IS machines: 80 years of continuous improvement

The IS machine has been continually improved in response to growing demands from its users and the requirements of the glass container market. Many new product ideas have been tried, but today the original 'two step' IS glass container forming process still holds industrial acceptance. Leo Diehm* reports.

In 1924 an engineer named Henry Ingle from the Hartford Empire Company (the ancestor of today's Emhart Glass) filed his patent 1'843'159 for a glass blowing machine, today known as the IS (individual section) forming machine. Three years later, after an intensive programme of research and development, the first commercial 4 section IS machine was installed at Carr-Lowry Glass Company Baltimore (see ***fig 1***).

Over the following 80 years the IS machine was continually improved in response to growing demands from its users and the requirements of the glass container market. Other new product ideas were tested but the flexibility and performance of the individual section concept ensured its domination of the industry, outperforming other ideas.

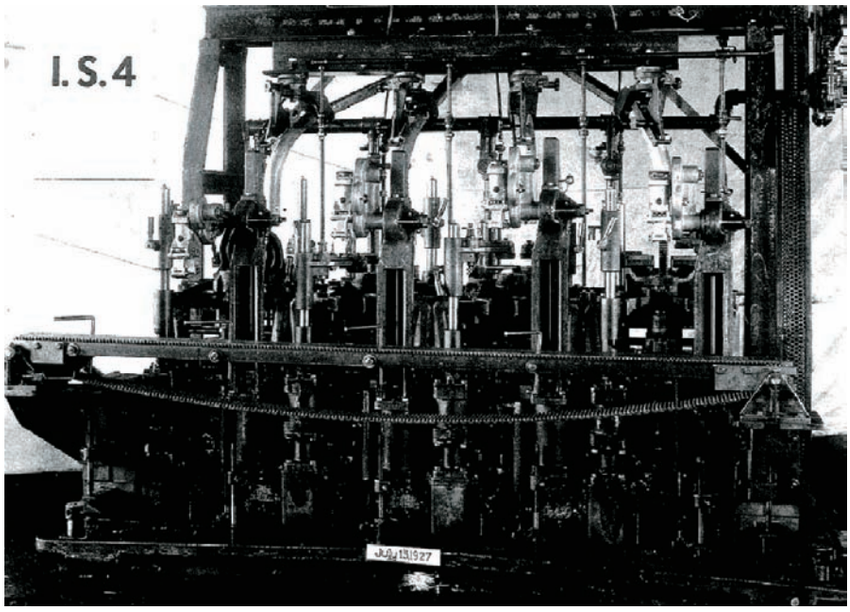

Fig 1. 1927: The first commercial 4 section IS machine.

Driving development

The IS machine evolution started in 1927 with a pneumatic 4 section Single Gob (SG) machine. As a first step the IS machines were 'enlarged' to 6 sections. In the 1950s, Double Gob (DG) became available, followed around 1967 by moving to larger centre distances ($5^1/_2$in DG, $6^1/_4$in DG) so that larger containers could be produced in DG. In the mid 1970s the Triple Gob (TG) was introduced at $4^1/_4$in and 3in centre distances.

Electronic machine timing systems started to supersede the inflexible timing drum, while the first parallel-movement mould open and close machine was introduced to reduce process variations. In the 1980s and 1990s the development pace accelerated: focus on cooling efficiency and better predictability led to more advanced cooling systems, higher production speeds and improved container quality. A variety of pneumatic, electric and hydraulic servo mechanisms were developed with the aim of achieving higher outputs with more precise and repeatable motions. Further improvements resulted from the introduction of programmable motions which increased overall flexibility while avoiding unpredictable operator adjustments. During the last few years ever more flexible machines have became available, allowing changes in process (NNPB, BB, PB) and even machine centre distance in less then a shift.

After 80 years of continuous progress, the benchmark has been raised to 12 section servo electric high performance machines producing in 95mm Quad Gob (QG) or 5in TG.

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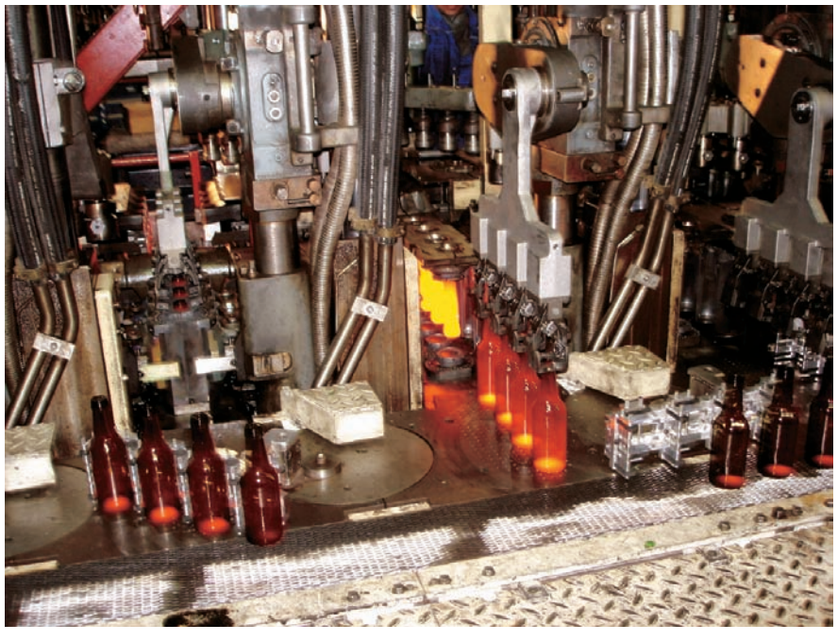

Fig 2. Servo electric 95mm 10 Section Quadruple Gob machine.

It is clear that improved Return on Investment (ROI) has driven IS machine developments, and continues to do so. For its part, ROI is driven by higher performance, better quality and increased flexibility.

Best fit IS machine

Selecting the right IS machine is a complex question and many different aspects have to be carefully considered. Making the correct decision is key to the success of a glass plant.

The 'best fit' machine means being able to adapt to an unpredictable glass container market. Major factors such as the strengths of global and local economies, glass consumer behaviour, regulations, other packing materials, energy costs, competing producers and filler strategies, results in a continuously shifting market. It is therefore difficult to predict the type of container that a machine should be producing one year later, far less over the life of the equipment.

The best fit IS machine will optimally balance the specific needs of a plant, giving maximum performance, producing highest quality and providing the required flexibility. During the evaluation process many questions need to be answered including equipment standardisation, the intended ware range and any deviations, transition cost to any new standard, investment and operating costs and expected ROI.

One of the key factors is bottles per minute performance. Estimating for the planned containers realistic production cycle times, multiplied with the planned number of cavities and adjusting for production efficiencies (pack to melt) results in projected sellable bottles per minute. An example of 90% pack to melt line efficiency on ***Fig 3*** indicates approximately production losses of 8.5%, directly or indirectly related to the IS machine. Down time, hot end losses, as well as the 'produced' and rejected defects are the 'money down the drain' contributors. Job change and work out time and swabbing losses are also partly connected to IS machine performance.

In assessing the ROI one factor is frequently underestimated or ignored the total cost of ownership. The maintenance cost, equipment life time, production flexibility, downtime and upgradeability are important elements which are just as important as the initial investment.

A closer look to the latest IS machine trends should be made because all the complex decisions made by the different glass plants should be visible and reflected in an IS machine trend.

Current IS machine trends

Trends in the IS machine market are determined by the buying patterns of the major glass producers who set the industry benchmarks. This is best seen by examining the current IS machine portfolio of Emhart Glass (see ***fig 4***).

Unsurprisingly, the trend for ever more cavities is unbroken. TG is

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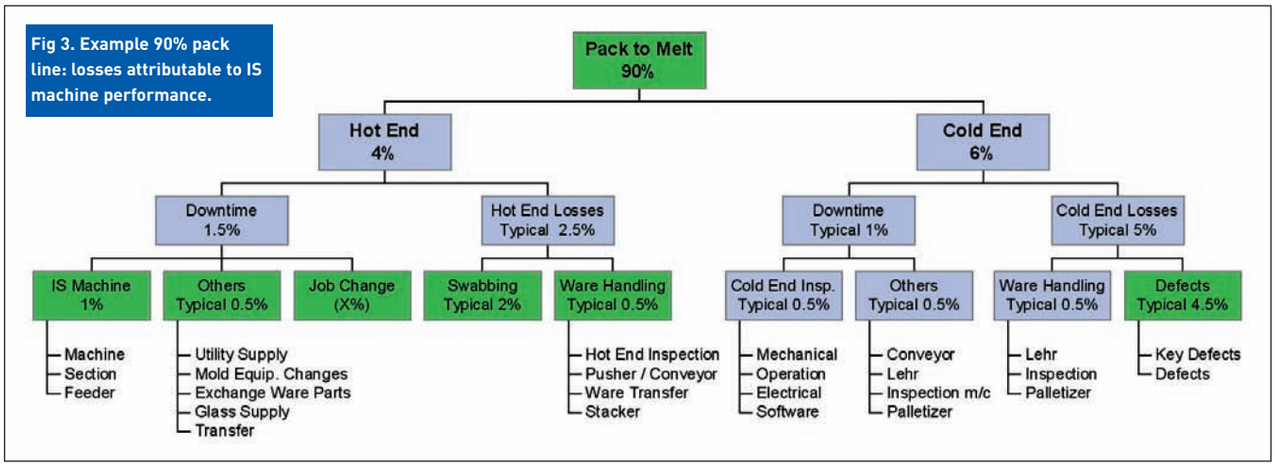

Fig 3. Example 90% pack line: losses attributable to IS machine performance.

Type	Name	# Gob	Center	Market Introduction	# of Sections 6	8	10	12	16	Machine powerd mainly by	Mold open & close
	NIS	QG	95mm	2005						servo electric	parallel
		TG	5"	2000							
		DG	6 1/4	2000							
		SG									
	6 1/4	TG	4 1/4	1976						pneumatic servo options	parallel
		DG	6 1/4	1976							
		SG									
	5 1/2	DG	5 1/2	1967						pneumatic servo options	arcuate
		SG		1967							
	6 1/4	TG	4 1/4	1969						pneumatic servo options	arcuate
		DG	6 1/4	1969							
		SG		1969							
	5"	TG	85mm	1997						pneumatic servo options	arcuate
		DG	5"	1985							
		SG		1985							
	4 1/4	TG	3"	1977						pneumatic servo options	arcuate
		DG	4 1/4	1950							
		SG		1927							

▲ Fig 4. Current Emhart Glass IS machine portfolio.

already standard in many cases and an absolute requirement to remain competitive. Today, even the previous obstacles to QG operations are disappearing. We see a similar situation with the number of sections, which has been increasing steadily ever since 1927. Today the minimum specification for a new high end IS machine is typically 10 or more sections in TG.

Machine type trends

■ *IS 5in DG convertible to 85mm TG or SG*

Interchangeability of centre distances within less than one shift offering exceptional production flexibility (extended ware range), combined with high performance and no quality compromises makes this type hard to beat. The ability to use existing 3in TG moulds on the 85mm TG configuration and 4¼in DG moulds on 5in DG, supersedes the 4¼in DG and 3in TG configurations. It is a merger of two machines, without the impact of a transition cost.

■ *AIS 6 ¼in DG convertible to 4 ¼in TG*

The parallel mould open and close on blank and blow side, optimised pneumatics, available servo mechanisms and the centre distance convertibility makes it the best conventional machine on the market. High container production quality, low maintenance cost, exceptional reliability and huge reduction in mould equipment wear (cost of ownership) are some of the factors why AIS customers come back for more.

■ *NIS 5in TG convertible to 95mm QG and 6 ¼in DG*

Since the introduction of the first servo electric IS machine the product line is now fully grown. There is every reason to believe that it will turn into a major trend since the need for ever increasing container production demands higher performance and sets the benchmark. Performance also drove the introduction of the QG configuration. The extended ware range now stretches from the typical 5in TG 'wine bottle' centre distance, to a 95mm QG configuration for the huge NNPB beer container market. Advanced servo technology reduces process variations while increasing reliability and total output, thus outperforming conventional machines. Producing wine in TG and beer in QG by converting the machine centre distance in less then a shift is an outstanding feature. Currently three NIS 12 section QG machines are setting new benchmarks.

Conclusion

The improvement process which started 80 years ago, with the commercialisation of the first 4 section IS machine, is still running strongly. The original 'two step' individual section process invented by Emhart Glass in 1924 has stood the test of time and remains the only accepted container forming process.

Although the basic process is the same, the IS machine has changed enormously. Driven by the need for ever larger, faster, more reliable and more profitable machines, the numbers of cavities and sections have steadily increased. However, even more dramatic improvements have been made in terms of control and flexibility. The result is higher output, accompanied by greater reliability and a far better capability of continuous adaptation of the machine configuration to meet changing market demands.

The improvements of the past 80 years have been driven by the needs of manufacturers and the industry as a whole. There is every reason to believe that this development process will continue. ■

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