Emhart Glass SA, Cham, Switzerland

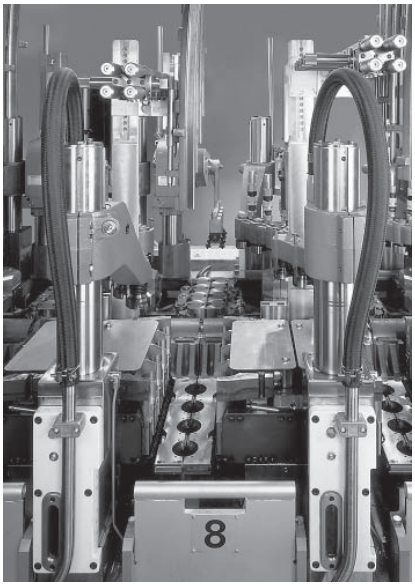
NIS – The Machine for the Future

By Alan Fenton, Emhart Glass RD&E

Today's need for high-speed production is pushing the process limit of the IS machine and its control systems, while the need to cut costs is pushing reductions in skilled factory personnel. This trend will pressure container glass manufacturers to further reduce costs and increase production output and speed. Two developments by Emhart Glass, the NIS machine, the first of a generation of servo electric-operating machines, and the FlexIS forming control system, offer a new future for the glass container industry that will allow the industry to achieve further cost savings, as well as productivity improvements.

The NIS Machine

The NIS machine, in its original form, was conceived as a 5-inch TG machine. This center distance allowed the production of a wide range of containers – from 60 to 95mm diameter.



The NIS machine features parallel mold open and close mechanisms on both the blank side and blow side (shown here in quad gob configuration), which enables more precise control of blank and blow mold movements. Photo: Emhart Glass

Today the NIS is available in 8-, 10-, and 12-section configurations, including 95mm Quad Gob (QG). In a quad gob configuration, the NIS is capable of producing beers, sodas, and food jars up to 65mm diameter. With adequate ware handling, the NIS in QG configuration is capable of up to a 30 percent increase in production compared to TG operation.

The NIS machine, because of its servo technology and the unique design of its mechanisms; offers a number of clear advantages over conventional IS machines.

- The container-making process can be fully optimized.
- Job change and work out times can be reduced.
- Ambient and machine noise can be lowered.
- Future degrees of automation are now possible.

Operation Improvements

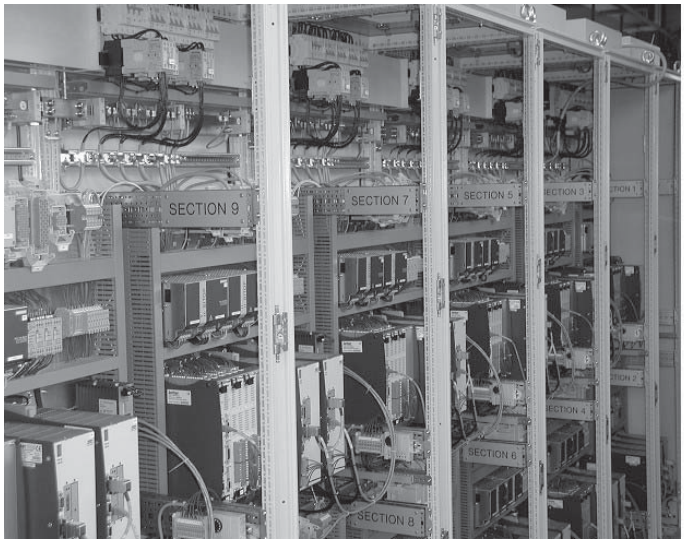
Servo technology ensures that a mechanism's motion is both programmable and extremely repeatable in time of operation and motion profile. Mechanism motions can be designed for specific containers. For example, mold opening distance can be reduced for a small diameter container and increased for a large diameter container. The downward force on the blowhead, as it sits on the blow molds, also may be reduced to zero or just enough to partially lift the blow head to improve internal cooling. The same is true for the baffle, except where a two-step operation of the baffle is used in conjunction with a Vee Baffle, which is designed to eliminate the use of the funnel in the Blow and Blow process. This produces containers without the customary mark in the base of the container produced by Valve-in-Baffle operation on the IS machine.

Servo takeout technology, allows precise adjustment of the takeout in and takeout out positions, as well as adjustment of the kickback position to minimize take out in time.

Similarly, the servo invert enables precise adjustment of invert and revert position, but it is also possible to stop the inverting neck ring arm on an NIS machine. This allows the operator to change the neck rings on the blank side of the NIS, rather than on the blow side over a moving column of hot bottles as it is done on an IS machine.

Finally, servo technology allows optimization of the container process not possible on an IS machine.

The precise motions of a fully servo operated machine mean that the interaction of the mechanisms can be timed so that collisions are avoided by the narrowest of margins (these points of contact are referred to as collision zones). "Dead time" is minimized. At the same time, it is now possible to adjust the forming times of the process by adjusting groups of mechanisms. Thus the process is



The new FlexIS control system enables more precise control of all forming operations and increased opportunities for production optimization.
Photo: Emhart Glass

adjusted – blank time, reheat time, mold time, rather than individual mechanism times. This, alone, simplifies the "art" of making the container and maximizes productivity.

FlexIS Enables Further Optimization

The introduction of the new FlexIS forming control for the NIS helps glass container manufacturers to further optimize the glass making process. FlexIS is a modular and, thus expandable, system that takes into account the future use of closed loop control strategies that will eventually lead to dramatic reductions in operator intervention and troubleshooting.
FlexIS adds a new level to glass container forming control.

- It can monitor the machine's mechanisms' motions and positions.
- It can monitor the servo axis temperatures and currents.
- It can statistically analyze trends and warn the operator of an improper motion characteristic.
- It can store all actions. With future, planned algorithms, the control system will learn and eventually be able to self-correct some process deviations.

With the use of servo-electric driven mechanisms and advanced control algorithms of the FlexIS, closed loop controls driven by expert systems become a real possibility for future glass plant operations.

Shorter job change work out times

A servo mechanism is rarely affected by changes in the ambient conditions of the machine, as is the IS machine. During a job change, an IS machine cools down. This, in turn, affects lubricity of the lubrication, bearing fit and other mechanical interactions. At the end of a job change, the mechanisms of an IS machine have to be adjusted once to start the machine from its cooled condition and again when it reaches its working condition. This is not the case with the NIS. Servo mechanisms have motion times assigned, and the mechanism maintains itself to always achieve that motion time. Therefore, once set, the motion never changes, therefore, the job change work out time is reduced.

Reduced Noise

To anyone who has worked around an IS machine, noise generated by the machine and associated equipment requires the use of hearing protection. An IS machine, equipped with only "stack wind cooling," generates the highest noise levels. A machine equipped with a system, such VertiFlow or axial cooling, has significantly lower noise levels.
With a fully servo driven machine, such as the NIS which is equipped blank side and blow side VertiFlow cooling, the noise level is even lower because noise from exhausting the pneumatic mechanisms is eliminated and all noise from mold equipment impacts is controlled.

Automation Potential

Perhaps the most important aspect of the NIS machine, the FlexIS forming control system, and the developing use of servo technology in automating the glass industry, is the potential for automating the glass plant and improving its versatility and efficiency.
The key difference between a conventional pneumatic IS machine and a servo driven machine is that, with servo mechanisms, the machine always knows where it is and what it is doing. Motion, time position, and power usage all are known, and under the control of the machine controller. This then, allows specific motion profiles to be applied to mechanisms, assignment of positions other than the full stroke of the mechanism, and programming of force applied. Full

and efficient use of the glass forming cycle is now possible to maximize forming time and minimize dead time. Going a step further, the NIS and FlexIS open the door to the possibility of a fully automated glass plant. For example in a plant producing containers 24 hours a day with three shifts, one shift (day shift) can perform all job changes and most maintenance. The other two shifts become "ghost shifts," in which one operator supervises three or four machines from a central control point. There is little need for a full maintenance staff and no mold maintenance.

To be competitive with other packaging types, the glass container industry must improve its efficiency. The working environment around the machine is dirty and arduous, and the aim of automation should be to remove the operator from this environment as much as possible to reduce labor costs and make the remaining jobs more appealing.

How could this be achieved? First, the process needs reject systems to interrupt the process throughout the forming cycle. For example a servo gob distributor can interrupt delivery of the gob to any section of the machine. It also must be possible to reject the formed parison before it reaches the blow mold. A defective container should be rejected at the dead plate or before the lehr.

With these systems in place, using video surveillance at the machine, an operator could supervise a number of machines remotely. Then from this remote position, the operator can detect a fault (or if he receives information from inspection of a fault) and interrupt the cycle of a particular section and send a technician to correct it.

The above is a very simplistic description of an automated glass plant but with a servo driven machine like the NIS and the new FlexIS forming control system for the NIS, as well as carefully thought out production systems, an automated glass plant is now a possibility.

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