Christian Fröba, Emhart Glass SA, Cham, CH

Optimization of Container Production with Plunger Process Control

The glass container industry today is facing high demands of product quality. Frequently glass container manufactures are confronted with quality issues in different areas, those applying narrow neck press and blow (NNPB) as well as wide mouth press and blow (PB) process are often experiencing finish defects. These defects often have there origin in parison forming process. The industry currently has limited means of controlling this vital process.

The new Emhart Glass Plunger Process Control (PPC) provides for the first time a complete visualization of the parison forming for narrow neck press and blow as well as wide mouth press and blow. The system records continuously the entire plunger stroke on all cavities across the machine in real time, as the plunger actually travels through the glass whilst forming the parison.

PPC also provides a precise gob weight control through automatic feeder tube height adjustment and optional needle height adjustment. The wireless connection from base plate adapter to plunger mechanism with full stroke sensor eliminates the risk of cable damages during a mechanism exchange. The Emhart Glass PPC system permits early detection of currently unknown variations in the NNPB and PB process, offering the potential to improve production quality. Especially finish defects can be detected and rejected by using the innovative software features and the automatic Hot End Ware Reject (HEWR).

Precise Plunger Position Detection

The full stroke sensor integrated into the Emhart Glass Quick Change Plunger Mechanism is the signal source of the system. The ceramic sensor tube carries at the inside a copper surface, which represents capacitor electrodes, influenced by a metal tube mounted inside the piston rod and surrounding the ceramic tube. A coil is connected inside the lower flange of the ceramic tube. Coil and capacitor in connection with the adapter plate create an electrical oscillator circuit. The capacity changes relative to the position of the piston which leads to a change in the resonance frequency of the oscillator circuit. The adapter plate is mounted on the plunger base plate and supplies the oscillator circuit of the sensor with energy wirelessly. The position signal is modulated onto the energy supply and transferred with one cable per cavity from the adapter plate to the master unit. This is a very stable method of position measurement and signal transition which makes PPC very reliable.

Piston and Rod with Full Stroke Sensor. Photo: Emhart Glass

Full Stroke Visualization and Production Tracking

The acquired signal is then, in real time, processed and analyzed in PPC Master creating valuable information about the parison forming process. Several screens at the Master are displaying this information and making them a quick and easy reachable source for process improvements.
The Status History screen virtualizes the selected plunger stroke.

①: The Master splits the entire stroke automatically into seven significant parts of the motion. The color coding of these intervals is consistent with other screens and allows the operator easy understanding of the process.

②: All important process parameters are displayed numerically and graphically and recorded every stroke with the production time. Limits of this values can be set which activates the Hot End Ware Reject (HEWR) in case of violation of these limits. This allows rejecting defective containers already at the hot end. As these data are available immediately the operator can react quickly without waiting until the defect might be detected at the cold end. This saves valuable time and helps increase the overall efficiency of the production line.

③: In the upper part of the screen the entire production recording is displayed. Abnormal production like violations of process parameter limits are marked with colors.

The Status History screen virtualizes the selected plunger stroke.
gray: reverse position – white: motion into loading position – blue: stop in loading position – dark red: fast upward to press – yellow: transition into final press – light red: final press – green: fast downward to reserve position

Photo: Emhart Glass

Easy navigation and recall of the stored process parameters and stroke visualizations is possible within the entire production time. A transfer of all the data to a standard PC is possible for permanent storage of the information. This allows a production tracking, which was not possible in the past.

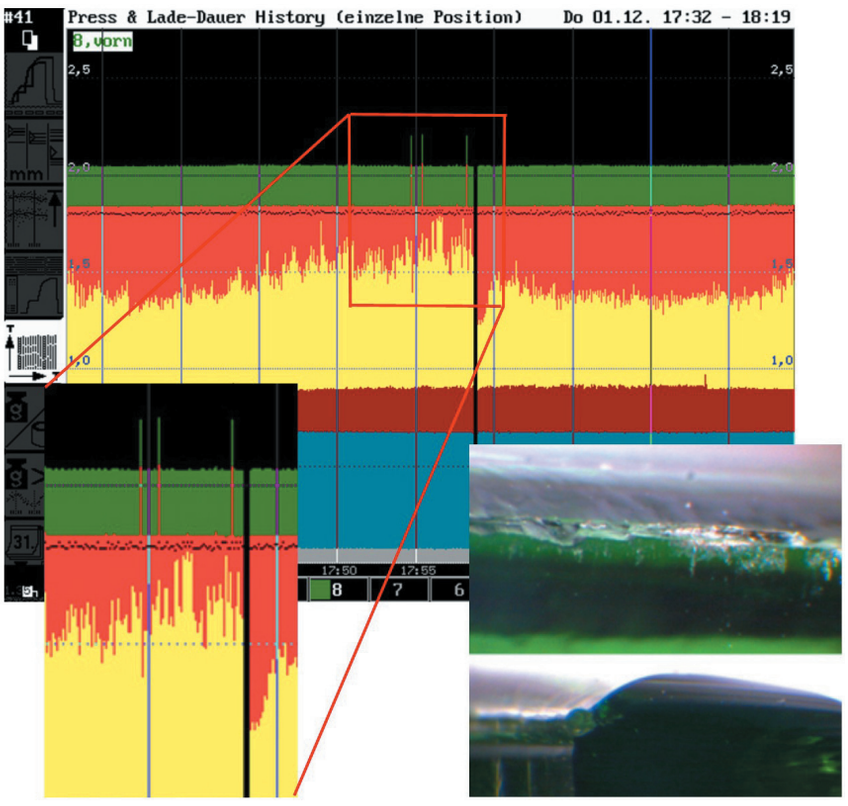
The connection to the plant wide information system, transferring weighing and HEWR information is closing the loop to integrated quality control.

Visualizing Process Variations

The Press and Loading Duration History screen shows the previously color code stroke visualization scalded by time. Each line represents one plunger stroke. This kind of visualization enables to determine long and short term deviations in the press duration behavior of the process, for example during swabbing, changing the molds, differences in cooling and press force as well as any changes at startup of a section.

In the light red "area" interval representing the final press duration a small black point is drawn. This visualizes the time, when the highest press position has been reached. This is a good indication of process stability as the more of these black points build up a horizontal line, the more stable is the plunger end position. The more the black points deviate, the more unstable plunger final press position is which shows variations during the parison forming process.

The effect of parameter adjustments can be seen immediately as this screen gives a very good overview about the current production condition on all sections as well as any drifts which



The Press and Loading Duration History screen.
– detail
– finish defects

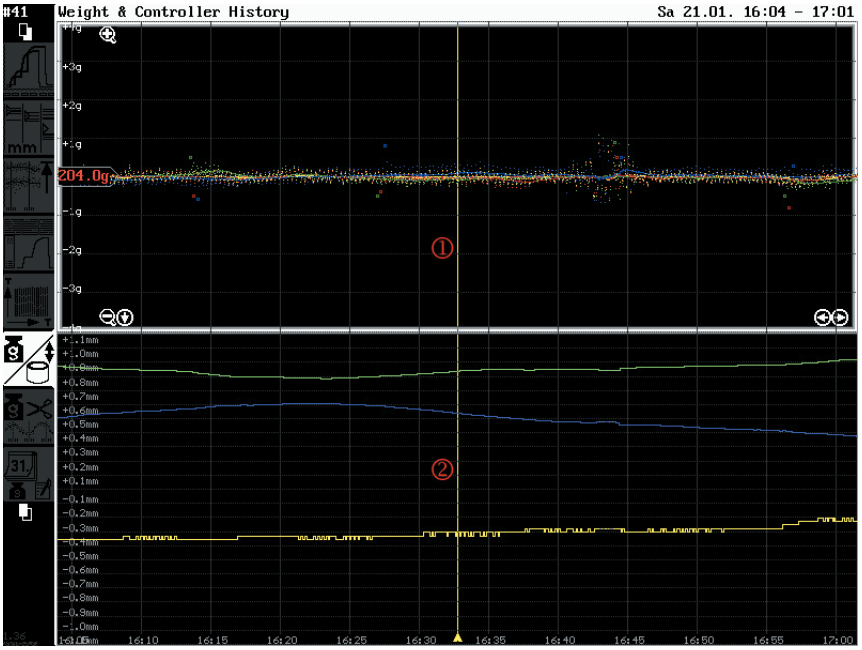
Photo: Emhart Glass

may only appear on one section. With experience, this information will allow conclusion about the machine adjustments and function/malfunctions of the machine, lubrication system and associated equipment like feeder and shear.

Precise Gob Weight Control an Essential Factor for NNPB and PB Production

Stable gob weight is one of the key factors for successful NNPB as well as PB production. Equal gob weight cut by cut without variations reduces the risk of producing critical defects right from the beginning. Customers experience shows that the PPC gob weight control works very stable using advanced control algorithms to adjust the tube height in NNPB as well as PB process. For higher precision demands the needle height can also be controlled individually. PPC manages to keep the gob weight very constant even with unstable upstream production processes like variations of temperatures in furnace and forehearth.

①: In the upper part of the Weight & Controller History screen the weight of each gob is visualized as a dot.



Weight and Controller History screen. Photo: Emhart Glass

②: In the lower part of the screen the controller history is recorded showing all adjustments made by the tube height control loop or one of the two needle height control loops at this TG installation. While PPC is taking care of the gob weight, the machine operator can concentrate on keeping the production and quality at a high level. All of this increases the acceptance of advanced technology in the glass plants.

In order to meet the quality demands of the packaging industry today and in future, process control and automation will be a major factor. Emhart Glass offers with PPC a valuable tool for NNPB and PB production optimization. Using PPC means producing good quality at the hot end instead of selecting for good quality at the cold end.

Further information:
Emhart Glass SA,
Hinterbergstrasse 22, PO Box 5361,
CH-6330 Cham, Switzerland,
www.emhartglass.com
The author Christian Fröba is actively as a Product Manager Plunger Systems at Emhart Glass AG.