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Ozone & its relevance today:

The perspective presented in this article is different from what we generally understand about ozone. We are aware of its pristine role in nature, its role in protecting and nurturing life on this beautiful planet. Life has been possible on this planet largely due to its protective benevolence. However, its relevance & promise in various applications is what we present here.

A historic look at ozone, its discovery, structure etc.:
Van Marum, a Dutch scientist was probably the first to detect ozone. He described a characteristic smell around his electrifier. However, the discovery of ozone is attributed to Schönbein. In 1840, Schönbein described the same characteristic smell during his experiments as Van Marum. He called this gas 'ozone', from the Greek word, 'ozein' meaning to 'to smell'. Schönbein is also the first person to research the action mechanisms of ozone on organic matter. After 1840, there were many studies on the disinfection mechanism of ozone. Most of the initial work on ozone was in Germany & France. The first application of ozone took place in Oudshoorn, Netherlands, in 1893. In 1906, an ozone based plant for treating the town water supply was set up in Nice, France.

What is ozone?
Ozone a tri-atomic molecule, consisting of three oxygen atoms (O^3). It is an unstable allotrope of oxygen, decaying to diatomic oxygen. It has a half-life of about 30-minutes at normal conditions. Its unstable nature is what makes it very useful in many applications, especially disinfection and oxidation of organic material. Ozone closer to the ground level is an air pollutant with harmful effects on the respiratory systems; however, the ozone layer in the upper atmosphere is beneficial, preventing potentially damaging ultraviolet light from reaching the Earth's surface. Ozone is present in low concentrations throughout the Earth's atmosphere. It has many industrial and consumer applications.

Generating ozone & some critical considerations in commercial applications.:
The model for ozone generation is what you observe in nature. Energy from ultra violet rays hitting the oxygen molecules in the ionosphere re-arranges the oxygen molecules, constantly forming and destroying ozone. We can express this reaction as:

$$3\ O_2 \underset{\uparrow \\ \text{Energy}}{\rightleftharpoons} 2\ O_3$$

For commercial generation of ozone, the choice of energy applied can be UV at ………………….. frequencies or corona discharge. Ozone generation with UV application is less efficient compared corona discharge. The oxygen concentration, temperature, dryness of the input gas will determine ozone concentration obtained.

While ozone generation to obtain the optimum concentrations is one aspect, applying it is another challenge. Owing to its limited solubility, injection and absorption to get its best effect is another matter.

Ozone is a pale blue gas, slightly soluble in water with a characteristic odor. In concentrations of as low as 0.01-ppm in air, one can easily smell ozone. It has a very specific sharp odor somewhat resembling chlorine bleach. Exposure of 0.1 to 1-ppm produces headaches, burning eyes, and irritation to the respiratory passages. Even low concentrations of ozone in air are destructive to organic materials such as latex, plastics, and animal lung tissue.

Ozone disinfection mechanism.:
Ozone disinfects by 'lysis'. Its action on the microorganism is direct. It oxidizes the cell membrane and all essential components – DNA, RNA, proteins, enzymes etc. In comparison, chlorine, the commonly used disinfecting agent penetrates the cell by diffusion and acts on the enzyme types within the cell.

The reaction / absorption of ozone are temperature and pressure dependant. Ozone can oxidize most metals (except gold, platinum, and iridium) to oxides of the metals to their highest oxidation state.

Though chlorine is still widely used in water disinfection, during the last couple of decades ozone applications are on the increase. A better understanding of the disinfection mechanisms of various disinfecting agents, especially chlorine and undesirable byproducts of disinfection is spurring the trend. Chlorine, for example, generates tri halo methanes (THM) and halo acetic acids (HAAs) as harmful disinfection byproducts. Both these groups of compounds are carcinogenic and their levels in water regulated in most developed countries.

Ozone with its comprehensive antimicrobial spectrum is a choice disinfecting agent when microorganisms that develop resistance to disinfectants, such as Cryptosporidium are present. Ozone is also very effective against Giardia a possible contaminant in swimming pools used by children.

Some typical ozone applications are:
1. Swimming pool water treatment. Read more . . .
2. Packaged drinking water manufacture. Read more . . .
3. Odor reduction in units using and or processing fish and fish products
4. Cooling tower maintenance. Read more . . .
5. Nitrate reduction in fish culture ponds and aquariums