Actionable data: XPAR VISION CEO on future-proofing container glass forming

A trio of major challenges confronts today's glass industry. Firstly, more container glass users and manufacturers are committed to a drastic reduction of CO_2 emissions. Secondly, container glass manufacturers need to increase their competitiveness with other packaging materials. And thirdly, glass manufacturers are seeing experienced people retiring and are having difficulties hiring and retaining new staff in their factories. In answer to the first challenge a few advances can be observed. Obviously, there is a movement towards the use of alternative energy sources for heating up furnaces. Besides that, there is more recycling of glass containers and more returnable containers instead of non-returnable containers. Finally, there is a movement towards redesigning containers with the aim of reducing weight. Lighter and returnable containers are a widely accepted answer to the first and second challenge. The third challenge though is not yet properly addressed. In my opinion, a stronger focus on the forming process is the answer to all challenges but remains underexposed. Briefly, these ideas come down to the following: the current container glass industry forming process performance has huge room for improvement. With a focus on forming process control and specifically by the use of actionable data, improvements can be realised, resulting in a potential gain of around 25 percent. This means producing better bottles, with less defects and less dependency on people, using

Unpacking how forming processes can be improved through actionable data, XPAR VISION CEO Paul Schreuders explains glass bottle production that has less defects while advancing decarbonisation goals and increasing competitiveness in the industry.

less raw materials and energy, and thus reducing CO_2 emissions, increasing competitiveness and results at the same time.

THE FORMING PROCESS

As we all know, container glass forming is a complex process. The complexity comes from the fact that there are many variables, which are constantly changing: raw materials, cullet, environmental temperature and humidity, glass condition and homogeneity and wear of metal machine parts as moulds and deflectors. As a result, its output is constantly changing. In this environment operators must ensure that the IS machine keeps producing. As such they swab the moulds and deflectors, change materials, align deflectors with troughs, change timings, etc. The better operators are trained for these tasks and the more experienced they are, the more the forming process stays within the natural working range and the more good bottles they produce. Of course, it also requires a disciplined shop floor, which is well organised around the tasks of the operators.

PERFORMANCE

Asking container glass manufacturers about their performance, the majority of them refers to pack-to-melt (or pack-to-pull, or pack-to-cut). The global container glass industry has a pack-to-melt of roughly 85 percent on average. This basically means that out of 100 percent melted, 15 percent are qualified as bad bottles. Most bad bottles have their root cause in the forming process, so it is obvious to conclude that the forming process performance is roughly 85 percent. There is no industry in the world that accepts these kinds of efficiency figures! Moreover, pack-to-melt is only a partial coverage of the forming process performance. The other part is called glass wall thickness variations or glass distribution variations. Those active in forming will admit that glass wall thickness variations are a representation of forming process variations, and the main root cause behind the bad containers produced. But even the good containers produced possess huge glass wall thickness variations, both horizontally as well as vertically, within a single bottle and between bottles produced. Even when produced in the same cavity. These glass wall thickness variations directly relate to the constantly changing forming process, in combination with the manual interventions made to ensure the IS machine keeps producing. These glass wall thickness variations are a so-called 'Hidden Factory', which has a potential for weight decrease, and eventually speed increase. The term Hidden Factory, outlined by organisation Six Sigma, is the hidden world of waste and flaws that slows down production and lowers the quality of goods. With infrared (IR) sensing technology containers are inspected and glass wall thickness variations are measured. Based on years of IR data collection, understanding of the forming process and the application of data science, it can be concluded that a possible reduction of glass wall thickness variations is estimated

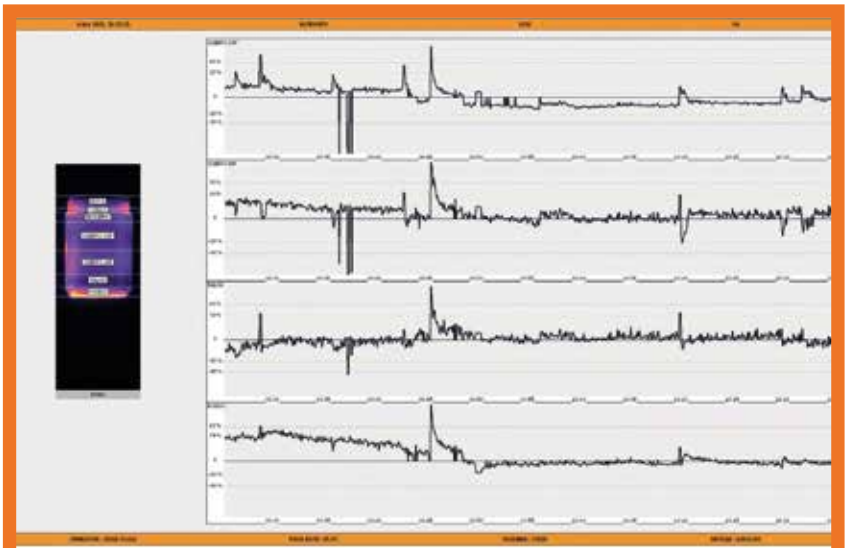
to be up to 30 percent. Knowing this, in combination with current pack-to-melts, it is safe to state that the current forming process performance has a potential for improvement of results and competitiveness and reduction of CO_2 emissions of around 25 percent.

CONTROL

Knowing the potential for doing better and knowing people's dependency when facing the challenges, as mentioned, a focus on forming process control is required. The aim should be to do more with less, forming more good bottles, with less energy/materials and less people dependency. Above all, it is a way to reduce costs and improve financial results, and it is a basic requirement for glass to become more competitive and sustainable. Only then, glass can be the preferred packaging material for foods and beverages. With IR sensing technology, the level of forming process control can be measured. The higher the level of forming process control, the lower the level of glass wall thickness variations and the higher the pack-to-melt. With IR sensing technology, the forming process performance, as well as any problem, change and/or improvement to this forming process, can be measured. So, in order to work towards the next level of forming process control, IR sensing technology is a must for any container glass manufacturing.

XPAR VISION

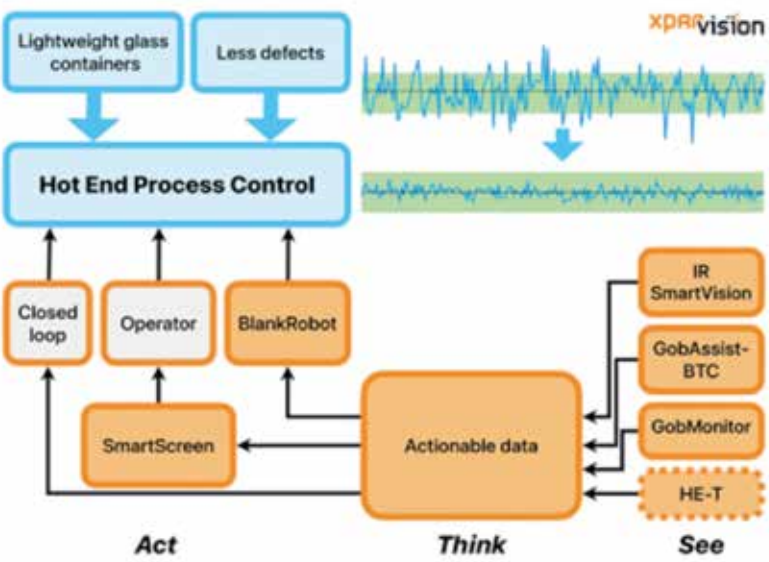
More than 25 years ago, Xpar Vision was the first supplier of IR sensor equipment for the container glass industry, meant for hot end process monitoring, and capable of inspecting and rejecting critical defects in the hot end. It started with a group of technologists with mostly beta backgrounds (physics, mathematics, computer science, and Artificial Intelligence), and later experienced glassmakers and data scientists also joined. After IR sensor equipment, other sensors and lately robot technology has also been developed. All for container glass and all for the hot end. With an install base of more than 650 globally, today the majority use the IR sensor equipment for inspection, and not for process monitoring, let alone for forming process control. This originates from the fact that the reading of forming process data collected by the IR sensor does require knowledge and experience of the tool, as well as of the forming process. For an average operator, forming process data collected by InfraRed sensors is difficult to read. Fig. 1 is the representation of infra-red intensity variation of four out of eight zones of a container, produced at one cavity during one hour of production. Besides intensity values, typical process data are asymmetry, verticality and diameter. These process data (up to 32 per individual container) are collected per container produced. Even if an operator can read the data, making combinations, applying statistics, overseeing various cavities at the same time, etc. is difficult and time consuming, even for a specialist.



▲ Fig 1. For an average operator, forming process data collected by Infra-Red sensor are difficult to read. E.g. picture is the representation of infra-red intensity variation of 4 out of 8 zones of a container, produced at one cavity during one hour of production. Besides infra-red intensity values, typical process data are asymmetry, verticality and diameter. These process data (up to 32 per individual container) are collected per container produced. Even if an operator can read the data, making combinations, applying statistics, overseeing various cavities at the same time, etc. is difficult and time consuming, even for a specialist.

ACTIONABLE DATA

Over the years, Xpar Vision has intensified its research and development activities drastically. More than 25 years of experience in hot end data collection, combined with understanding of data, understanding of the forming process, and lately also the application of data science, has led to a breakthrough: abstract data are now converted into action-



▲ Fig 2. Direction to operators is given through a SmartScreen, showing SmartAdvices, which are actionable data, generated through raw data, collected by sensors.
Obviously, SmartAdvices are available for the operator, but also for closed loop control and robot control.

able data. An important subset for actionable data is SmartAdvices: a system that gives advice for action to operators, based on a statistical trend recognition of combinations of process data, with the aim to stabilise the forming process once it starts to destabilise. Because the SmartAdvices are based upon process data, early intervention is possible, preventing defects from being produced. Consider it as a virtual consultant for even the least experienced operators to execute specific actions at the right time, even without training to use the tool and even without specific glass forming experience. Following SmartAdvices will lead to the production of more good containers with less energy/materials and less people dependency. The logic of SmartAdvices is visualised in Fig 2. The next level of forming process control can be achieved by using SmartAdvices. The result is less defects produced and less glass wall thickness variations, with the possibility to produce lighter glass containers, eventually at higher speed. Besides SmartAdvices, another subset of actionable data are metrics to measure and quantify the forming process variations in a certain period. As such, within a job priorities for action and/or improvement can be qualified. Also, the effect of actions can be monitored. And finally, with the same logic, production lines or specific jobs can be benchmarked.

IR SMARTVISION

SmartAdvices and SmartScreen are available in the new generation IR sensing technology, named IR SmartVision. Besides SmartAdvices and SmartScreen, the IR SmartVision includes:

- SmartDetection: a renewed algorithm to inspect containers, round, and non-round, with or without engravings and embossing, which is self-learning, and does not require example containers.
- SmartSettings: easy to set up (only two set points).
- SmartView: a possibility to use multiple cameras, through which 360° inspection and thus even more effectiveness is realised. A hardware redesign has resulted in a smaller footprint of the camera stands.
- SmartSensing: an extra sensitive filter ensures over and/or underexposed parts of the container to be corrected for, as such adding to the effectiveness of inspection.
- SmartCooling: a thermo-electric camera cooling system, lowering both installation (no piping for water) and operational costs (no compressed air), and bringing the robustness to a next level.

With IR SmartVision container glass manufacturers have the tool to create the next level of forming process control, producing containers with less defects and less glass wall thickness variations, allowing for weight reduction and eventually speed increase, being less dependent on people. As such, IR SmartVision is opening the door to realise the potential gains of around 25 percent, and a major step to reduce CO_2 emissions, bottom line results and competitiveness with other packaging materials, and a major step towards 'heading for perfection.'

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