What’s New in Glass Container Inspection?

Amir Novini* discusses the latest inspection technologies designed to examine the ever-more complex shapes, colours and textures that glassmakers demand.

4. Glass containers can be easily manufactured in different colours not only for aesthetic reasons but also to reduce container contents’ exposure to ultraviolet light, which can be damaging.

The art of glassmaking has been ‘perfected’ over centuries, however its amorphous, non-crystalline, free-form solid chemical formation makes consistency a challenge.

Just as it has been throughout its history, today’s glass is prone to defects during manufacturing that can compromise quality and durability.

Therefore, today’s glass containers are inspected more than any other type of rigid food and beverage container before reaching fillers and the public.

Due to countless variables, glass inspection is extremely challenging. Here are a few reasons why:

1. Glass manufacturers’ continuous efforts toward light-weighting or the process of using less material in the manufacturing process can lead to the formation of certain defects and glass instability.

2. Container complexities such as non-round shapes, etching, embossing and handles create opportunities for distortion in the inspection process.

3. Differentiating acceptable process variations versus actual defects remains the most challenging aspect of automated visual glass inspection. Some visual defect classifications are very subjective even among trained inspectors so entrusting the role of inspection to a machine adds another layer of complexity.

One of my first experiences with this scenario occurred in 1988, when I realised there were many false rejects resulting from a normal glass manufacturing by-product on the bottom of many glass containers called the baffle mark. The semi-circular or arc-shaped mark was often identified by inspection machines as a defect.

In order to tackle this situation, I developed an inspection method that was able to reduce false rejects by finding and ‘erasing’ the mark in the image before inspecting it while not missing any actual defects close by or right on the baffle mark. The Baffle Mark Filter (Patent #5,095,204, field 1990) became the first of Applied Glass’ many US glass inspection patents.

Applied Glass continues to push the glass inspection envelope today with new and improved technologies designed to examine ever more complex shapes, colours and textures that customers demand to attract consumers in an increasingly competitive marketplace.

Our current glass inspection efforts are focused on the following:

1. Non-contact inspection of glass containers wherever possible. If necessary, we rely on minimum contact but at full production manufacturing line speeds.

2. Inspection of complex shaped, patterned and colorfully decorated containers (including labels) in random orientation.

3. Providing accurate and traceable defect classification so problems can be identified and solved more rapidly resulting in less product rejects and better productivity.

4. Utilising a section of the electromagnetic spectrum well beyond the limitations of visible light.

This range includes but is not limited to soft x-rays, ultra violet radiation, infrared, radio frequencies and sound waves.

In so doing, we have been able to solve complex problems that other technologies cannot manage.

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5. Developing the latest computer hardware and software technologies to solve complex problems while making our inspection systems easy to set up and manage by non-engineer plant personnel.

6. Making dynamic inspection systems that are reliable in demanding and harsh production conditions while being easy to maintain and service.

Non-Contact Inspection Process
One major issue glass manufacturers have faced for decades is cold-end inspection speed restrictions.

The glass manufacturing lines are normally split into several lines after leaving the annealing oven only to allow inspection equipment to grab and rotate the ware while looking for flaws.

This process takes up precious space in the manufacturing facility and increases cost and spoilage. Therefore, non-contact or limited contact inspection greatly increases speed and improves productivity. Perfecting this process has become one of our top priorities.

Inspection of Complex Shapes
One of the more appealing aspects of glass is its ability to take on different colours and shapes resulting in an attractive container. Until now, the majority of such containers have not been able to be inspected by automated systems due to their imaging and handling complexities, but thanks to our technology that is about to change.

Defect Classification
For many years glass container manufacturers have used various mould identification codes to trace defective ware to its origin. Although a great step in process monitoring, this method has generally required quality control personnel to identify the nature of the defect, go back to the mould and take corrective action. Despite the claims by some glass inspection manufacturers of having achieved automated defect classification, these claims have produced incomplete or inaccurate results.

Typical vision inspection is generally adequate at finding flaws, however identifying the type of defect requires near ‘human intelligence’.

This is another area where our company shines through with nearly three decades of research and development in the area of artificial intelligence and complex computer learning. In another words, our computers analyse the shape, formation, surrounding information and multiple views of each defect while building a unique characteristic for each defect type and assigning a confidence level to that decision. This confidence level will be a useful indicator of how comfortable the computer is with its decision and the user can then set a threshold to accept or ignore the classification.

Electromagnetic Spectrum
The portion of the electromagnetic spectrum visible to the human eye is quite small and yet the majority of the spectrum invisible to our eyes provides incredibly powerful problem-solving potential.

When it comes to glass inspection, with the exception of a tiny portion of infrared, the spectrum has been largely ignored. This is primarily due to the lack of knowledge and experience on behalf of the inspection providers. At Applied Glass, we’ve not only mastered the process of utilising the entire visible portion of the spectrum in multi-colour illuminators such as our Multiview lighting system, we have also developed the ability to utilise the previously untapped portion of the electromagnetic spectrum.

Latest Technologies
This is a critical aspect when it comes to providing solutions that bring tangible value to our customers while making our systems easy to use. By utilising the latest technologies available, we can solve problems for our customers that were unmanageable a decade ago.

Solutions
One of our strengths is delivering practical solutions to seemingly impossible problems. We have perfected the process of research and development, engineering, product development, delivery and service so that our systems are practical and sustainable. Our inspection systems not only work in the theoretical world but also in the demanding environments of our customers. We use the latest manufacturing techniques and quality control processes to ensure system stability and reliability while backing it with a knowledgeable and experienced global service and support team.

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