Use Of UV Technology Gaining Acceptance Within Process Industries

The use of Ultra Violet (UV) technology within process industries has grown tremendously in recent years. Water, fruit juice, syrup and brines are increasingly seen as the largest volume ingredient in many food products, and the need to protect human health, whilst reduce the level of chemical preservatives, and to extend shelf life leads to the incorporation of UV systems within the food manufacturing process.

UV light is used mainly as a non-chemical disinfection technology, and is favored because of what it does not do: no taste or odor changes, no chemical residual to be removed, and importantly no micro-organisms have demonstrated any tolerance to UV, unlike chlorine, which a number of pathogens, including Listeria and Cryptosporidium have become tolerant to very high chlorine or chlorine dioxide doses. Recent advances have now led to UV being certified as an equivalent technology to Pasteurization, and so the use of UV light has been extended to dairies and Grade A milk producers.

How does UV light work?

UV light is absorbed by the DNA and the resulting damage renders the organism non- viable; dimers are formed at the specific sites of damage in the DNA and all of the normal cell functions – respiration, replication and assimilation of food by the organism quickly cease. The damage is caused in picoseconds, and the UV light is non selective. Any planktonic organisms in the water or fruit juice will be damaged, and effective disinfection achieved.

Modern UV systems are generally performance validated by a third party, and incorporate features such as wiping systems, to remove fouling from the optical path, sealed and calibrated UV monitors, to accurately measure the UV light entering the water, and the systems are designed using advanced Computational Fluid Dynamics (CFD), which allows system designers to position the UV lamps for maximum effect, and ensure that the target UV dose is being delivered at all times to the fluid. Food users have borrowed this thinking from the drinking water community, who pioneered the use of independent validation of the UV system performance.

System controls now include full date and time stamp events to provide a forensic audit trail; this verifies that the water used at food production plant was not the source of any subsequent infection. Product recall is notoriously expensive and damaging to brand equity for the food manufacturers.

Commenting On the use of UV within food processing facilities, Toby Barrera, Field Service technician stated “We see a lot more interest in the use of UV to protect product integrity at Ready To Eat (RTE) food plants these days. They like to have the automatic wipers because it saves them dismantling the equipment to clean it”

New applications within the food processing industry

Water is predominantly used as part of the manufacturing process, or in fact as one of the ingredients.

Clean in Place (CIP): This final rinse is used to flush any residual chemical out of the pipe prior to the flow of product. The final rinse must of course be disinfected, and this is an ideal candidate for UV disinfection. Most modern UV systems are designed to tolerate the active CIP regime, and can cope with elevated temperature and caustic rinses.

Motive Water: water is often used to move food around a plant; for example pasta flumes and vegetable canning operations will use motive water. The use of UV light has two main benefits; it ensures that this water is not a source of contamination, and secondly the water life can be extended between dumps, often by several weeks. Likewise the water is used to chase, rinse, de-foam and cut food products prior to packaging can all be disinfected by UV light.

Heating and Cooling: water is often used for cook in the can products, and other heat based processes. Many thermophilic (heat tolerant) species are identified with product spoilage, taste issues and shelf life reduction. These micro-organisms are easily disinfected using UV light.

Fruit Juices & Flavored Waters: These products are growing in popularity, as consumers become more health conscious. A number of organisms are associated with the soil that typically is present on the raw fruit as it arrives at the processing plant; for example Alicyclobacillus is a Gram positive, rod-shaped, spore forming bacteria. It lives in the soil, and these spores survive pasteurization, whilst the bacteria are able to grow in acidic conditions. This combination poses a real disinfection challenge for fruit canners and bottlers.

Alicyclobacilli have been shown to grow at temperatures between 68 and 158 °F with the optimum temperature range being 107–140 °F and pH values of 2.0 to 6.0.

When a product is spoiled by *Alicyclobacillus*, the juice products develop a pronounced disinfectant-like odor and flavor due to guaiacol production. Guaiacol is a naturally occurring organic compound which is readily synthesized by a variety of organisms. This yellowish aromatic oil is usually derived from guaiacum or wood creosote, and typically darkens upon exposure to air and light. The compound compliments the flavor of many products such as roasted coffee, however for fruit juice or flavored water it is undesirable.

Milk & Cheese production: UV systems from some of the leading UV manufacturers have now been certified in accordance with the Pasteurized Milk Ordinance, as being equivalent to the more traditional pasteurization process. Pasteurization is slow and energy consumptive; the product must be heated to a pre-defined temperature, and then cooled prior to packaging. Not only is the process slow, but thermophilic species survive and cause spoilage. Brines are now being disinfected using thin film devices, similar to UV systems designed for sugar syrup disinfection.

De-chlorination: UV light is able to effectively remove free chlorine from process water, and replaces the more traditional use of Granular Activated Carbon (GAC). The manufacturers of Ginger Ale in the USA use UV light to remove the chlorine taste, which provides the added benefit of high level disinfection of the process water.