APPLICATION OF OZONE GAS ON MICROBIAL POPULATIONS ON SAMPLES COLLECTED FROM THREE DIFFERENT PLACES OF FAIZABAD

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Abstract: The lethal concentration of ozone in water of three stations (Saryu River, deep well and municipal water) has been determined for bacteria i.e. total coliform, *E. coli*, salmonella and *staphyllococci*. The threshold concentration of ozone gas for the microbes is found to be in the range of 0.082-0.112 mg/1 and the effective time is obtained to be in the between 15-20 min. It seemed evident that, in the treated cultures the ozone attacked the primary structure of nucleic acid or their decomposition products only after they had been released into the medium by leakage or lysis. Indeed, this method is found to be technically feasible and economically viable for the treatment of polluted water for different purposes.

***Index Terms* - Microbiology, Ozone, Coliform, Diseases.**

I. INTRODUCTION

The treatment of polluted water to provide microbiologically safe, aesthetic, potable end product has been normal practice since long before. Discharge of untreated sewage and effluent into water reservoir leads to water quality deterioration due to high microbial contamination (Shukla and Pandey, 2001; Pandey et. al., 2002; Meenakumari and Hosmani, 2003). The microbial examination of water enjoys a special status in pollution studies as a direct measurement of deleterious effects of pollution on human health. However, contaminated water may harbor bacteria capable of causing typhoid, diarrhoea and cholera. These organisms may be present in water bodies, contaminated by domestic sewage and other pollutants. Saryu River receive sewage, domestic waste and industrial effluents. Therefore, it becomes essential to examine the presence of pathogenic organisms in water bodies and their possible abatements through ozonation. As an alternative to chlorination in drinking water disinfections, ozonation of the water supplies has become an established means of disinfections (Hann and Manely, 1952; Rice et al. 1981 and Chaudhary and Pandey, 2003). Reports regarding the effect of ozone on physicochemical characteristics of water (Rosen. 1979; Rackness 1987: Renner, 1988; and Kirpalani, 2004) are available but its effect on microbial population is very scanty. Keeping this in view, the present study has been carried out to assess the effect of ozone on microbial populations of three stations of Faizabad (Saryu River, Deep well and municipal water) at different doses for different periods.

II. MATERIAL AND METHOD

In the present study three different sites viz., A, B, C of each stations (Saryu River, deepwell and municipal water) were considered for the microbiological examinations. The Site- A (Guptar Ghat), Site-B (Raj Ghat) and Site-C (Cremation Ghat) were chosen for the Saryu River. The A -(Janura), B- (Fatehganj) and C- (Sahebganj) sites were chosen for the Deep well water, and the Site- A (Civil Lines), Site -B (Amanigan)) and Site -C (Lalbagh) were chosen for the Municipal water. In order to assess the microbiological examination of water samples of three sites of each station, were collected in clean, sterilized, narrow mouthed neutral glass bottles. Grab sample method was adopted for the collection of sample from different sampling points. For the studies of microbial population, samples were taken in 1000 ml sterile borosil bottle. Samples were collected fortnightly throughout the period of experimentation. Characterization and preliminary identification of bacteria were made on the basis of morphology, motility, colony characteristics as per standard methods (APHA et. al., 1998). The observations were made ten times. Microbiological populatio n was represented as mean of ten replicates before and after exposure of ozone gas in laboratory conditions. In order to produce ozone gas, Ozone generator was used. It was procured from M/s Precision Instruments, Varanasi. In this system Ozone is produced by ultraviolet (UV) exposure of air passing through the ozonator module where a portion of oxygen (O,) present in the air is converted into Ozone (03). The instrument is calibrated for UV radiation of 186 nm to produce 0.1% ozone in air. Ozone generation was done by the earlier standard method (Chaudhary and Pandey, 2003).

In order to assess the effectiveness of ozone gas on the reduction of microbial population, reactor was used for ozone gas mixing. The dissolution of ozone gas in water samples (Saryu River, Deep well and Municipal Water) was varied between 0.021-0.112 mg/1 and the effective time of ozone potential was found to be between 15-20 min. In the present study the effective concentration of ozone gas was found to be between 0.082 to 0.112 mg/l in all samples of water.

III. RESULT

Changes in microbial population of Saryu river water following exposure of ozone gas have been presented. The water samples collected from Saryu River were observed with high fluctuation in microbial population and beyond the permissible limit (1/100m1) at all the three Sites. The Total coliform was recorded as 94, 403 and 109/ 100m1 at Sites A, B and C respectively. The *E.coli* was found as 85, 151 and 95/100 ml at the A, B and C sites, respectively. The *Staphyllococci* was recorded highest at Site B (87/ 100 ml), followed by site- A (42/ 100 ml) and site- C (38/100 ml). The Salmonella was observed highest at site B (49/100 ml), followed bysite C (35/100 ml) and site -A (31/100 ml).

T. coliform was found to be reduced 100% following 15-20 min exposure of ozone gas at all sites of Saryu river. *E. coli* was reduced 100% at A and B sites following exposure of ozone gas for15-20min. Meanwhile, it took less time (10-15 min) for the 100% reduction at C site. The reduction was same in the case, of *Staphyllococci* at Site-A and- B; while it took less time (10-15 min) at C site. The 100% reduction was seen in Salmonella population at Site- A after 5-10 min while at Site- B and Site -C it took 10-15 min for 100% reduction.

Microbiological characteristics of deep well water samples were observed with fluctuations, which were beyond the permissible limit (1/100m1) at all sites. The Total coliform was recorded as 22, 68 and 124/100 ml at Site- A, B and C respectively. The *E.Coli* was found at Site-A, B and C- as 20, 56 and 80/100 ml, respectively. The *Staphyllococci* was found absent at A and B site and 32/100 ml at Site- C. The Salmonella was observed highest at Site-C (46/ 100 ml), followed by Site- A (5/100 ml) and absent at B site. An ozone gas was taken 15-20 min time for the 100% reduction of T. coilform at A and B sites while 20-25 min was found to be at C site. The *E.Coli* was reduced 100% after 15-20min exposure of ozone gas at B and C sites and it took 10-15 min at Site-A. The *Staphyllococci*was reduced 100% after 15-20min exposure of ozone gas at C site. Salmonella was reduced 100% after5-10 min exposure of ozone gas at Site -A while 15-20 min at Site-C. The Total coliform of municipal water was recorded beyond the permissible limit at A, B and C sites as 37, 105 and 167/100m1, respectively. The *E.Coli* was found as 19, 43 and 46/100ml at A, B and C sites, respectively. The *Staphyllococci* was found totally absent at all sites of municipal water. The Salmonella was found to be absent at Site-B, while it was recorded as 16/100 ml and 21/100 ml at A and C sites, respectively. T. coliform was completely reduced after 15-20 min exposure of ozone gas at A and C sites while it took 20-25 min exposure at B site. The *E.Coli* was reduced 100% after 15-20 min exposure of ozone gas at all sites. The *Staphyllococci* was found absent in municipal water. The Salmonella was reduced 100% after 15-20 min exposure of ozone gas at A, B sites while it took 20-25 min at C site.

IV. DISCUSSION

A significant microbial population was not seen in water samples of deep well and municipal water while Saryu river water contained heavy microbial population which were found to be beyond the permissible standards (ICMR 1963; BISJS 10500; MHW 1975). Water of open source contains sufficient nutrition to maintain the development of microorganism the richer in organic matter, the greater quantity of microbes can water contains. The water of river always becomes richer in bacteria after it passes through town. Coliform is a general terms used to represent aerobic, facultative anaerobic, gram negative, non-sporulation bacilli bacteria which produce acid and gas by fermenting lactose. The typical species of this group are E. coli and *Stayphyllococci. E. coli* normally inhabits the intestinal tract of man and other animals whereas*Staphyllococci* most frequently on grain and plants but may inhabit the faeces of man and other animals.

In present investigations the microbial population of river, deep well and municipal water are fluctuating from site to site. The Total coliform varied between 94 to 403 /100ml, 22 to124/100ml and 37 to 167/100m1 in river, deep well and municipal water, respectively. The population of *E.Coli* varied between 85-151/100ml, 20-80/100ml and 19-46/100ml in River, deep well and municipal water, respectively. The population of*Staphyllococci* was varied between38-87/100ml in Saryu river water. It contained only in deep well water at Site-C while it was totally absent in site -B. The population of Salmonella varied between 31-49/100ml, 4-46/100ml and 16-20/100m1 in River, deep well and municipal water, respectively. The population of *E.coli* showed similar fluctuation trend as in case of Total coliform whereas, *Staphyllococci* is totally absent in municipal water while Saryu River showed fluctuating trends as in case of total coliform. Population of Salmonella also showed similar trend as Total coliform. The microbial population was found to be maximum in Saryu River, at highest at B site. Several reports were available that polluted river contained microbial populations (Pandey et. al., 2002:Koshy and Nayer, 2002; Meena Kumari and Hoshmani, 2003; Sharma et. al., 2003: Rayee and Prakasam, 2003) at different situations.

The reduction in microbial population in water following treatment with ozone gas is important for the maintenance of good water quality. Ozone is an excellent disinfectant due to its high oxidation potential and low toxicity in treated water. The destruction method of ozone is more of an oxidizing action than a metabolic reaction. According to Block, (1982) ozone is a very effective bactericides and viricide with inactivation of bacteria and viruses taking place as quickly as 10 s to 5 minutes but in the present investigation the maximum reduction in the number of bacteria was found to be between 15 to 20 min of treatment of ozone which are accordance with the results of several workers in different Situations (Davis ,1959; Goinvarch,1959: Scot and Lasher, 1962 and Broadwater et. al., 1973). It was assumed that lysis of cell would result from a direct contact between the ozone bubble and the microorganisms. In similar type of experiment Broadwater et. al.,(1973) found that threshold concentration of toxicity of ozone for Bacillus cereus was approximately 0.12 mg/I. whereas for E. coli was approximately 0.19 mg/l. These values correlate well with those cited in the literature, especially for E. coli. The threshold value was found to be ranging from 0.1 to 0.2mg/l of residual ozone as effective for killing E. coli. (Whitson, 1950: Bringman, 1954 and Bean, 1956) Indeed, in the present study it has been observed that effective concentration of ozone was found to be between 0.082-0.112 mg/l and that was more effective between 15-20 min time exposures at all sites of each station for the reduction of microbial populations.

Ozonation is very effective than other treatment methods, which reflects the oxidizing properties in the ambient water. Because of the non-accumulation, less residual, less time taking, low operative cost and this was an economical approach in improving the water quality. To improve the water quality of Saryu River / other water bodies at Faizabad, it is necessary that all the drains should be diverted before joining the river and /or ozone treatment processes would be adopted for the improvement of water quality for various purposes.

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