

DRINKING WATER PURIFICATION WITH OZONATION PROCESS

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ABSTRACT: -

The primary goal of our project is to protect health of in human beings with the help of supplying water without dangerous viruses and pathogens and other harmful micro pollutants. By this project an effort of supplying water with acceptability very low concentrations of microbial and chemical contaminants is imposed. For this purpose ozone is a strong oxidant and having a powerful disinfectant quality. It has been used in drinking water treatment for close to hundred years (Rakness, 2005).

KEYWORDS: - Water resources, parameters, drinking water act, Ozone history,

1. INTRODUCTION:-

Water is one of the most important resources present on our planet, but most of it is not suitable for human consumption and only a little bit of that water is for drinking as we don't have good and efficient. Apart from course contaminants frequently crop up: micro pollutants viruses which are very difficult to remove by primary methods i.e. technologies to develop and purify ocean water. There is no. of methods present for remove pollutants present in drinking water and make it pure, but ozonation is most effective technology to be considered cause of its powerful capacity of disinfection with best reduction levels of chlorinated disinfection giving by products (DBP).

1.1. DRINKING WATER CAN BE DIVIDED INTO FOLLOWING PARTS: -

1.1.1. Surface water: -Surface water included lakes, reservoirs, rivers, and streams and this are the primary source for human being.

1.1.2. Groundwater: - Ground water includes underground water in aquifers as such as permeable rocks, soil, and sand. This type of water can be extracted by the wells or found as springs. Ground resources exceed salt-free surface water on Earth, but humans can use surface water mostly because it is easier to access in large amount.

1.2 IMPORTANT PARAMETERS FOR THE DRINKING WATER TESTING

- | | |
|--------------------|--------------------------|
| • BOD | • Total solvent |
| • COD | • Total dissolved solids |
| • Hardness | • Total suspended solids |
| • Ph | • M.P.N |
| • Iron | • Conductivity |
| • Chromium | • Fluoride |
| • Phosphate | • Turbidity |
| • Chlorine | • Color |
| • Copper | • Taste |
| • Ammonia | • Odor |
| • Dissolved oxygen | • Sulphates |

We will discuss all these parameters in materials and methods section.

1.3. WHY DRINKING WATER SHOULD BE CLEAN: -

As we know that water is a matter indispensable for all the creatures and without it no living being can survive. It represents a linkage between ecosystems of all the planets. But unfortunately we have only 3 % of water resources are fresh and still 2 % of this is trapped in the form of ice, which is present. All mainly in the Polar Regions or in deep aquifers and not available for the use of human beings and remaining 97 % are in the form of sea water and sea ice (Carapeto, 1999). Less than 1 % of the planet's water is available for the consummation of people and other beings.

Water that we consume in our body must be clean and pure because it is directly connected to our health. We should know that more than 2 million people in the world die each year from the diseases as like as cholera, typhoid, dysentery etc, those were dispersing by polluted or un-pure water and by lack of water for hygiene. These illnesses have been strong eradicated in developed nations, although detonations can still occur. In the year 1993 an infestation of cryptosporidium which is a protozoa that causes gastrointestinal illness, it killed approx 110 people. The water treatment system of cities was in compliance with the federal and state regulations at that time, but after the detonation of federal regulators enhanced testing requirements for turbidity in drinking water, an indicator of possible polluted water.

1.4 OZONE: -

Ozone was first discovered by Dutch philosopher Van Marun in 1785. In 1840 Schonbien reported and named ozone from Greek word "ozein", meaning to smell. The earliest use of ozone as a germicide occurred in France in 1886, when de Meritens demonstrated that diluted ozonized air could sterilize polluted water. In 1893, the first drinking water treatment plant to use ozone is constructed in Oudshorn, Holland. Over 100 years ago it had been demonstrated that ozone O₃, the unstable triatomic allotrope of oxygen could destroy molds and bacteria, and by 1892 several experimental ozone plants were in operation in Europe. Ozone (O₃) also called trioxide. It is a molecule which is composed by oxygen having three atoms. It is a temporarily existing in a very unstable and reactive state in troposphere. It is so reactive that a suitable container for storage probably does not exist. Ozone is produced by the use of energy to subjecting oxygen (O₂) to high electric voltage or to UV radiation. The required amounts of ozone can be produced at the point of use but the production requires a lot of energy and therefore it is costly.

Physical properties having ozone are:-

Ozone gas has molecular weight of 47.9982 g/mol,

It has Bond angle of 117.47 & Bond length is 1.2716 A,

Vibration frequency of ozone is 1103 cm⁻¹,

Ozone has force constant for bond stretching is 5.74 N/cm or m dyn/A,

It is having a color of like pale blue. Boiling point of ozone is -112°C at atmospheric pressure.

Ozone is partially dissolved in water. When a single oxygen atom (O) forms a tight bond with twin hydrogen (H₂) atoms, we have water (H₂O), without which this planet would be as barren as the moon. Without water in this planet life as we know it cannot exist.

Ozone is a very strong disinfectant & oxidizer. Any pathogen or pollutant present in drinking water that can be disinfected, altered or removed via an oxidation process will be affected by ozone. Some studies also presented the Industrial production of ozone. Ozone is one of the strongest molecules of all; available for disinfection in water treatment, and also it is second only elemental fluorine in oxidizing power. In few studies researches gives the effects of pH on the abatement of biochemical oxygen demand of pharmaceutical industry wastewater treated by

ozone, As Compared to chlorine, which is one of the most common water disinfection chemical, ozone is more than 50% stronger oxidizer and acts over 3,000 times faster of it.

2. MATERIALS AND METHODS:-

For an ozonation process the system consists normally with two apparatus, an ozone generator and an ozone reactor. In the reactor ozone is bubbled into water to be treated. For the treatment of the drinking water apparatus such as ozone generator set-up assembled that consisted of ozone generator with inbuilt ammeter voltage regulator, oxygen cylinder, and two outlet lines bifurcated by a valve. Because of the best disinfection oxidation qualities ozone is widely used for drinking water i.e. fresh water, and ground water. It can be added at many points throughout the treatment system.

Methods includes in ozonation process are:-

- Pre – oxidation
- Intermediate oxidation and
- Final disinfection.
- **Pre – oxidation:** - First of all pre-oxidation is used in drinking water ozonation process, for the treatment of the plant. It is important to enhance the removal of suspended solids and few chemicals during the treatment. For this process some particular oxidants are used include: Chlorine, Chlorine dioxide, Ozone and Potassium per manganate.

Pre oxidation is useful for:-

- Control the biological growths in the treatment plant,
- Control the tastes and odors of the drinking water,
- It oxidizes the organic matters present in the drinking water,
- Oxidizes arsenic present in drinking water to permit its removal by the coagulation , therefore turbidity removal..
- **Intermediate oxidation:** - Oxidation processes in the drinking water occur through the oxidants, ozone and OH radicals. Ozone is a very selective oxidant, OH radicals react fast with many dissolved compounds and the water matrix. For the ozone reactions there were about five hundred or more than it, rate constants have been scale or hydroxide radical reactions the database is even bigger and contains a few thousand rate constants. With the profitable effects of intermediate oxidation the undesirable by-products can be formed by reaction of ozone and OH radicals with water matrix components. Ozonation is usually followed by the biological filtration; so that partly oxidized organic compounds can be mineralized micro- biologically. The latter methods tend to the information on dynamics of the oxidation of a micro pollutant during ozonation of drinking water.
- **Final disinfection:** -Final disinfection means last stage of drinking water disinfection with ozone. This process purifying a medium up to the extend that it by it no longer cause infective disease in humans , plants and animals which come in the contact with medium i.e. mainly in water.

2.2. Ozone disinfection is mainly occurs in following treatments: -

- **Pre-treatment oxidation** — In this, oxidants is added to the drinking water early in the treatment process.

- **Primary disinfection** — A common component of primary treatment of the drinking-water, and it is important cause of granular filter media do not dislodge all the microbial pathogens from drinking water.
- **Secondary disinfection** — It is used to maintain the drinking water quality achieved at the treatment plant throughout the distribution system up to the tap.

This treatment involves following steps: -

- Animation of a bacterial cell by computer.
- Ozone molecule meets up on the wall of bacterial cell.
- Bacterial cell wall penetrates by the ozone and because of this corrosion is germinate.
- Ozone effect meets up on the bacterial cell wall.
- Bacterial cell after it has come in the contact with a number of ozone molecules.
- Finally cell destruction occurs and drinking water is being pure.

3. PROCESS IMPLEMENTATION: -

We set up seven different the sites for the analysis of drinking water. The samples can be taken from the different engineering colleges and from the hostels. The results taken at 7 different days at the different times, we worked on 25 Parameters in Oxidation and different types of methods in Ozonation and found the difference in the process.

3.1. Performed method : -

We took parameters for purification of drinking water such as Odor, Color, pH, COD, BOD, Taste, Turbidity, Aluminum, Copper, Zinc etc. and different methods. For color, order and pH are taken in Pt - Co scale and for Turbidity it has a unit of Nephelometry Turbidity Unit (NTU). For all other parameters we have unit of mg/l.

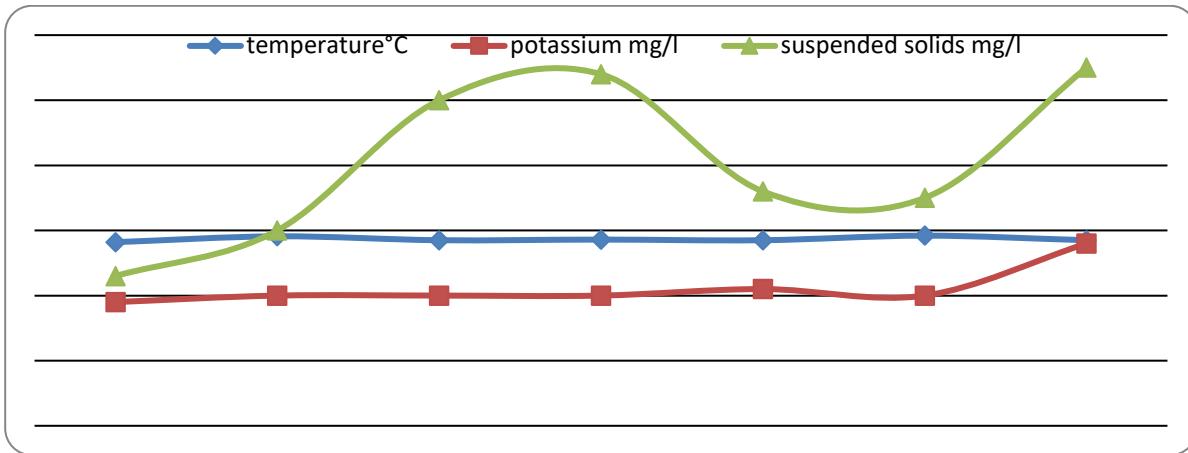
Table3.2. Water quality based determination of Ozone Point application for drinking water treatment: -

Demand of ozone	Water characteristics	turbidity	Where to add	reason
Low	Raw water	Low	Raw water	For only practical purpose
Low	Inorganic materials(clay, slit)	high	After pre-sedimentation	Decrease ozone demand
High	Dissolved constituents (Br, Fe, Mg...)	low	Raw water	Biological treatment for bio degradable organics
High	High conc. Of inorganic material	high	After sedimentation & filtration	Very high organic may require biological treatment

In above table we mention about the demand of ozone in purification of drinking water treatment. Here the demand of ozone is low for raw water and water having inorganic materials like clay, slit etc. in this condition the turbidity is low for raw water and high for water having inorganic materials. These characteristics are for only practical purpose. The water having dissolved constituents as such as Br, Fe, Mg, and high conc. Of inorganic materials needs high demand of ozone dose. We also show where (after which process) ozone should be added.

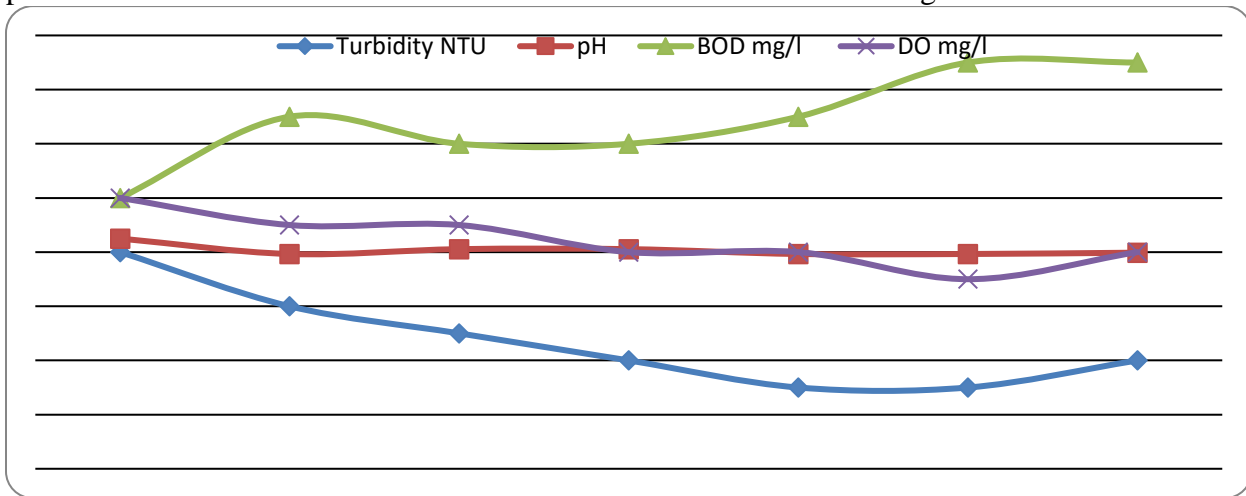
4. RESULTS AND DISCUSSIONS

In Graph 4.1 we practice about comparison between oxidation and ozonation from which, we found by ozonation we get better results as we can see in the following graphs.



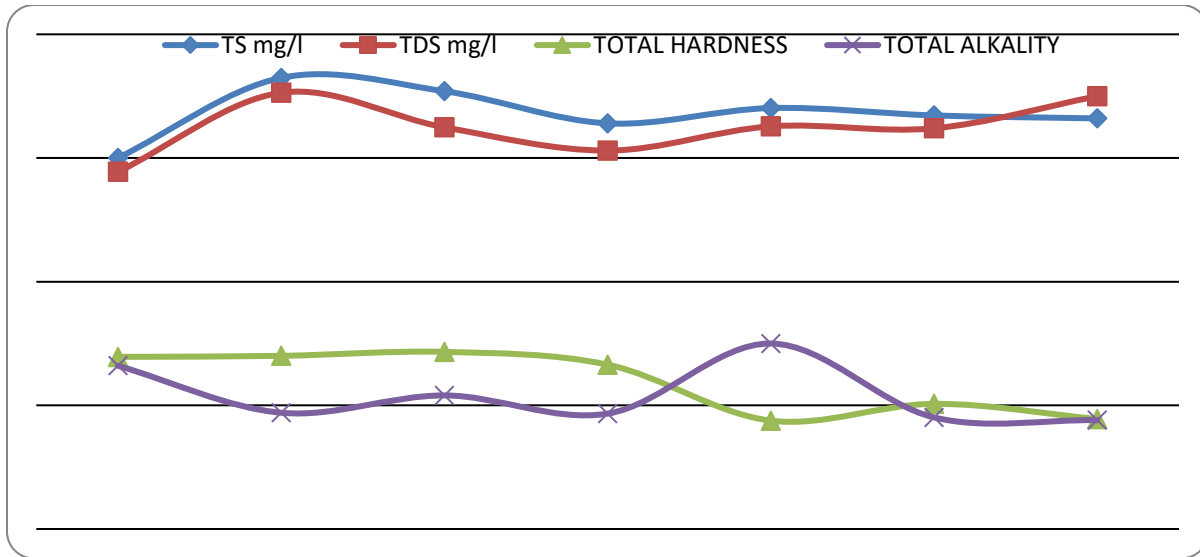
Graph 4.1

Here we can show the different results of temperature, potassium and suspended solids by oxidation process. After this we also practice all these parameters by ozonation with its different processes and we find better results which can be considered best for drinking water.



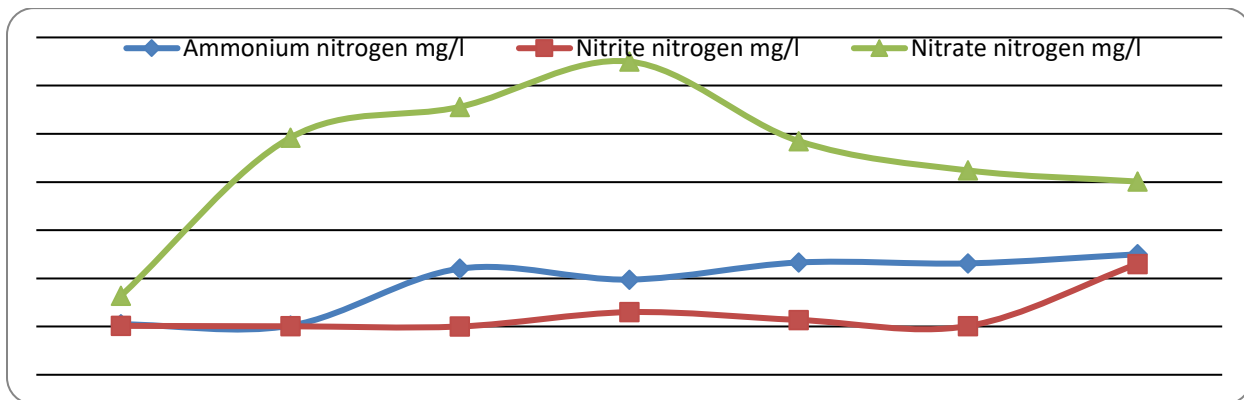
Graph 4.2

In graph 4.2 it depicts about different readings of turbidity, pH, BOD and dissolved oxygen by oxidation as mentioned in table, by which water is not enough pure and by ozonation they were given fair results for all samples taken which can be considered better for drinking.



Graph 4.3

In graph 4.3 we shows the results of total solids, total suspended solids, total hardness and total alkalinity with ozonation and oxidation of all samples and found, ozonation gives better results of all samples.



Graph 4.4

Here in graph 4.4 it shows the different readings of ammonium nitrogen, nitrite nitrogen and nitrate nitrogen by oxidation process and by ozonation with its different processes gives better results for drinking water.

When compared to other drinking water treatment alternatives, such as air stripping and activated carbon, AOP (advanced oxidation process) is an emerging technology. Presently, there are only a few cases where organic contaminants as like PCE (Tetrachloroethylene) and NDMA (N-Nitrosodimethylamine) are being removed from drinking water using an AOP. To assess the Ozonation processes with respect to oxidation by ozone and OH radicals, the concentrations or the exposures to both oxidants have to be known. Ozone concentrations can be easily measured by electro chemical, optical or colorimetric methods.

5. CONCLUSIONS: -

Ozone disinfection of drinking water shows very sufficient effects. In particular for drinking water, regarding reutilize where pollutants such as harmful bacteria viruses are the target micro organisms. Ozone treatments implementation will be the most effective, if it is evaluated on site by site basis. Disinfection of drinking water by ozone process is very highly effective against a large range of pollutants and pathogens and it also including *cryptosporidium*. Main limitation of ozonation process for drinking water systems is, it produce the bromated ions. However; the methods controlling bromate formation have been developed.

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