Drinking Water Purification with Ozone Process of Ujjain City

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Abstract:-

Drinking water quality must be managed in such a way that has no adverse health effects are encountered. Such hazards are usually attributed to contamination. Disinfection of water and wastewater with oxidation appears to be a potential alternative to the use of chlorine as a disinfectant. Chlorine has the disadvantage of forming potentially toxic and carcinogenic by-products, like as trihalomethanes and haloacetic acids. This concern, coupled with the facts that germicidal ozonation is effective in the inactivation of a variety of microorganisms and does not produce undesirable by-products as a viable disinfectant for drinking water.

This paper discusses the effect that ozone take in the contaminants present in the drinking water and how it ozone reduce that contaminants, focus is on Ujjain.

History:-

1886: Ozone recognized as a disinfectant for water. 1891: Pilot Plant proved effective against bacteria in Germany.

1893: First ozone drinking water treatment facility in Netherlands.

~1903: First plant built in the U.S.A., in Niagara Falls, NY.

By 1915 About 50 major ozone water treatment facilities in Europe. WWI Poisonous gas research leads to the development of cheap Chlorine production methods. The war and the chlorine competition slowed down ozone expansion.

In 1936 only France had approx hundred treatment facilities of ozone water as they found it has a property to remove taste and odor, along with iron and manganese, while still disinfecting their water supplies. 1940 Oldest currently operating plant in US came on line in Indiana.

1970s Concern over chlorination by-products began in US.

1990s Cryptosporidium renews interest in ozone treatment.

Introduction:-

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 Oudshorrn, 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 trioxygen. 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.

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(*Ashish Gome and Kanjan Upadhyay 2013), 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. Both chlorine and fluorine are highly toxic chemicals.

There are few common uses by ozone are given:-

1) algicide - very effective, most if not all,
2) Ozone is used as a very effective deodorizer, most are removed,
3) fungicide - it is very effective, all known,
4) fungicide - very effective, all known,
5) oxygenator - ozone is also used as an oxygenator is extremely effective, particularly wells,
6) softness - for the softness of drinking water, somewhat effective, assists & improves specifically,
7) turbidity - turbidity is quite effective of ozone, it prepares inorganics and organics for filtration,
8) Used as decolorizer, usually effective, organic & inorganic,(simple & complex), mineral & carbon.

after treatment by ozonation process drinking water can be expected to be:- clearer, colorless, non staining, odorless, palatable, safer & oxygenated.

Physical Properties of Ozone:-

Physical properties having ozone are:-

Ozone gas has molecular weight of 47.9982g/mol,
It has Bond angle of 117.47 & Bond length is 1.2716A,
Vibration frequency of ozone is 1103cm-1,
Ozone has force constant for bond stretching is 5.74 N/cm or mdyn/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.

Drinking water –

Drinking water is the most important resource on our planet. But not all water present is naturally suitable for human consumption. Apart from course pollutants, far more dangerous pollutants often crop up; Viruses, bacteria, parasites or micro pollutants which cannot be removed with simple filtering technologies. Continuous degradation of the quality of water can contribute to scarcity of water cause to limited availability for both the use of human being as well as ecosystem (Murty and Kumar, 2011). These harmful micro-organisms and contaminants can be oxidized in an eco friendly manner with ozone. The use of ozone is often the only and most effectual technology for providing good & high- quality drinking water. Some reports emphasized on the risk in which the use of pharmaceutical compounds on surface water directly and indirectly involved (Schaar et al., 2010). Pesticides are used in the agriculture to improve productivity of crops by protecting them from disease and infestations. (EFSA, 2015; Handford et al., 2015). The ingestion, process of the food contaminated with pesticides residues are associated with the reproductive, endocrine and also nervous system disorders, as well as risk of cancer (US EPA, 2014; Blaznik et al., 2015; Chiu et al., 2015). Some reports presents the corona discharge method can obtain high concentrations of O3 at a very low cost; however, The UV radiation also can be used for the commercial production of O3 but with a lower concentration and yield (Tapp and Rice, 2012). Ultra sound represents a wide range of frequencies beyond human hearing capacity, range of its frequencies varies from 20 kHz to about 20MHz. Ultrasound is generated from mechanical or electrical energy with an ultrasonic transducer (Botha, 1993). Pre-diffusion cleaning and its applications to the photo resist removal, of treated water with ozonation process ozone decomposition, chemistry of ozone with organic species, and also simulation of the ozone decomposition. (SangWoo Lim and Christopher Chidsey) (Stanford University) February 29, 2000. Nelson, S. L. and Carter, L. E., (1999). Some researchers presented the biological treatment in which both the chemical and biological oxidations of drinking water involved (Scott et al., 1995). “A Process Used by Ozonated Water Solutions to Remove Photo resists After Metallization”. There are more than 50 bacterial species and approx 70 distinct sero groups, presently includes by the genus Legionella. Many of these species are considered pathogenic (DSMZ, LPSN, 2014; Pearce et al., 2012; Bartram et al., 2007; Fields et al., 2002). In the mid-1980s, the future of ozone in drinking water treatment seemed bright. However, Japanese researchers had just reported that the bromated ion in drinking water apparently is capable of causing kidney carcinomas in rats (Kurokawa et al., 1986). Few studies reported in the field of medical science in which Ozone and Its Usage in General Medicine and Dentistry are studied.Seidler V., Linetskiy I., Hubalkova H., Stankova H., Smucler R., Mazanek J. (February 26, 2008; June 9, 2008). A petition is submitted in August 2000 to the Food and Drug Administration (FDA) for approval of ozone as a direct food additive for the treatment, storage and processing of foods in gas and an aqueous phases has been recently accepted (Federal Register 2001). Present study deals with the ozone treatment of the industries of drinking water treatment and assessment of biochemical oxygen demand reduction, post

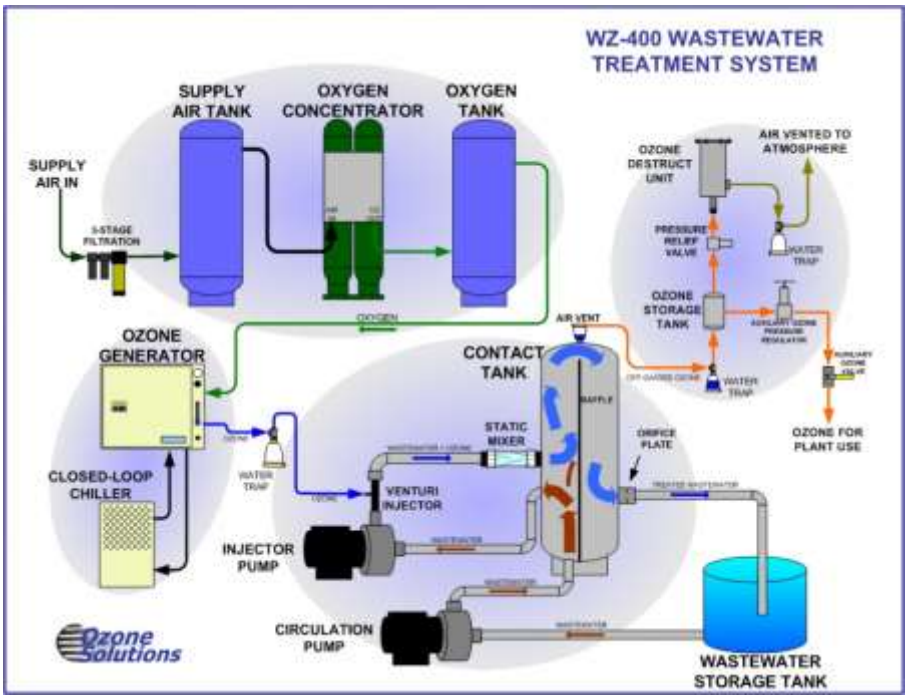
ozonation. BOD can measures the pollution level in the drinking water and gives the amount of biodegradable matter required to drink that water. It gives the additional amount of oxygen which is needed for microorganisms to biodegrade the matter present in water sample. BOD of a particular water/wastewater/drinking water sample depends on the microorganism's capacity which is added in the matter or it may be already present to digest the matter, aerobically. The biodegradability assessment of industrial wastewater and drinking water is also significant for the better analysis of removal efficiency (Arslan Alaton, 2002). Thus, for the determination of biodegradability of drinking water i.e., BOD/COD ratio, measurement of BOD Is very important.

Materials Sampling And Methodology:-

The samples of drinking water were collected from different areas from the govt. engg. collage Ujjain, in Ujjain (m.p.).

Heavy metal analysis on the drinking water was done to analyze copper (Cu), cobalt (Co), cadmium (Cd), nickel (Ni), chromium (Cr), lead (Pb), molybdenum (Mo), and manganese (Mn) and zinc (Zn).

removal of inorganic species present in drinking water are eliminated most of the time using by pre-oxidation.(Rice and gomez taylor 1986). However pre ozonation process must be followed by filtration. in that way metallic ions can removed, likewise they form insoluble species over ozonation process.(Bourbigot; 1983 , Nieminski & Evans; 1985).



Methodology:-

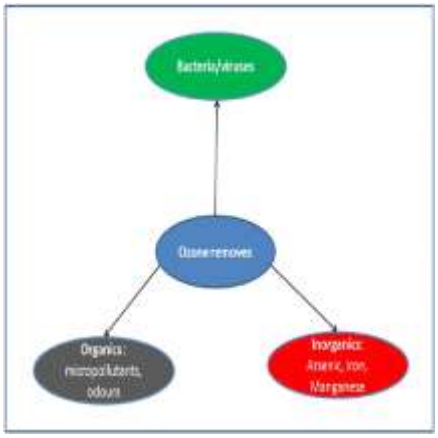
For an ozonation process the system is consists normally with two apparatus, an ozone generator and an ozone reactor. In the reactor ozone is bubbled into water to be treated.

For the treatment of the drinking water apparatus such as ozone generator set-up assembled that was consisted of ozone generator with inbuilt ammeter voltage regulator, oxygen cylinder, and two outlet lines bifurcated by a valve.

Results and the Effect of Ozone:-

The effectiveness of the ozone is resulting by powerful oxidizing effects of it, on the chemicals and micro-organisms these chemicals and caused by the generation of reactive oxygen species during ozone transformation to oxygen. Ozone molecule is directly attacks on the surface of

micro-organisms and destroys their cell walls. When this process occurs the cells lose their cytoplasm and can no longer reactivate themselves. Ozone can induce an oxidative degradation of many organics and leaves more biodegradable compounds. Besides of it ozone can also oxidize metallic ions as like iron Fe(II), magnesium Mn (II) and arsenic As(III) producing insoluble solid oxides that can be easily separated from water by sedimentation and filtration.



Here the different types of contaminants removed by ozonation shows below:-

Cost and Considerations:-

The cost and consideration of the ozone disinfection systems is depend on the manufacturer, the site, and the capacity of the plant in which it is treated, and also the characteristics of the wastewater to be disinfected. The costs of this ozonation process are generally high when it compare to the other disinfection techniques. For the removal of the micro contaminants present in drinking water, there are additional operation costs for ozonation in which it is combined with sand filtration are around 3-4 Swiss cents/m3).

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