Smart Feeder

Encouraged by specialised glass plants with experience in multi article production, Bucher Emhart Glass has invested in setting up production with a multi gob application.

Multi gob weight production was already supported on a basic level by the first FlexIS controls generation. The current FlexIS generation, with its newly built User Interface, supports a true multi article setup. On this basis, a further supportive tool, the Multi Gob Application (MGA) was integrated into the controls system.

The MGA allows the operator to define a desired sequence of gob weights and then calculates the optimal settings for the feeder. This may sound easy, but changing the feeder settings for one gob can influence the previous or the next one in the cutting sequence.

The MGA algorithms provide a solution to this problem, no matter how the weight sequence has been defined by the operator. This is already a great help, but still requires a certain number of weighing to fine-tune the result. Automatic weighing could resolve this issue while additional gob measurements would also be welcome. To meet this need, Bucher Emhart Glass (BEG) is currently developing the Smart Feeder product, which is a fully closed loop controlled feeder system to form the desired target gobs, including gob weight, length, shape, and tilting control for each individual section. The BEG GobRadar will serve as the gob sensor for the Smart Feeder system (***Fig 1***).

GobRadar

In 2019, Bucher Emhart Glass completed the acquisition of Symplex Vision Systems, which expanded the BEG inspection capability in the hot and cold ends. The GobRadar is one member of the vision systems family. The GobRadar system is installed under the gob shearing system to provide real time gob information, including: gob weight, length, diameter, 3D shape, gob tilting angle, gob drifting, and gob temperature for every individual cut. The GobRadar system itself offers the capability of pure gob weight control through tube and feeder plunger height adjustment and works with a user-friendly interface (***fig 2***). By providing the needed real time feedback of gob weight, length, shape and tilting for each individual cut, the GobRadar system advances the Smart Feeder development.

Automatic gob weight and length control

A mathematical model was developed to correlate gob parameters (gob weight, length, ...) with feeder control parameters (feeder plunger motion, tube height) and shear control parameters. The model has been implemented into the FlexIS user interface to setup multi gob weight production. The operator can type in a target gob weight for each section and the MGA will determine a feeder parameter preset to achieve the target weight sequence. Providing the actual gob weight, the MGA can further fine tune the feeder setup to maintain the desired gob weight over time.

With the GobRadar integration into the system, the MGA will receive the gob measurements cut by cut and can carry out the fine tuning automatically and continuously.

The MGA system requires some model calibration procedure during which the user needs to grab bottles/gobs to do measurements and feed the gob information into the model. This is a somewhat time-consuming step in the original use of the MGA. The GobRadar's auto measurements will greatly relieve the operator from the bottle grabbing and weighing work and reduce the calibration time.

The control model was recently expanded to include gob length control in addition to the gob weight control capability. The GobRadar measurements are now fed back into the control algorithm to fully close the gob weight and length control loop for each cut. A series of trials on the BEG research machine and in field production validate the Smart Feeder control capability on gob weight and length control. Figure 3 shows a closed loop gob length control test on the four-section research NIS machine. The gob weight was maintained at 400g for all sections. The gob length of section 4 was set to 200mm and in a second step to 180mm while the other three gob lengths stayed at 220mm.

Figure 4 presents a field trial of a gob weight control. Section 9 and 10 gob

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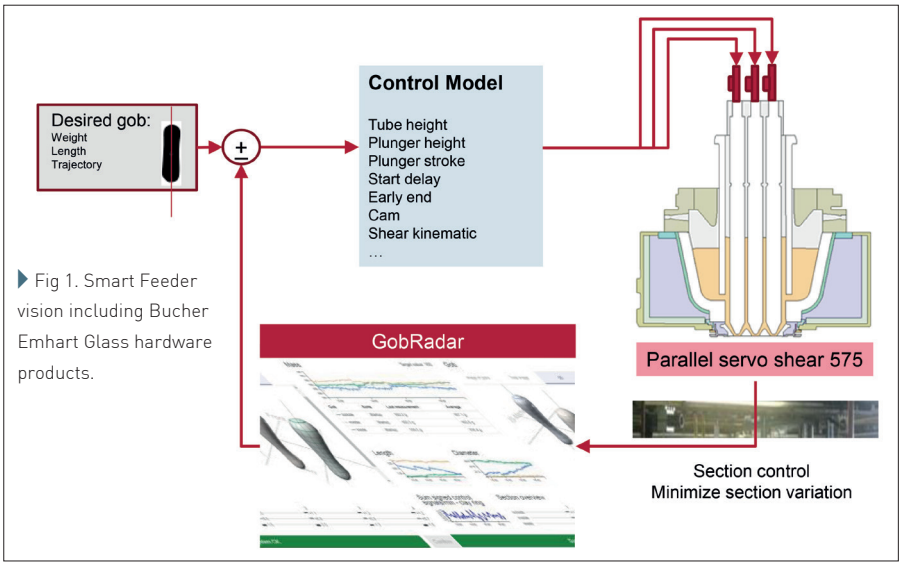


Fig 1. Smart Feeder vision including Bucher Emhart Glass hardware products.

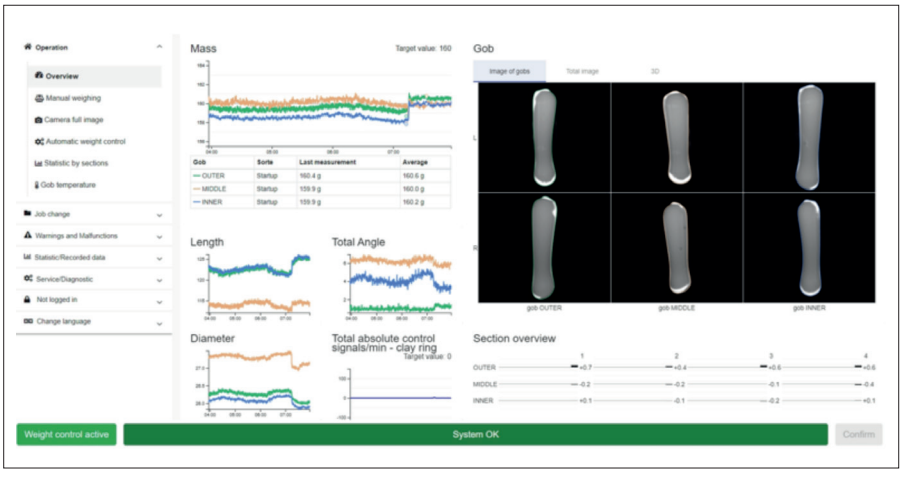
weight and length were set to 506g and 131mm. On all other 8 sections, the gob weights and lengths were kept at 496g and 128mm. The various test results show that the Smart Feeder control can achieve the desired gob weight and length for each individual section and maintain the target gob weight and length precisely.

Smart Feeder vision

The goal of the Smart Feeder development is to provide an automatic setup of all relevant gob forming parameters to form and maintain the desired gob sequence for the production. This includes a stable gob weight, length, shape, dropping etc. for single weight and also multi weight production.

The useful potential of the entire BEG product range is far from exhausted. In addition to the already running gob weight and length control, further functions are on the development list.

- Monitoring and uniforming of the gob length/shape also on the blank level by processing signals from the BlankRadar
- Automatic compensation of the tilting of each gob (thicker/thinner) by influencing the shear parameters
- Achieving a similar gob shape as with the last good run of the same production
- Extension of the achievable range of double and triple gob multi weight production by the Individual Needle Feeder



▲ Fig 2. GobRadar user interface showing gob weight, length, diameter, tilting angle, tube and feeder plunger heights and gob shape images.

At the end, the Smart Feeder is a fully closed loop controlled gob forming system. The Smart Feeder system will also serve as an information source within the End to End concept. The basic principle of a viscometer is somewhat similar to the feeder with its tube and plunger mechanism. When the information of the gob characteristics measured by the GobRadar is connected with the 9-point grid history data of the forehearth and tube/plunger height settings, changes in glass viscosity can be detected. Awareness of these changes gives the possibility to adjust the forming process and the gob shape accordingly and to proactively counteract defects. ■

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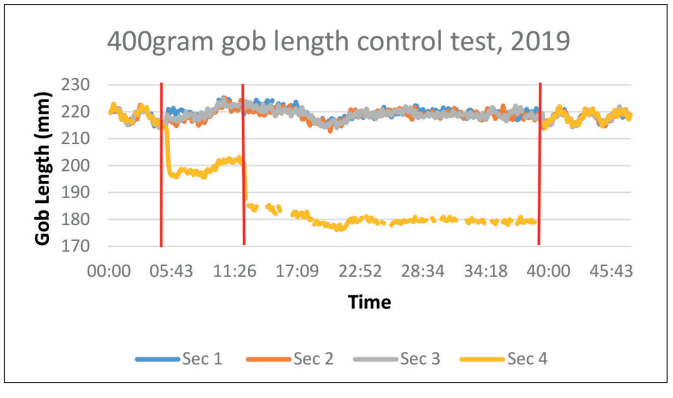
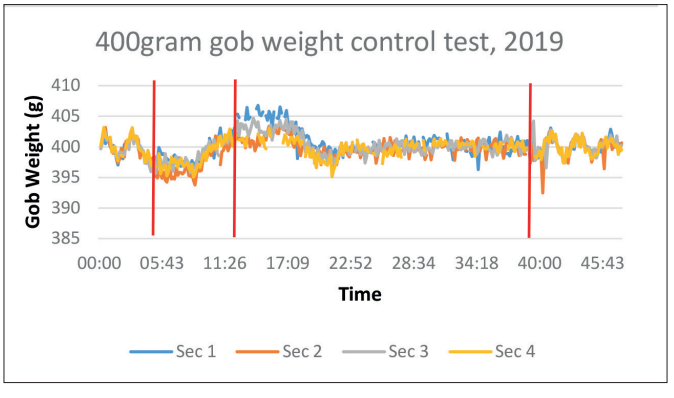
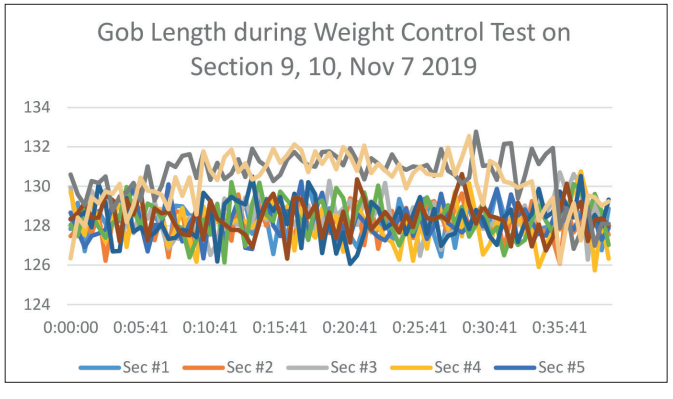
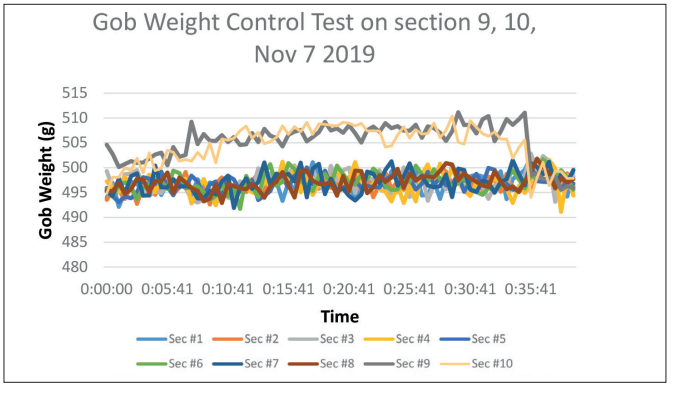




▲ Fig 3. Section 4 gob length being shortened to 200mm and then to 180mm maintaining its weight.





▲ Fig 4. Section 9 and 10 gob weights were set to +10g compared to the others. Their length was set to +3mm compared to the others.