glass WORLDWIDE

# Tube inspection developments

## The inspection of glass tubes is now at a level where quality records of individual tubes are available. According to Henrik Hegelund, this makes it possible to produce traceable reports related to each batch and will allow producers to document their quality.

For more than 25 years, in-line defect inspection has been available for glass tubing lines. Classical systems measure and detect defects such as stones, blisters, seeds, knots, airlines and cord.

Unlocking the latest advancements in camera, computer and lighting technology has secured a much higher accuracy in defect detection, eg down to five microns on airline width and making it possible to deliver even better glass quality.

The next step towards better quality is not only to improve the quality of individual measurements but also to link all the data to get both the full pictures of the process and trackable data on individual tubes or bundles of tubes.

Today, therefore, the latest developments in tube inspection takes place in three areas:

- More precise classification.
- Optimising the production line.
- Using 'Big data' from all sources.

### MACHINE LEARNING

The latest technology keeps pushing the boundaries of what previously seemed impossible. Deep learning technologies have shown remarkable capabilities in classification of open and closed airlines etc.

Training on recorded images of the two defect types has shown that a detection level of approximately 95% is achievable. The first systems will go into production at the end of the year. Machine learning is also used to improve the ability to distinguish otherwise similar looking defects like inclusions, seeds and blisters of the same size.

Installed SK-3020 inspection system.

### CLEVER CUTTING

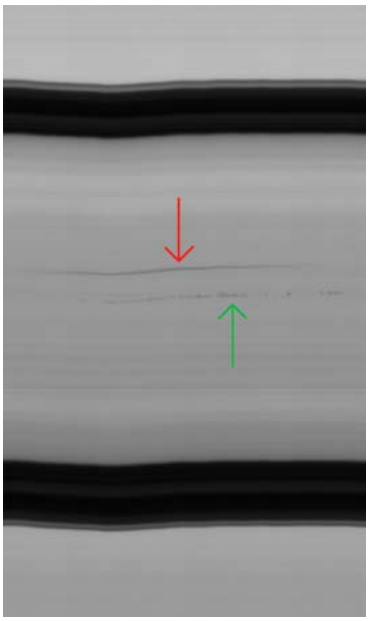
Innovative cutting control technology has entered production so the cutter will be able to cut the tube in shorter sections. Thereby, any defect detected will no longer necessarily result in a full length of tube being discarded. Smaller portions of tubes, including the defects can now be timed for rejection. This maximises line efficiency.

Depending on the physical cutter, cutting the tube in half, one-third, one-fourth or even one-fifth of a full length tube is possible. On the bottom line, this can reduce the number of tubes being rejected by up to 40%, without additional runtime costs.

### BIG DATA

Today, the camera inspection system is capable of linking all measurements, including external measurements from any other instruments like OD and WT gauges and also data from tube end inspection systems located on the conveyor after cutting. Results are combined on individual tube level, making it directly linkable to the tubes in an auto-packed bundle.

Reports can be generated for each bundle and accompany the delivery as a quality record/ documentation. It is performed by connecting sensors on all individual conveyors from the cutter to the finished auto-packed bundle and thereby 'counting' the location of each tube all the way. The detail level of a report in excel or PDF can be configured individually, either providing 1:1 data or a summary of measurements on tube, bundle, pallet, hour and/or shift level. This will automate this part of the quality control process.



Compressed image of an open airline, marked in red. Machine learning helps classify open/closed airlines. Acceptable surface defect are marked in green.

Data can also be entered directly into a production database. This gives essential data not only for quality control and the management but also as feedback to the furnace control systems. Analysing the tube production data will therefore help optimise production and yield.

JLI systems are used by all major glass tube manufactures and more than 100 in-line tube inspection systems in the SK-3000 series have been installed worldwide. ■

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