PULSED LIGHT sterilization - sterilization of packaging materials

There are currently several methods being utilized for the sterilization of packaging in the food industry, in order to prevent a renewed contamination of products. However, current consumer inclinations show that some methods are better suited than others. More and more consumers are rejecting artificial ingredients, flavours and preservatives, and are therefore forcing manufacturers to revise their product formulation and thus their production processes. The R&D and production departments are faced with the task of having to develop alternative recipes that neither influence the taste nor the consistency, but still comply with the requirements for food safety and cost control.

To what extent does the consumer's decision for healthy foods influence the packaging sterilization?

Nowadays consumers are increasingly exhibiting a health-conscious lifestyle: a correlation between their eating habits and their well-being has been clearly proven. Their demands for foods and beverages are ever-increasing. "Clean label", natural, unprocessed products are major drivers of the food and beverage industry. Many leading companies in the industry have embraced this request as an opportunity and are now developing new marketing strategies throughout the “Free of” market.

How can manufacturers react to these new consumer requirements?

The manufacture of products without preservatives and additives using only natural ingredients, increases the risk of bacterial contamination. This fact represents a real challenge for the industry: Beverage and food manufacturers need to change ingredients and production processes for the products, while the sensory properties and the high level of food safety must continue to be guaranteed.
How can manufacturers master this new challenge?

Packaging sterilization is an important step in the production process. Currently there are several technologies available for this purpose, for example, sterilization through the utilization of chemicals or constant UV radiation. Especially the pulsed light technology has established itself within the last 10 years as a new viable method on the market.

Why is the pulsed light method more significant than ever before?

The pulsed light method initially appeared in the 1980s, and has since then developed into a powerful industrial tool for the decontamination of packaging. During a time where industrial companies are pursuing an increase in productivity, while having to observe regulatory requirements, in addition to being confronted with the pressure of having to implement a sustainable manufacturing, the pulsed light method represents an optimal solution for the replacement of thermal, chemical and radiation-based technologies.

How does pulsed light work?

The pulsed light technology is based on the germicidal effect of intense white light flashes, which are produced by xenon lamps. It is a “cleantech” process that uses short, intense pulses from a wide spectrum of light to sterilize packaging surfaces. All kinds of germs and even spores are killed immediately. Some obvious benefits of pulsed light sterilization, compared to the conventional methods of the same sterilization degree, were recognized by the industry:

- Compact and easy to integrate
- Cleantech: chemical-free, water-free, low energy costs
- Cost effective
- Powerful

Functional principle

Energy is stored in a capacitor, and a high-voltage signal creates a light arc in a Xenon lamp. This light arc makes the lamp conductive, and the capacitor is subsequently discharged into the lamp, which enables the Xenon gas to ionize into plasma. This plasma emits a high-intensity and ultra fast flash of light, consisting of white light, which has a high proportion of UV light. Despite its very low energy consumption (the flash only lasts 300 micro-seconds), this physical phenomenon has an extreme performance degree, approx. 1 MW. The peculiarity of the Xenon flash is the production of high-energy UV light. The power of a flash is expressed as follows:

Energy = lamp energy / flash duration = 300 J / 0.3 ms = 1MW

A double effect on micro-organisms

Despite the fact that both methods are founded on the same principle, the pulsed light treatment relies on two physical parameters, which completely distinguishes it from the continuous UV method, and makes it much more efficient:
• The spectrum is continuous, meaning that all stimulation possibilities for covalent bonds within the molecules of the cell are affected. With continuous UV light only the 254 nm wavelength which is specific for the DNA will be effective.

• The energy is so high that an instant saturation of the molecule absorption capacity can be achieved, which then destroys them. The result is a strong change of the cell, without the possibility of recovery.

Even with resistant spores such as *Aspergillus brasiliensis*, *Bacillus pumilus*, *Bacillus atrophaeus* and others, as well as bacteria a reduction of germs could be proven. A great amount of effort was invested into scientific research at the INRA, the National Institute for Agricultural Research in France. The institute was the first scientific institution that published a precise correlation between the energy density and the destruction of microbes in reaction thereto.

**Can pulsed light be utilized in every industry?**

Packaging sterilization with pulsed light is suitable for a wide variety of foods: from water to drinking yogurt, from juice to beer, from weak carbonated beverages all the way up to non-alcoholic wine. The packaging sterilization with pulsed light ensures that most beverages can be safely introduced to the market, with a minimized addition of preservatives and a longer shelf life assurance, while maintaining the sensory properties of the product and avoiding chemical residues. Some tangible benefits can be highlighted:

• Water bottling operations can reduce or avoid the use of ozone or other decontamination measures,
• The process for the hot filling of beverages is simplified, and the preforms are relieved, because the sterilization through heating is eliminated. When it comes to the packaging sterilization for organic natural beverages and pure spring water, the chemical and residue-free pulsed light technology will become even more relevant within the scope of the marketing strategy.

**Can the pulsed light sterilization be applied for each type of packaging?**

Packaging sterilization with pulsed light has proven its efficiency for a wide range of packaging materials: from standard closures to sport caps, from preforms to cups, and from containers to covers. Regarding the integrity, the technology has been adapted to a wide range of materials: PET, PS, PE, PP, PLA. Actually, the pulsed light technology is a WYSIWYG (what you see is what you get) technology, which in this case means that only visible areas are sterilized: Shadows and specific geometries represent a real challenge. Part of the know-how and expertise is in the design of reflectors, which are adapted in order to reduce the shadow areas to a minimum.
For example, the pulsed light technology was selected by VILSA-BRUNNEN because the process perfectly fits to their requirements regarding purity and naturalness.

VILSA offers the largest product range in the field of non-alcoholic soft drinks. Headquartered in the northern part of Germany, the VILSA spring offers a pure, spring-fresh, balanced mineralized and mild mineral water.

There was a search for a sterilization system for flat caps (cap made of polyethylene, 28 mm from Alcoa), which was able to ensure the necessary reduction of microorganisms by 3 log levels, and ensure the quality of the product. Therefore, in 2011 they opted for an initial pulsed light system for the sterilization of packaging materials. The utilization area includes the filling of non-carbonated, acidified and flavoured mineral water, as well as carbonated soft drinks (spritzer). Due to the extremely positive results the first plant was able to attain, two more lines were equipped with pulsed light systems in 2012.

VILSA BRUNNEN: The Pulsed Light system is compact and easily integrated into existing lines

Dr. Reinhardt, Managing Director for Technology and Finances of VILSA-BRUNNEN Otto Rodekohr GmbH & Co. KG, explains: "Every season has its own requirements for the closures. Pulsed light facilitates the use of one or two-piece closures while maintaining the high level of sterilization, without affecting the sensory characteristics of the product. In addition, the annual costs of a pulsed light system are much lower than the cost of peracetic acid baths. For this reason and due to the positive experiences that we encountered with the first system from 2011, the replacement of peracetic acid baths with pulsed light in 2012 on to further lines represented a logical consequence."
Pulsed Light systems are used to sterilize packaging for the food and beverage industry.

Since 2010, the company LOEHRKE has been the exclusive distribution partner for the PULSED LIGHT technology in Germany and Austria. More than 200 PULSED LIGHT systems have already been successfully installed in beverage and dairy companies throughout the world. As an industry-experienced distributor of the company Claranor, LOEHRKE offers cleaning and disinfection systems in addition to the PULSED LIGHT technology and the associated engineering services.

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