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COLD ROOM OZONATION- A BOON TO THE INDUSTRY

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Today 90% of all Cold Storages in the US are ozonated. Ozone usage has helped reduce wastage, helped preservation during Transportation & increased shelf-life . Usage of Ozone in Cold Storages has been the Best thing that has happened to this Industry this Century.

Brief Introduction to Ozone :

Ozone is a strong Oxidizing agent that is also known as super charged Oxygen.
by virtue of its strong Oxidizing power (3000 Times more than Chlorine) , it has found very useful in numerous applications such as water treatment, swimming pool water treatment, Cooling Tower water treatment, etc. The use of ozone is considered very safe especially in comparison with the use of chlorine which is very harmful due to its side effects. Ozone is a very powerful agent that kills Bacteria, viruses , cysts , amoebae etc more predictably than chlorine or UV lamps

Ozone being a gas, has various properties that other commonly used oxidizing agents do not have;. Namely the decolorizing, deodorizing and flocculating properties and above all the penetrating effects that is used in the preservation industry.

OZONE IN PRESERVATION AND STORAGE

Here, reference will be made to the possibility for the quick and efficient destruction in an ozone atmosphere of various non-pathogenic micro-organisms including molds, spores and other primitive single cell creatures. The wide ranging possibilities for using ozone in the food industry and agriculture as well as in other fields, are created similarly by it's bacterial and germ killing power. Not only does it act as a germicide but as a spore killing agent as well. Fruits, foodstuffs, etc., exposed to its effect, under go a more or less pronounced change as a consequence of it's action on the vital process of cells, the process of there metabolism particularly, through the inactivation of their metabolic products. At the same time it reacts with other materials present that can be oxidized and thereby it destroys fragrances and odors.

Utilization of these properties makes ozone eminently suitable for increasing the storage life of perishable foods in refrigerated premises. At the same time it's use is economic as the investment and operational costs of the equipment are on a acceptable level in relation to the size of refrigerated rooms. It's application eliminates the risk of leaving the unpleasant odor or other traces of antiseptics used for preservation on food stuffs.

Utilization of ozone for increasing the storage life of food, particularly if held at low temperatures, is believed to have started in 1909 when, in the cold storage plant of Cologne, the reduction in the germ count on the surface of meat stored there was observed after an ozone generator had been installed in the duct of fresh air used to ventilate the storage room.

Practical operations for preservation start with the sterilization of air in such a way that air entering the storage room contains a sufficient amount of ozone to destroy micro-organisms. At the same time, however, ozone decomposition to a significant extent is to be expected due to the high moisture content required, The walls of the storage room, the packaging materials, the absorption effect of the stored goods, and also to the oxidation reactions taking place.

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These two requirements demand the most perfect distribution of ozonized air in the storage room and make it imperative that the capacity of the ozone generator ensures the maintenance of the appropriate ozone concentration throughout the whole mass of air. This is an application need .

During storage, ozone exerts a threefold effect by destroying the micro-organisms, oxidizing the odors and effecting the processes of metabolism.

GERMICIDAL EFFECT

For applications in the food industry, a greater emphasis should understandably be put on the changes in quality taking place following the ozone treatment, along with the specific effects exerted on individual products. The germicidal power of ozone is generally specific in respect of individual species.

It's primary action on molds is to suppress there growth and this effect can set in rapidly, particularly in the initial stage on a mold free surface. Afterwards this process leads to the destruction of cultures already formed. Ozone attacks immediately the easily accessible cells on the surface since ozone exerts a surface effect in the first place and has a only slight depth of penetration.

Kolodyaznaya and Sponina investigated the micro flora causing the deterioration of the potato. Pure mold cultures of Fusarium Solani, Rhisoctonia Solani, and Phytophtora Solani were exposed to the action of ozone. From these species Fusarium Solani proved to be resistant to ozone. **Ozonation applied for the storage of refrigerated meat destroys surface micro-organisms, particularly the family of Pseudomonas responsible for spoilage**.

Increasing the moisture content of the environment favorably influences the germicidal effect. This is brought about by the swelling of microbes making them more susceptible to destruction. Experiments conducted with beef showed that ozone is most efficient if the surface has a definite moisture content of around 60%.

EFFECT ON ODORS

Ozone itself has a characteristic odor, yet the result of application does not mask odors. Atomic oxygen formed by decomposition of ozone immediately oxidizes the differently smelling materials.

The characteristic putrid odor, however, remains and is difficult to eliminate even with the use of ozone. In general, the lower the temperature and the larger the molecules taking part in the reaction, the weaker is the oxidizing effect. The moisture content in the air has no effect on the process. **At very slight concentration, say between 0.01 and 0.04 p.p.m. ozone, the air of the room of storage space is felt to be fresh and pleasant and no stuffy odor is sensed any more.**

It is an established fact that the odor of aromatic fruits such as strawberries is enhanced in the presence of ozone. It is possible that the formation of fragrances and odors giving the fruit its characteristic flavor is assisted by ozone. The sterilization of the air in fruit stores by ozone prevents the odors of packaging materials from being transferred to the goods stored, a phenomena which fequently takes place otherwise, particularly when wooden crates are used in refrigerated stores at relative humidity of 85% to 90%

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EFFECT ON METABOLISM

The effect on metabolism is also a consequence of the strong oxidizing power of ozone. **No deterioration of fruit was observed**, but the reason for this is that ozone only affects the surface of fruit which contain compounds difficult to oxidize in most cases. During storage the process of respiration of fruit is speeded up and so is ripening. In the case of a more rapid ripening than would be desirable, **ethylene is produced which affects the other fruit** and so initiates even more intensive ripening. The external signs of this process are the turning brown of the skin, the softening of the flesh of the rest of the fruit and, finally, decay. **This process is controlled by the presence of ozone** because it oxidizes the metabolic products created initially, reducing thereby the process of back action on other fruits. Moreover, it promotes the healing of wounds and enhances resistance to further infection.

MEAT

For the storage of meat it was found that a satisfactory effect can be brought about by one or two periods daily of ozone application, lasting two hours each time if the ozone content was held at 6 mg. (0)m. (air). Application of ozone proved to be particularly beneficial to the process of tenderizing meats. During tenderizing, fresh beef sides are kept for 42 to 44 hours in a closed space at a temperature of 293K and a relative humidity of 85%. The process of tenderization consists, in actual fact, of the digestive action caused by enzymes naturally present to soften and slacken muscles and connective tissue.

The same process can take as much as 20 days at a temperature of 279K. The accelerating effect of temperature increases on tenderisation promotes the formation of fertile soil suitable for the multiplication of infectious bacteria and spores of deleterious nature.

The aim to be achieved with ozone treatment is the destruction of these harmful surface organisms. In such a tenderizing room a concentration of 0.1 p.p.m. and a relative humidity of 60% to 90% should be maintained, according to well. According to others, ozone is efficient, even if present in a concentration of 0.04 p.p.m. and, although it fails to bring about full sterilization, it still retards the growth of bacteria. The germicidal action of ozone is restricted only to the surface in the case of meat too, and has a small depth of penetration. Molds present in the form of spores can be destroyed only if attacked by a high concentration of ozone. The storage life of beef in a refrigerated state can be increased by 30% to 40% if the beef is kept in a atmosphere of 10 to 20 mg. (0) m (air) and the microbial saturation of its surface is not greater than 10 bacteria cm. Billion conducted a detailed investigation on the storage life of beef, veal, lamb, pork, chicken, and rabbit in Ozonized atmospheres. In the case of the varieties of meat stored in a normal atmosphere, it was found that a significant microbial contamination sets in after 7 days. Contamination's of the same level were reached on meats exposed to the action of ozone only after 14 days under identical conditions.

It can be stated in general that, in a refrigerated atmosphere and **in the presence of ozone, the growth of the surface micro flora (Pseudomonas families, spores, salmonellae, staphylococci) is slowed down.** Nevertheless, no effect is exerted by ozone on the surface micro flora if the extent of contamination is large already. Thus, although ozone fails to produce an express antiseptic effect on stored meats, it still makes the atmosphere of refrigerated stores fresh and healthy.

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Freshly caught fish can be stored longer if washed in water containing ozone; If it is preserved by ice produced from ozone containing water a higher increase in damage-free storage time can be obtained.

CHEESE

Experiments for the use of ozone during the process of ripening and storage of cheese were successfully conducted. Spores created on the surfaces of cheese during the ripening period were destroyed and

storage life was increased to 11 weeks by the application of a small ozone concentration (0.02 p.p.m.) at 288K and a relative humidity of 80% to 85%. Experiments were conducted on cheddar cheese indicating that odors otherwise present in storage rooms were also eliminated by the oxidizing action of ozone.

EGGS

Ozone has been successfully used for the storage of eggs. By the end of the 1930s, more than 80% of refrigerated egg stores in the United States were equipped with ozone generating equipment to increase storage life.

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