KEG-Inspection Today

Freshness from the well-kept KEG

Images: Syscona

Full container KEG foam inspection in the area of the fitting (leak test)

Beverage consumption from KEG barrels is rising again. With an average "life expectancy" of over 30 years in some cases and a large number of deposit-secured cycles, this valuable reusable container serves people and sustainably the environment. In order to ensure the functional quality and hygiene of KEGs, their inventory and logistical management right from the start, modern inspection systems along the entire cycle are indispensable. This article provides an overview of the latest state of the art.

What actually needs to be "inspected" in the KEG circuit? Well, it's all about logistics, product quality and hygiene, as well as the essential application functions of these pressure vessels made of bare or PU-coated stainless steel or composite constructions with plastic head and foot rings. The requirements for such professional containers are even higher than for reusable bottles.

Let's talk about logistics

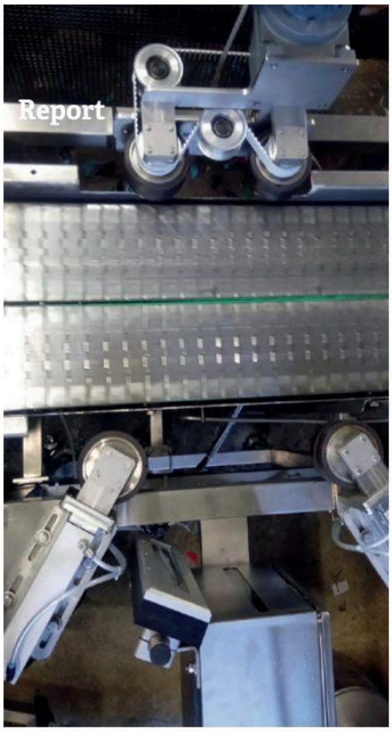
With automated storage systems, the KEG that arrives as empties can already be identified on the pallet. To this end, Syscona has developed a line scan camera-based pallet inspection system, called "PIA", which can identify containers and containers of various types and arrangements on pallets on the basis of container type, logo, color characteristics, dimensions (drum height and diameter) and other criteria in incoming goods and "book" them to taught varieties. Even mixed pallets with drums and crates can be detected very reliably thanks to the software intelligence. After depalletizing, individual drums are recorded on the conveyor in another inspection station with regard to their individual identity. Pressed or lasered serial numbers, bar, matrix or dot codes in combination with manufacturer designation or branding, embedded transponders (tag) for RFID capture or sometimes adhesive labels can be read on jacket or floor surfaces. For permanent markings on jacket surfaces, a turning station is typically used for a >360° rotation of the drum in conjunction with a line scan camera and special lighting. Cycle times of 6 to 10 seconds, depending on the size of the barrel, are achieved.

In a number of applications, a focus is also placed on the fitting or the fitting nozzle: fitting type, color ring or type marking, residual cap detection and condition detection of various kinds. In most cases, a distinction can be made between the common six types of dispensing heads (flat type A, basket type D, triangular type G, combi type M, basket type S, draft stout type U). With the link to the provenance of the barrel (brewery, non-alcoholic trademark), the dispensing head type determination can be additionally secured. Due to the diversity of this image content, the use of modern AI image capture tools has now also brought clearly noticeable improvements in recognition reliability. At this point in a KEG drum line, however, the condition of the KEG can also be automatically examined with regard to damage: dents, damaged handles, as well as head and foot edges or stacking rings, demolished connections (sleeves, nozzles, tap holes) are detected according to defined optical characteristics. Unreadability of screen prints or worn color rings are also detected. On the basis of programmable limit criteria, the reconditionability can even be assessed on request and the rejection path of corresponding niO drums can be selected. A large proportion of damaged KEGs can be "saved" by repair services. To ensure that breaks on plastic handles that are difficult to detect without any doubt, Syscona has developed a load test station in which the path in mm at spread load was recognized as the safest method as a distinguishing feature for fractures in the grip area.

If the KEG is filled with beverage under CO_2-pressure, it is marked with the corresponding production data (product, quantity, manufacturer, line, date, etc.) with plain text and coding. Typically, this marking is done by means of a paper label on the bottom of the drum or on the sealing cap of the fitting. The determination of the presence, completeness and consistency of the marking is the task of an inspection station at this point on the line. This is achieved using a high-resolution camera and suitable LED lighting. Is a barrel e.g. equipped with a separate action tag or the like, this can be integrated into the image evaluation at the same point. If a KEG barrel has a transponder or a serial number, the KEG is "married" to the current filling process to the exact date. In this way, the barrel location/status and product freshness can be indexed and the so-called barrel history can be created. The data collected for the further journey of the barrel is transferred to the common, linked materials management and logistics software systems along the supply chain, where it is used consistently and without error.

Ensuring product quality and hygiene

And now to inspections to ensure product quality and hygiene: After the drum has been cleaned, it must be ensured that no residual liquid has remained in the interior of a drum. This is an important checkpoint (CCP = critical control point). For this purpose, Syscona has found a clever solution that allows the presence of small liquid residues to be concluded from temperature distribution effects. With a high-resolution thermal camera, the bottom area of a barrel is examined by means of a false-color interpretation. The risk of product contamination and thus a possible significant impairment of product quality is thus minimized. Another CCP is located immediately after bottling. The filling quantity is usually determined gravimetrically or by gamma-ray based detection of the fill height in the flow. It is now essential to check the freshly filled KEG for the smallest leaks. Leaks are to be detected. The focus is typically on the



Empties KEG inspection with 360° turning station and line scan camera for detecting own and foreign KEGs

Full container KEG inspection of the sealing cap for checking color, label, best-before date, EAN

fitting. Leakage is usually manifested by leaked droplets or foam. However, recognizing this is not always so easy, as optical effects from the metallic shine or variances in the fitting or floor surface can lead to misinterpretations. In any camera-based inspection, the information content of the primary image is essential. Depending on the circumstances of the application, the inspection experts use optical means with which the desired features are highlighted in the best possible way, such as brightfield/darkfield illumination, polarizing filters, etc. A clever solution is a double-image comparative analysis. Between the two images, the sealing area of the fitting is subjected to a compressed air pulse. If droplets or foam are present, they are "blown away", which then becomes clear in the image comparison. Especially when micro-leaks are relevant, there are also solutions with sniffers that are placed on the fitting to seal them. In practice, other possible leakage points of a KEG are inspected less frequently by bottling companies. In particular, product escaping behind PU sheathing, e.g. in the area of a safety rupture point (typically designed for 35–40 bar burst pressure), is mentioned here. Leaks can lead to unpleasant hygiene problems.

Wherever image processing is part of an inspection station, it has now been shown that a significant increase in recognition and reading reliability has been achieved with the help of AI image processing tools. Of course, this has an impact on the consistency of product and process quality. For this purpose, Syscona uses so-called Max R-CNN modules, which can be used to better "filter out" the variety of optical interference effects through so-called "deep learning" routines. What you want to recognize is extracted more erroneously. This result is achieved in several stages by the mathematical principle of "convolution" and a correlative classification of characteristics. The system training takes place under real conditions even during operation.

All modern inspection systems for KEGs should meet the requirements for flexible use and ease of use. Using Syscona technology as an example, this means, for example, automatic pneumatic or electromotive height adjustability of the sensors when changing formats (e.g. lines for 20 l, 30 l and 50 l KEGs). And little qualification and time required for system adaptation, e.g. when creating new products and features or when making changes in labeling elements. And, of course, remote maintenance access. And simple primary analysis of the captured data and images along the timeline. Since each inspection station not only records data and statuses, but also makes decisions, it usually includes one or even more rejection devices (usually 90° rejection). For comparatively slow KEG barrel lines, these are usually pneumatic, end-position-damped pushers with a V-shaped slide to center the KEG to be discharged.

In the sense of industrial digitalization, such inspection stations must be understood as data-giving and data-receiving components of a consistent, IT-based production management system. The inspection systems described are based on highly developed standards, such as Windows 10/11 operating system, Hewlett Packard IPCs and proven mechanical assemblies. They thus represent components of an industrial network in the sense of "Industrie 4.0".

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