productivity is increased while quality is improved by directly linking the production data provided by production process parameters, monitoring systems, FlexInspect and MiniLab systems. Leo Diehm and Jeff Hartung explain.

Many manufacturers of glass containers face the same challenges: The need for productivity and efficiency in order to decrease costs and improve quality with ever-increasing expectations from their customers. Glass container manufacturing has maintained a traditional approach, where pack rates often reach low to mid 90%. But is this sufficient? And if not, what can be done to assist manufacturers to improve these pack rates and control and monitor their processes?

Emhart Glass has recently released products that allow for improvements to the current situation in the glass container industry, namely FlexRadar (not for sale in Germany), FlexInspect T and BC and MiniLab Statistical Sampling. This equipment affords possibilities to close loops at the hot end with a vision of making the bridge to the cold end by correlating data

between hot end early detection, cold end inspection and automated MiniLab statistical sampling. From our point of view, the sooner we make the bridge, the better.

TRADITIONAL APPROACH

The current state of traditional container production begins by counting gobs produced per minute. Each cut gob is an opportunity for a glass container to become revenue. Unscheduled section downtime, job changes, mould changes and maintenance all impact the opportunity to produce cut gobs into containers. From there, it is possible to count the number of containers produced from the sections and containers sent to the lehr. Necessary processes like swabbing, section start-up to steady state production and jams are just a few events that impact the number of containers entering the lehr. Then, after one hour or so, we have the count of containers that are fed to the cold end. Containers lost in the lehr from handling issues decrease the number even further from its original potential at gobs cut.

Inspection machines are often

utilised in traditional manufacturing as quality control devices, rejecting the bad (as defined by the customer) and passing the good. Statistically, the higher the percentage of defective containers entering the cold end results in two outcomes: With stringent inspection parameters comes good ware loss; or less well-defined inspection parameters increase the risk of defects into pack. This is the sensitivity of inspection in traditional cold ends.

In addition, lines are manually sampled by quality personnel and manually measured in a lab using go/no go or manual instrument gauging, before transcribing the information to quality records. If a mould does not meet specification, it is selected by mould number for rejection. Cold end personnel spend time adjusting machines/finetuning machines so that lines are rejecting at similar rates. Ultimately, a certain number of containers enter the cold end and fewer containers end up on the pallet.

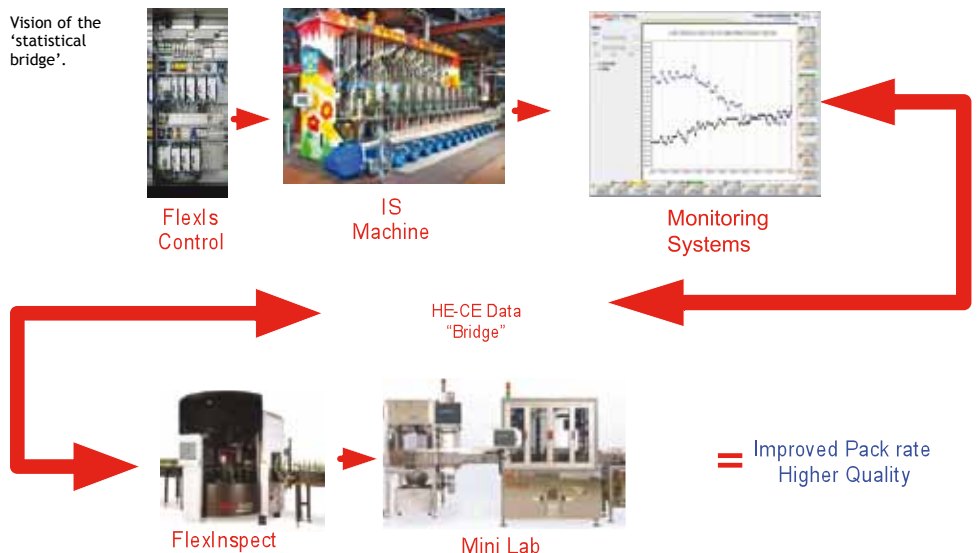
BURNING MONEY

Using a practical example of 89% pack to melt, the money can be seen burning! Approximately 4% is a typical loss at the hot end from ware handling (typically 0.5%) and swabbing issues (typically 2.5%) - hot end inspection, pusher/conveyor and ware transfer issues. In addition, downtime losses can vary but assume 1% attributed to the IS machine itself; feeders, machine, conveyors etc and others such as loss of power, mould equipment changes, wear parts, glass supply, transfer and maintenance.

Ninety six percent into the cold end means the most a manufacturer can expect is 96% with zero cold end losses.>

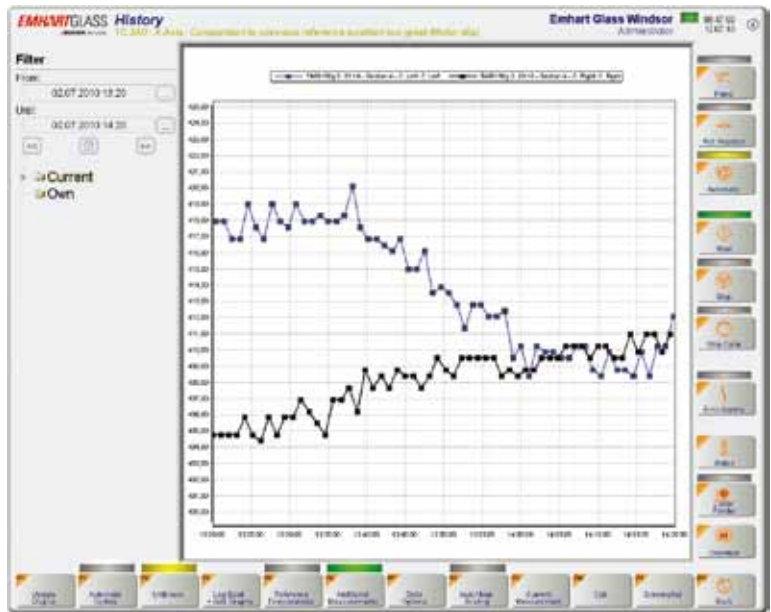


FlexIS machine control.





FleXinspect in-line inspection.



Monitoring systems.



Emhart Glass IS machine.

Zero loss at the cold end is not practical, so consider a typical cold end loss of 7%, downtime accounting for 1.5%, with 1% of that stemming from inspection machine issues, mechanical/operational/electrical or software issues and others such as conveyors, palletisers and accumulation table losses.

A cold end defect loss of 5% critical defects is typical, involving mould reject, tolerance and finetuning adjustments to equipment, combined with 0.5% loss from conveyor handling, transfers, line stop/starts. This adds up to 11% of the opportunity that originally existed at gob cut is lost every day. Today, the situation is heavily dependent on the skill of hot end and cold end operators, requiring as long as one hour up to 90 minutes for containers to reach the cold end through the Lehr before defects (especially

trending defects) are fed back to the bottlemaker. So the question remains: Is this acceptable? Is what is needed available and in the right places? Many process parameters at the hot end are dependent on the skill level of bottlemakers and cold end operators sorting out defects. Is this an expert system? How far off are we?

MAKING BRIDGES

Utilising the available equipment from Emhart Glass and building on the vision of closing loops and making bridges between hot end trending analysis and cold end inspection results and trending, Emhart Glass believes we can start down the road of expert systems that reduce variation, resulting in increased pack to melt and improved container quality.

Rejects at the cold end are a function of procedure; mould number selection, type of defect, as well as a function of equipment operator and type of defect. Defect

types are functions of cavities (inner, middle, outer) and section, time, operator, mould number and process parameter changes. If all this information is known, we can begin to correlate by shift, section, defect and parameter changes. Consider how advantageous it would be if you knew that the back cavity of sections one and three were producing more out-of-vertical containers than other sections and cavities? How many glassmakers know this information about their production lines?

The purpose of an expert system is to attack and trim down the money lost, create full transparency of the process, explore the potential for closing loops and continuously improve the process. The targets are verification of production process parameters, correlation of real time data, match real time data with cold end inspection results, conclude on correlations, open loop expert systems and use closed loops where possible.



MiniLab Statistical Sampling.

REAL TIME MONITORING

FlexRadar provides real time monitoring where infrared imagers are scanning containers, understanding which moulds are outliers prior to the Lehr. The Emhart Glass FlexInspect machines and Automated Statistical Sampling MiniLab provide manufacturers with the potential to take action prior to the mould going on a reject list, thus saving the Lehr from faulty glass. This real time corrective action is enabled by the FlexRadar production analysis, combined with the continuous data provided from the FlexInspect cold end machines and statistical trends from the MiniLab. FlexRadar detects outlier moulds, MiniLab shows trending defects and FlexInspect stores and presents information on mould, cavity, defect image and location, finish dimensions and wall thickness data.

Based on feedback from FlexRadar detection and confirmation at the cold end, the FlexIS control could theoretically take real time corrective action prior to the mould going on a reject list. These open and closed feedback loops eliminate the variation from operator to operator and from shift to shift. As a result of the information exchanges, more transparency exists in the process.

Going back to the example of the leaner bottle, if the container exceeds reject limits and makes it to the cold end, it is too late. With the FlexRadar and a closed loop, the defect is corrected automatically through the temperature control system adjusting the blank mould half temperatures, thus correcting the problem before reaching reject limits and the Lehr is lost – early detection and corrective action are key. Networking the information from the cold end, correlating this information, confirming inspection machines automatically with the MiniLab and providing access to defect images at the hot end all provide the potential for reducing variation, closing loops at the hot end between the FlexRadar and FlexIS machine control. All provide the manufacturer information about preventing loss and money burn.

CLOSING LOOPS

The aim at Emhart Glass is to provide the capability for the manufacturer to inspect, measure and monitor process parameters (PPC, TCS, gob monitoring etc), perform real time glass forming analysis with FlexRadar, inspect and report in-line inspection with FlexInspect T and FlexInspect BC and monitor process control with

MiniLab automated statistical sampling. With these tools, manufacturers can begin to migrate towards expert systems, closing loops where possible, optimising their quality and increasing productivity.

Closed loops between the Temperature Control System, PPC, FlexRadar and Flex IS control become possible. Making information bridges from cold end FlexInspect equipment and MiniLab to the hot end help us quickly identify bad trends and correlate mould numbers and sections with defects. Real time glass thickness and distribution trends become possible. Automation of lab activities reduces human measurement variation and inconsistencies caused by transcribing data to forms.

Using all of this numeric information allows for correlations between outlier moulds and defects throughout the production line. Operators are notified of discrepancies and

trends, while images of defective containers throughout the cold end can be associated with the corresponding data. The FlexRadar system can be used for closed loop functions by exchanging container information with FlexIS machine control. All these closed loops aim at reducing process variation via automation of the container forming process. ■

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