The N.I.S. machine and the future

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THIS ARTICLE DISCUSSES THE DESIGN AND DEVELOPMENT PHILOSOPHIES OF EMHART GLASS AS REPRESENTED IN THE NEXT GENERATION I.S. MACHINE (NIS™), AND THEIR VISION OF HOW IT MAY SERVE AS THE BASIS FOR FUTURE PROCESS AUTOMATION.

The NIS Machine and Controls system was introduced in 2000 with the goal of setting the next standard for glass forming machines and for future investment in the glass container forming industry. In addition to the high capacity for which the 5-inch triple gob machine was designed, the NIS provides a platform for the state-of-the-art process control that Emhart Glass believes is needed in the glass industry.

With the advent of servos and associated controls, the NIS machine has demonstrated that better control of the forming process and higher productivity are attainable goals, and Emhart Glass believes that this technology is the foundation on which future plant automation will be built. In the coming years, as further advancements are made in sensor technology, an even higher level of automation will be achievable.

The heart of the NIS concept is electric servo technology. The great advantage of the servos and their associated controls is the precise and accurate command that can be achieved over the machine and the process. What was a (more or less) "open" timing system on pneumatic machines, can now be closed and operated in real time. The mechanism motions (profiles) can also be controlled precisely and optimized for best performance - as defined by process requirements. "Best" can mean anything from minimizing motion time, to minimizing stress on the glass. In some cases, it could also mean running as slowly as possible with-

out affecting the non-time-critical events in the process. In addition to motions and timing, the various forces used for items such as clamping molds can be optimized. This means that they can be electronically adjusted to precisely deliver what is needed for the process - thereby minimizing the wear on not only the mechanisms and machine, but the mold equipment as well.

Knowing when events have completed (and not just when they were instructed to start) has allowed not only for tighter control of the forming process, but also has allowed for full job repeatability, and faster job change and "workout" times. All of the mechanism motions and speeds that historically have been adjusted via pneumatic controls (regulators, flow/speed controls, cushion controls) are adjusted and stored electronically. A job change can be as short as changing mold equipment and loading the job. Any environmental changes such as ambient temperature, humidity etc. that have occurred since the last time the job was run are automatically compensated for by the control system eliminating the need for mechanism "tuning". Running adjustments on the machine are also not necessary since the controls are constantly monitoring the machine performance and adjusting for the various short and long-term disturbances that occur. These disturbances and changes include items such as mold equipment wear, mechanism wear, and some thermal changes. This automatic monitoring also helps to reduce defects by making the machine operate within the parameters that have been set.

Having control of the mechanical motions, profiles, forces, and a built in real-time monitoring have resulted in obvious benefits to the production process. The machine and controls have been designed such that a migration to a process variable control is possible. Bottlemakers of the future will probably not need to concern themselves with "on" and "off" times of events in a sequence, since they will interface with the machine by adjusting the thermodynamic process. Today, a simple adjustment to a particular thermal time requires the adjustment of several "events" in most cases. On the NIS Machine, this will eventually become a single entry on the interface computer. In the background, several sophisticated calculations will be made in order to accommodate the user's request for a process variable change. Going hand in hand with this feature will be the ability to easily optimize the machine cycle to a "best fit" for the container being produced.

Full automation requires that all process variables are monitored and can be controlled without human intervention. A full understanding of the forming process is also a must. Through state of the art computer simulation and modeling techniques, much of what was not fully understood about the forming process is now well understood and proven mathematically. Thanks to advances in computers, containers can now be formed completely in simulation to predict process times, speeds, and even final container shape and glass distribution. By embedding this knowledge into the controls system, adjustments to the forming process can be made programmatically as opposed to the manual way operators must adjust mechanisms today.

The pace at which automation can be achieved will be based primarily on technological advancements in sensors and feedback devices. However, more information about the containers and other inputs to a given process will be needed before fully automatic control can be made available. In the short term, much more information about containers will need to be collected and fed back into the hot end for processing. As technology advances, more and more of the process will transition to continuous online monitoring and correction as far upstream (in the hot end) as possible. This will dramatically reduce the number of defects due to process variation by detecting them before the lehr. In many cases, defects could be eliminated completely by this type of approach.

Beyond the immediate benefits of the NIS, such as providing more and better control of the machine and forming processes, is the machine's capability to support a migration toward automation. For obvious reasons, full automation is not possible with a pneumatic machine. The servo-controlled motion offered by the NIS, however, is a required building block in the process. Coupled with process knowledge stored in advanced control systems, the possibility of high-output, highly efficient automated operation of the forming process is becoming more science than science fiction, and Emhart Glass expects the NIS to lead the way.

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