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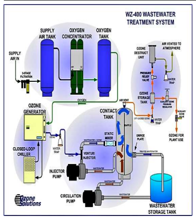

Ozonation as disinfectant process in the food industry

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Introduction: For several years, ozonation has been used to disinfect drinking water. Ozone has various other commercial applications, including bottled water disinfection, swimming pools, cooling tower fouling prevention and wastewater treatment. The use of ozone in bottled water has been granted widely accepted as safe (GRAS) status by the US Food and Drug Administration. When used in compliance with good manufacturing practices, ozone was a GRAS agent for use as a disinfectant or sanitizer for foods. Because of its potential oxidizing ability, ozone is a potent antimicrobial. The use of ozone in the food industry may have several benefits. Food surface hygiene, sanitation of food plant facilities, reuse of wastewater and lowering biological oxygen demand (BOD) and chemical oxygen demand (COD) of food plant waste are some of the suggested ozone applications in the food industry. The ozone generation processes, its microbial destruction mechanism and the application in the food industry are discussed in the article.

Ozone generation : There are two methods commonly used to produce ozone for food applications, corona discharge (CD) commercially and photochemically with ultraviolet (UV) light.

To produce ozone through the corona discharge method, oxygen molecules are allowed to pass through the electric field, which results in splitting or O_2 into oxygen-free radicals. The free radicals then further react with diatomic oxygen to form the ozone molecule (O_3). In order to disrupt the bond between the oxygen atoms (O–O), a great amount of energy is required. Production of ozone can be achieved through the following method: UV wavelength can be together with a corona discharge to initiate the formation of oxygen free radicals through the photo disassociation process. In the process of photo disassociation, a small percentage of oxygen molecules are separated by UV rays into unbalanced oxygen radicals. Then in order to become more stable chemically, O_1 radicals readily make a bonding to the surrounding O_2 molecules forming ozone shown in Fig. 1.

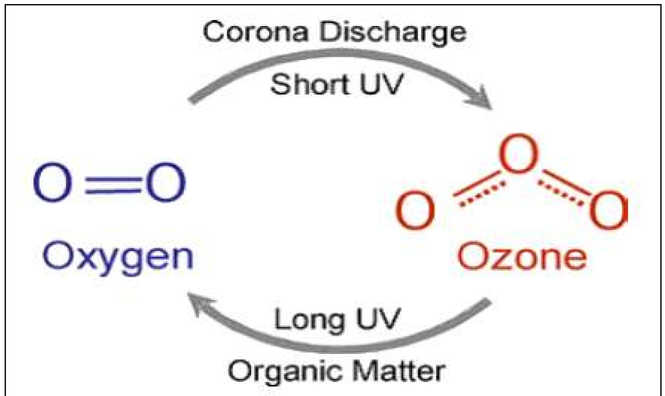

Fig. 1: Formation of ozone through UV light of wavelengh shorter than 242.4 nm

Advantages of ozone usage:

– One of the major advantages of ozone is being a non-thermal process.

– It is a powerful sanitizer and relatively safe and trustworthy for food processing applications. It has an oxidation potential of 2.07 V without leaving any residue on food.

– Ozone gas can be produced on-site, and it does not need to be stored or transported from another location. However, it must be used in a well-ventilated area since it is toxic when inhaled.

Inactivation micro-organisms by ozone: Deactivation entails destroying a microbial cell's biological activities, such as inducing changes to the cell's structural components, resulting in cell death through a change in cell permeability and cell lysis and altering a cell's ability to divide and reproduce. Ozone damage causes cellular membrane breakage, inhibits cellular reactivation processes and oxidizes unsaturated fatty acids, lipid fatty acids, glycoproteins, glycolipids, amino acids and sulfhydryl groups certain enzymes, phenolic rings and nucleic acids, among other things.

Application of ozone in the food industry:

Vegetable preservation : Due to a decrease in the surface microbial count, ozone extends the shelf life of vegetables. It may be used instead of refrigeration to extend the shelf life of vegetables. Various optimization studies in the literature have demonstrated positive results regarding the antimicrobial effectiveness of ozone treatment of vegetables and fruits. Ozone has been used to wash vegetables in the food processing industry, and it only takes a short contact period and a low concentration of ozone to inactivate bacteria. Inactivation of bacteria in wastewater, on the other hand, necessitates a higher ozone concentration and a longer contact period due to oxidizable materials.

Fruit preservation : Fruit juice processing necessitates a 5-log reduction. In the United States, commercial food producers began to use ozone for fruit juice treatment and water pasteurization. Ozone has been used to process a variety of fruit juices, including apple cider and orange juice. Apple weight loss and spoilage are reduced as a result of the ozone treatments. *Staphylococcus aureus* populations and coliform on date fruits could be reduced with five parts per millions of ozone applied for one hour.

Grain storage : Malathion and Dichlorvos (organophosphate insecticides) are used to manage insects in stored materials, as well as phosphine or methyl bromide. Ozone is an insecticidal oxidizing agent that is highly reactive and strong. Ozone as a fumigant was the most effective in controlling storage grain insects such as *Sitophilus oryzae, Rhyzopertha Dominica, Tribolium castaneum, Oryzaephilus surinamensis* and *Ephestia elutella* in lab and field studies. The toxicity of ozone varies depending on the life stage of the insect. *T. castaneum*, for example, is ozone sensitive in its larval and pupal stages, with sensitivity declining as the stage progresses.

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