EMHART GLASS
a BUCHER company

100
1912 2012

Emhart Glass: SERVING GLASSMAKERS FOR 100 YEARS

Martin Jetter

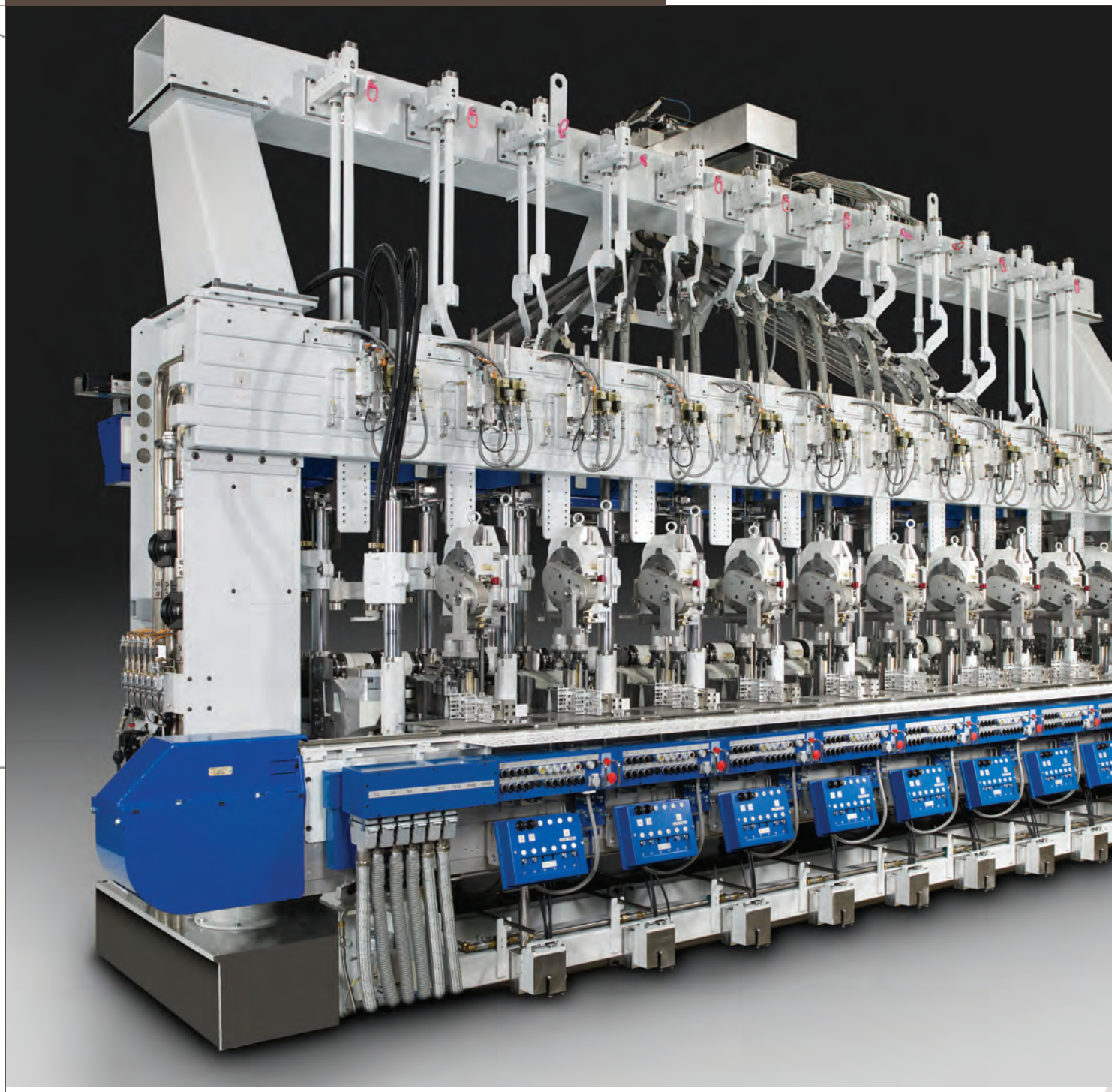
We visited Emhart Glass, one of the hollow glass market's most enduring companies, to learn how it has grown and evolved over the last 100 years. We found that the company that invented the IS machine is still innovating, in every area from forming to inspection.

CELEBRATING 100 YEARS

What does this centenary mean to Emhart Glass?

Martin Jetter (President): Obviously, 100 years is a long time! But for me, what is even more fascinating is that the IS machine, which changed glassmaking so profoundly and permanently, is still in use today.

Our early years saw the creation of automated glassmaking as we know it, and the inventions have lasted for 100 years without significant change. They've been improved, of course – but the principles and processes are the same.



Normally, firms that are founded in the US stay in the US. What was behind Emhart Glass' move to Europe?

MJ: From their tiny workshop in Hartford, our predecessors explored the whole world – developing their business, building new production units and moving headquarters. The principle was 'follow the market' – something many really successful companies have done.

We have to remember that the last 100 years have seen two World Wars and some major economic changes. Originally, the US was the dominant market for containers – and everything else. But after World War II, US markets were saturated and the economy stagnated, while Europe played catch-up with double-digit growth.

Our first steps were into Sweden, when we acquired our factory in Sundsvall in the early 1950s. That was the dawn of production in Europe for the European market, and it ultimately led to the closure of our production site in the United States at the end of the 1980s.

In 1987 we got our first European President, Michel Cornaz. He had already spent decades developing our business in Europe and Asia, and he is Swiss, so it seemed logical to move head-

quarters to Zurich. But the real change came in 1998, when Swiss group Bucher Industries acquired Emhart Glass from Black and Decker. Then we really were a Swiss company.

We can see the same eastwards trend today, with the US and Europe having two to three per cent growth, while in Asia and China there is six, eight or even 10 per cent. That's why we're focused on developing new markets in Asia.

How is Emhart celebrating this important anniversary?

Marlen Debrot, Marketing Communication Manager: First and foremost, we're sharing the occasion with our teams around the world. This autumn, each of our locations is hosting a special event for employees and their families. The production plants will also have Open House days, when local businesspeople and politicians can have a look round and learn more about our work. Some plants are inviting schools too. As a global company, we encompass many different cultures, so each branch is celebrating in their own way.

For customers, *glasstec* (23-26 October, Düsseldorf) will be a great platform to learn about our history. They can watch our specially made history movie, which includes interviews with many of our previous presidents, and view some historical timelines at our stand.

Next year, we're hosting a Glass Packaging Forum, from 14-16 May in Lucerne, near our HQ in Switzerland. Industry leaders and other experts will come together to discuss the key issues facing the glass industry, and what the future holds.

We'll also be announcing a series of technical symposia, focused on our own innovations, following up on announcements made at glasstec. Both the forums and the symposia are things we used to do as a company, and we think they're worth reviving.

Finally, we've written and produced an illustrated hardback history book, over 100 pages long, that tells our story from 1912 to the present day.

Could some of these ideas turn into regular events?

MD: Definitely. We're using the centenary as a starting point to rethink our marketing.

As we developed our history book, it became very clear that a lot of Emhart Glass' success always was and still is down to listening to customers, finding out what they need and creating solutions to deliver it.

Through symposia, our product managers and engineers would tell customers about our plans and use their feedback for refinements and improvements – and that's one reason why we wanted to restart them.

EMHART GLASS TODAY

As Emhart Glass has developed and progressed, so has the IS machine. What can you tell us about the current versions of it?

MJ: The standard IS is a mainstream machine – a solid, proven, mature technology. There are few differences between our machines and those of our competitors, because there is not much any of us can do to improve it. We're very strong in this segment, but there isn't much differentiation.

Now, above that standard segment is the high-tech market, where we're talking about innovative solutions. We dominate this segment completely. With our Research Centre opened in 2007, no one can match our development pace.

We started with parallel mould opening and closing, which was implemented on the AIS machine. More recently, we introduced NIS, which is a servo-electric machine with a larger centre distance than any other machine. NIS can operate in five-inch triple-gob or quad-gob, and can even produce beer bottles in quad-gob and wine bottles in triple-gob – the only machine on the market that can do so.

Now, we have BIS, which is smaller than NIS but still features the latest technology – servo, improved safety, higher speeds and very sophisticated cooling technology. With that feature set, BIS is targeted at the high-end market. However, what we're seeing is that many mid-sized glass companies are differentiating themselves from the giant glassmakers by investing in high technology. Advanced tech delivers higher efficiency and lower production costs, allowing smaller players to take market share from the larger groups. So this is where we're focusing our efforts in terms of high-end machines.

Tell us more about the investment decisions that your customers face.

MJ: For glassmakers, the equation is very clear. They can either go for the cheapest investment and save on capital expenditure, or they can invest more and go for the cheapest container cost. For both business strategies we have an attractive product offering.

Of course, quality is always an issue, but here the benchmark is set by the fillers. If glassmakers don't reach those quality levels, the fillers won't buy their bottles.

So how can you make glass bottles cheaper?

MJ: One-third of the cost of a glass bottle is energy. One way to reduce that is by making bottles lighter, which is why all glassmakers aim for it. It's also why there is a trend towards technologies such as narrow-neck press and blow NNPB).

Another possibility is to look at staffing. For example, if you are running a quad gob-machine with 12 sections, you have 48 cavities. That's effectively the same as hav-

ing two double-gob machines, but with half the staff. However, a quad-gob machine is more expensive than two double-gob machines, so you're investing up front to reduce costs over the long term.

Then we have 'pack-to-melt', or the efficiency of the machine in turning melted glass into finished product. If it runs at 95 per cent efficiency instead of 85 per cent, that helps your bottom line. At 85 per cent, you're using 10 per cent more energy and wasting 10 per cent more glass – and that glass needs to be re-melted, which consumes even more energy.

Finally, we have automation, which reduces costs by increasing quality. For example, if five per cent of your bottles have defects that are picked up on the inspection line, you are bearing an additional five per cent of costs. If you can reduce those defects through automation, you're improving efficiency and reducing cost. With our Closed Loop technologies, we're aiming to make the machine as fast as possible and optimise container production, leading to better efficiency. At the end of the day, the key word is always efficiency.

What global markets would Emhart Glass like to develop?

MJ: We're present around the world, but there are areas where we'd like a higher market share. For example, until about a year ago, we had a relatively low market share in China. Now, through our joint venture with *Sanjin*, who is a market leader, we've improved our share of the Chinese market.

We have very high market share in Europe and the Middle East. In Africa, we're mainly present in South Africa, where we work with *Consol* and *Nampack*, and in Northern Africa. The rest of Africa is a developing market, where we also aim to be present.

We're also working on developing the South American market. We have several clients in Mexico, and will be targeting this country in the future. In North America, the market is mainly repairs to existing machines.

What about International Partners in Glass Research?

MJ: IPGR was founded in 1984 to look at ways to improve the glass-making process. Today, the members are *Wiegand Glass*, *Vetropack*, *Yamamura*, *Sisecam*, *Vidrala*, *Gallo Glass*, *Bangkok Glass*, *Amcor*, *Fevisa* and ourselves.

We meet at least twice a year to discuss R&D developments and share best practice. The glass plants exchange personnel for training, carry out benchmarking exercises and share their experiences with different equipment, processes, moulds, coatings and so on.

But we are also working on projects to improve glass production processes, which then can be used by all IPGR partners.

For our part, we can share our latest developments and get feedback on what glassmakers really want. Lots of IPGR members want to be the first to use new technologies, so it's a win-win proposition.

In my opinion, IPGR is a great way to improve the standing of glass in the world of packaging. The biggest threat to glassmakers doesn't come from other glassmakers. It comes from rival packaging materials such as aluminium and PET.

THE PRESENT AND FUTURE OF INSPECTION

Please explain the importance of glass-container inspection.

Jeff Hartung, VP Inspection: As Martin has explained, identifying defects as early as possible helps to improve the glassmaker's efficiencies, while automation allows for fewer staff and reduced costs. Effective inspection and statistical information helps glass plants reach a 'steady state' more quickly – in other words, getting their pack rate back up to production levels following a job change.

But consumer safety is also very important. For example, defects like 'birdswings', can result in glass contaminants in the filled container. Glassmakers and fillers take extreme

Jeffrey D. Hartung

caution and make certain the equipment is detecting such defects. Or defects in the finish of a container can chip when the container is opened or handled. Obviously, these defects can be dangerous, and inspection equipment is designed to do everything possible to detect and prevent such defects from making it to the end user.

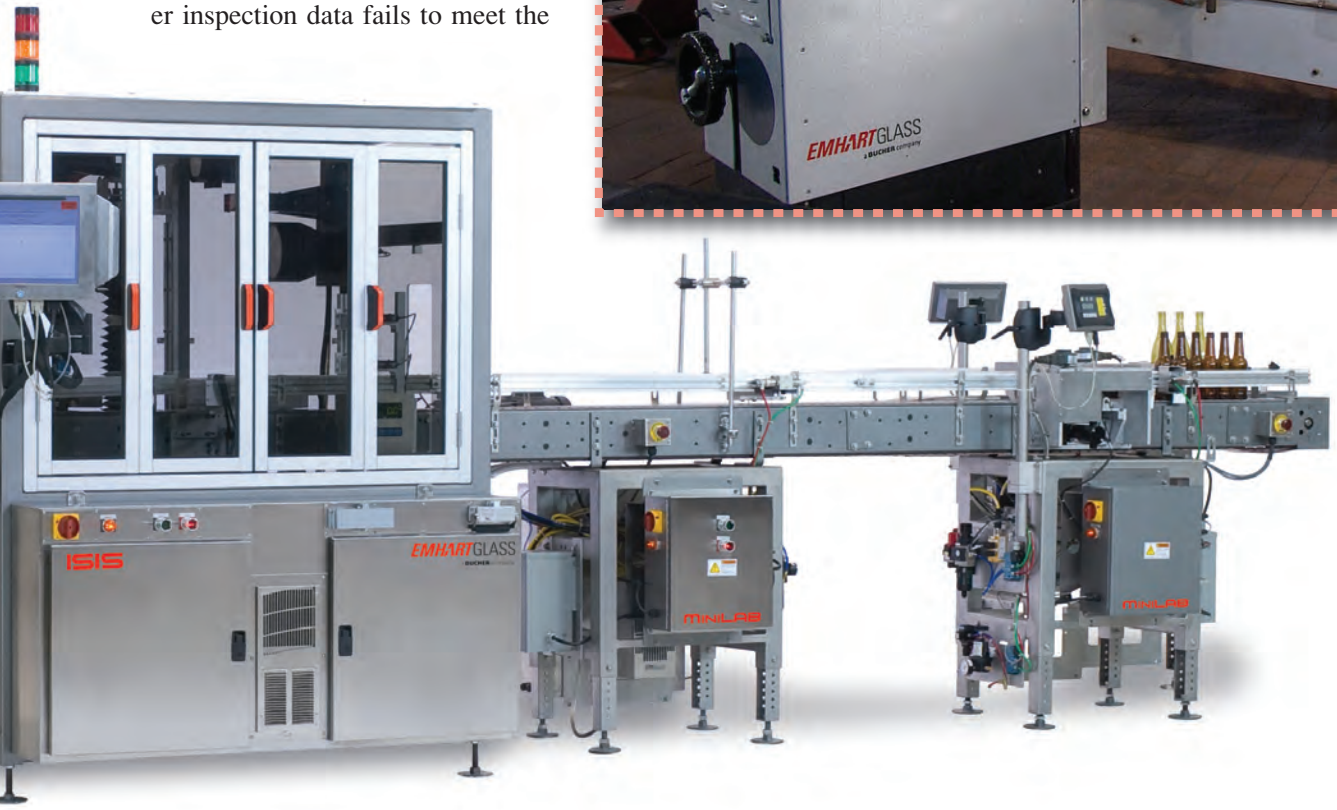
Different clients use our equipment in different ways. Some focus on ensuring their customers get the best possible quality by detecting and eliminating the defective containers, while others both eliminate defects and also use the inspection information to optimize the processes and improve their operational effieciencies.

Tell us a little about how it works.

JH: In basic terms, our machines use different types of sensor and vision technologies to inspect each container. The results of each inspection are then correlated into a data packet associated with each container. If the conatiner inspection data fails to meet the parameters established by our customer, then the container is rejected and recycled. The good container inspection results are added to the data packet and reported in statistical format to the bottle makers and quality personnel.

These days, inspection equipment can detect all the most common types of defects and ensure those containers aren't filled and shipped to consumers. The focus now is to what accuracy can the equipment inspect? And how well can the machine handle the grey zones of cosmetic quality - marginally good and marginally bad containers? In other words, the equipment needs to ensure the marginally bad containers are rejected while the marginally good are not. This requires the equipment to classify defects and have the precision and accuracy to fine tune the inspection sensitivity.

The number of cameras varies from machine to machine. In our sidewall machines we are generally

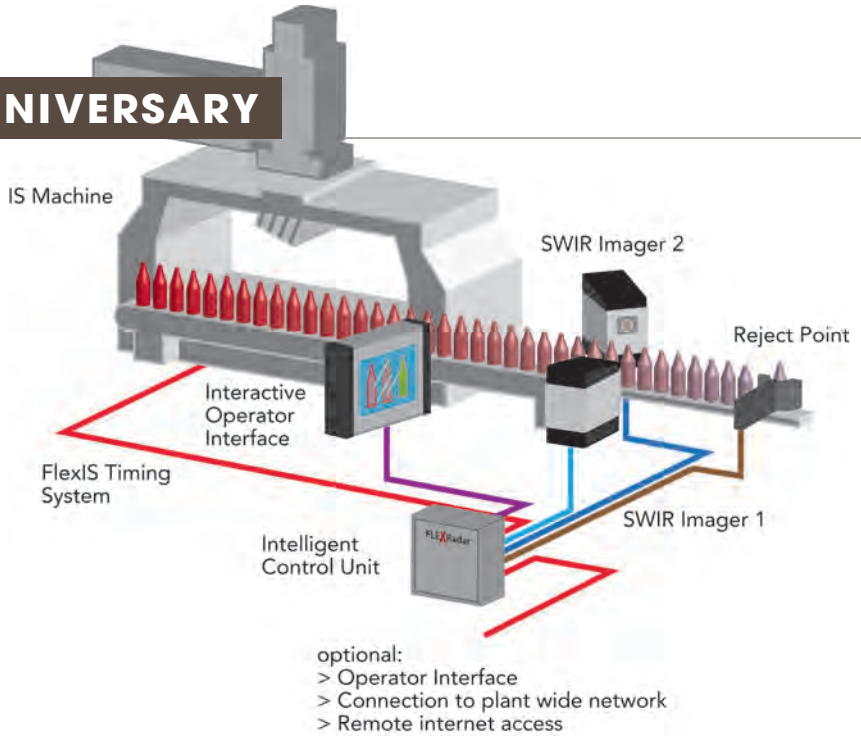


talking about 18 cameras, but six of those take two images, so that's a total of 24 images per machine – the equivalent of 24 cameras.

Typically, each IS machine will have two, or sometimes three inspection legs. It all depends on whether the machine is double- or triple, or quad-gob and the speed it is cutting and forming.

Currently we are working with technologies that can learn on the job – for example, they can learn a good container and when the inspected container differs from the good container we ask if the container is good or bad? From there a library of good containers is built. This helps improve inspection in embossed and decorative areas, pinch grips, and lug areas. In this model, the machine rejects the item because it's different from what it knows to be good, as opposed to rejecting it because it's bad.

In glass plants, depending on what industry type of end customer they are supplying, quality samples are removed manually from the production lines every two or three hours depending on the plant, taken back to the glass plant's lab to undergo gauging and measurements. Now, the Emhart Glass MiniLab provides a way to automate this process. The inspection machine can be instructed to choose containers on a periodic basis to be analysed by the MiniLab at the frequency determined by the plant. The MiniLab then reports the resulting information electronically to the plant operating system. Operators are not needed to pull samples, measure containers, transcribe numbers, or enter data, which means less human errors and lower labor costs. Statistical inspection machines have a slower throughput but are much more accurate. Instead of using go/no-go gauges, you actually work with



WRITING HISTORY

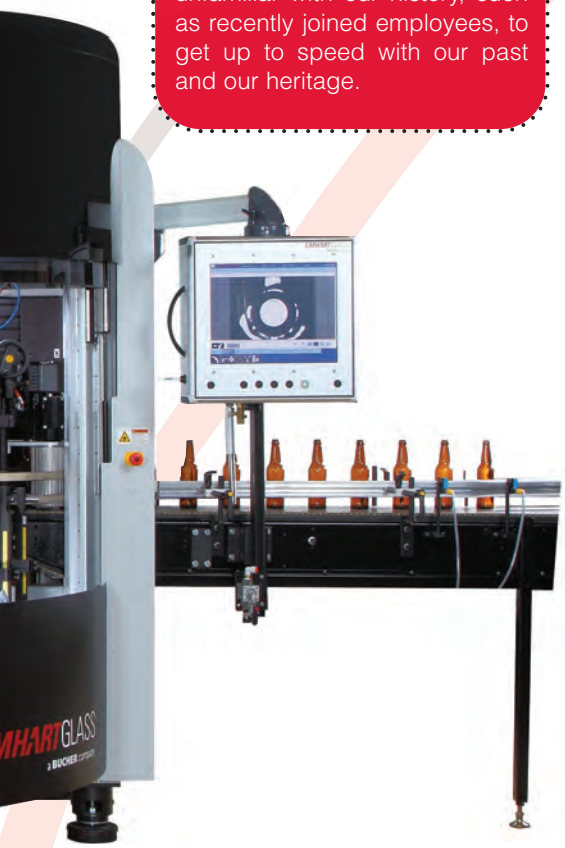
How much work was involved in the preparation of the book and movie for Emhart Glass' 100th anniversary?

MD: From start to finish, it took about nine months, including research, interviewing, writing, design and printing.

An important part of the project was speaking with industry veterans and Emhart Glass retirees around the world, including former executives and Presidents. Talking with them face to face helped us understand the background to the decisions that had been taken in past decades, as well as filling in the human side of our company's history.

Once all the proofreading and checking had been completed, we finally signed off the printers' proofs on 23 July. A few weeks later, we held the first copies in our hands!

The movie covers the same events as the history, but in a much more concise way. It includes lots of fascinating archive footage, as well as interviews with several of our former Presidents, and Martin Jetter. It's a great way for people who are unfamiliar with our history, such as recently joined employees, to get up to speed with our past and our heritage.



numeric values, which is an important advantage. You can see trends and correct issues before you are in a No-Go situation and need to put a mold on a reject list – saving the lehr of glass for that mold.

So, how near are we to achieving the perfect bottle?

JH: Well, defining perfect is done by our customers and their customers. We simply aim to assist them to achieve this in the most efficient and cost effective way. Some container specifications are literally books of parameters and standards. But a truly perfect bottle would be difficult to define – but I guess is defined as perfectly meeting the standard.

We have certain targets for capability and accuracy, and we design to those. For cosmetic and marginal defects, we provide configurations that will allow some customers to inspect more strictly while minimizing the loss of good ware.

Does inspection go hand in hand with the development of glassmaking machinery?

JH: Historically, within the glass plant, the Hot End and Cold End have been two distinct operations. Often, developments in each area were carried out by different groups of individuals and the teams were separate too. Emhart Glass is unique in that it has both under one roof – in one company.

Now, we are using this advantage and are exploiting our capabilities and facilities to see how we can bridge these two operational areas. The sooner the Hot End can take corrective action and prevent moulds from going on the reject list the less ware is lost in the process. We want to close some inspection/control loops within the Hot End, while bringing more information from the Cold End into the hands of the bottlemaker – but it's still at the working concept development stage.

Sometimes, inspection can be seen as a necessary evil. The heart of a glass plant, where the money is made, is in the HE. After all, our machines throw away the containers the IS machine makes! But that culture is changing, as people begin to see that better process control and feedback to the hot end will deliver better production efficiencies.

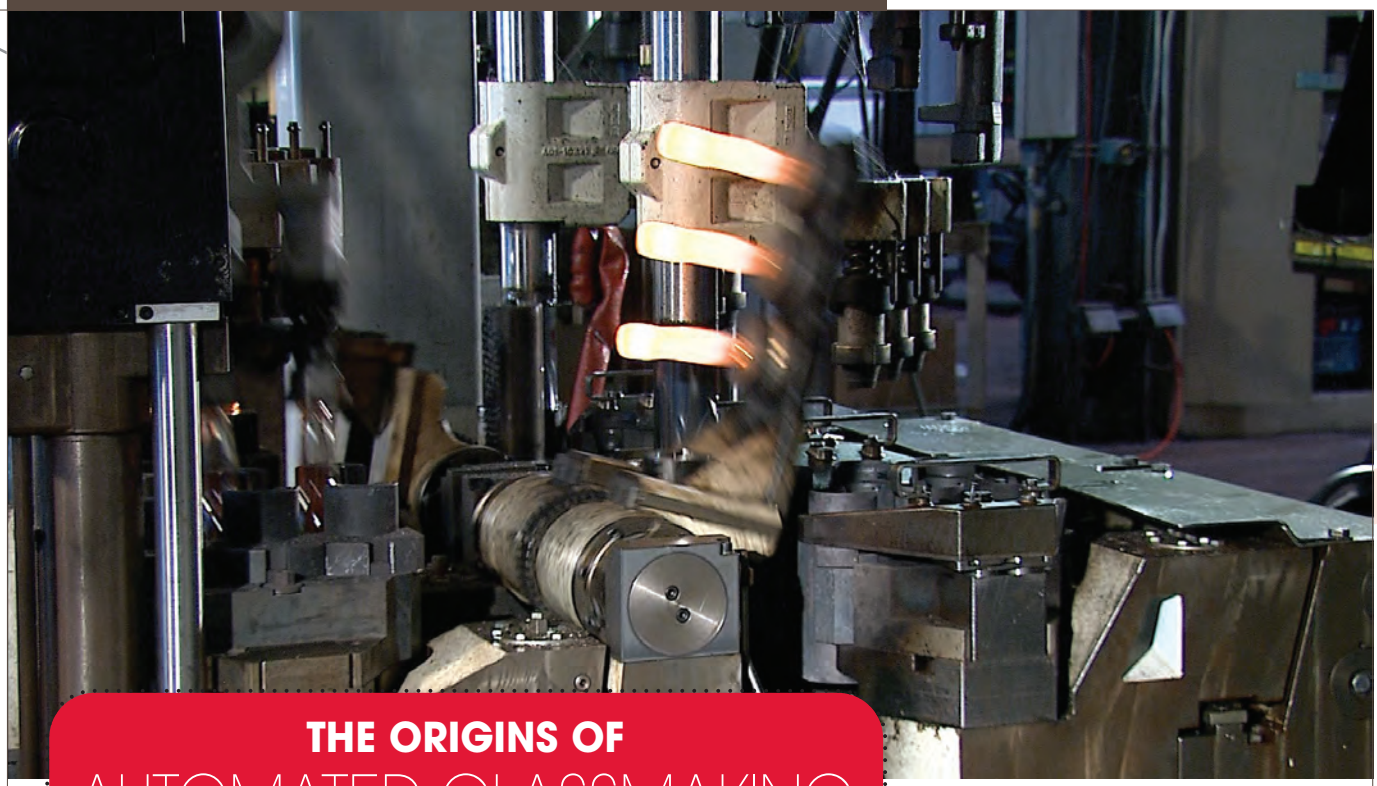
And what about inspection at the Hot End? What does that involve?

JH: Well, 'inspection' is probably the wrong word although that does occur with our equipment. You do take images of the container, but the real value exists in the statistical information, understanding statistical outliers within the set and making corrections automatically or manually within the forming machine controls before getting to a reject status.

The more you can do at the Hot End, the better, because the feedback loop is so much shorter. It takes 45 minutes to an hour and a half, on average, for a container to reach the cold end and be inspected and get the information back to the HE. So if you can detect problems in the Hot End, you can save an hour and a half's worth of glass per event.

Currently, there's a limit to the amount of inspection you can carry out at the Hot End because you can't handle the bottle, but you can use infrared and different types of vision technology to acquire images and compare them. Such a two camera Hot-End system is not capable to observe view the full 360° container and therefore giving limited inspection results.

In addition, however, some defect types – checks – do not totally manifest themselves until they have gone through the annealing lehr, so for now anyways one has to do some type of inspection at the Cold End.



THE ORIGINS OF AUTOMATED GLASSMAKING

Emhart made the first real machine to make bottles completely automatically. How were they made before that?

MJ: Originally, bottles were made by hand, with manual blowing, which was troublesome, laborious and very slow.

In 1902, Owens (now *Owens-Illinois*) invented a machine for making bottles that today we would call 'semi-automated'. It was very expensive and difficult to operate, and it still required a lot of manual labour. But it was the first step towards automatic glass-container making.

The next step was the IS machine, invented by Emhart Glass. It hugely improved the process, and soon displaced the Owens machines from glass factories. So while Emhart Glass can't take all the credit for automating the glass-container industry, we can certainly claim to have invented the first fully automated and efficient IS machines.

Do quality levels differ around the globe?

JH: It's not so much down to geographical location although that may have some influence but is not a universal, but rather the industry and market segment that the container manufacturer is supplying as well as the specific requirements of the filling company.

Quality standards are increasing in the emerging economies – pressures to be more efficient are increasing also. Markets are evolving very fast and making new demands, which means that companies have to improve and respond quickly to the new standards. In some cases, companies from the west are opening production units in these developing countries and as a result more stringent standards become part of the game.

The local market in China is a very difficult market to compete in unless you are on the ground in China. Now, Emhart Glass has a joint venture with Sanjin to serve the domestic market there.

What could be the next step in inspection?

JH: One of the 'holy grails' of inspection is to inspect without handling the container. At present, for some types of inspection, such as wall thickness and check inspection, the containers still have to be physically rotated. And the other important step, as I've mentioned, is to have more inspection at the Hot End, where the containers are being manufactured.

Vision technology has really changed glass inspection and that was a big step in the industry – from mechanical to visual inspection. Additionally, increasing what is automated is important too – saving manpower in the CE helps our customers decrease their costs. Other technologies are getting more and more accessible and will provide a new "leap" for inspection. The machines are getting more and more powerful and at faster speeds. For glassmakers, our customers, it all adds up to improving efficiencies, reducing costs and achieving the highest possible quality levels. ■