ASSESSMENT OF WATER QUALITY

Pooja. D. Somani[1], Siddharath Ray[2], Sanjay Singh[3]
Assistant Professor, Department of Civil Engineering,
Saraswati College of Engineering, Kharghar, Navi Mumbai
[1]poojadsomani@gmail.com, [2]raysiddhartha93@yahoo.com, [3]sanjaysingh511@yahoo.com

Abstract: Potable water when passes through the distribution system deteriorates in its microbial quality. Further the quality of water deteriorates as it is stored in sump tanks, overhead tanks and loft tanks. Since the tanks are not regularly cleaned the quality of water is affected as it reaches the end user. Due to irregular and improper cleaning of the tanks there is an accumulation of organic matter in the tanks due to which the different microorganisms grow in water which leads to spread of various diseases. In this study different sampling sites from Navi Mumbai have been selected which are tested for free residual chlorine and microbial contamination. Study indicates that there is successive increase in the microbial contamination as water passes from sump tank to overhead tank. Maximum contamination is observed in case of water stored in loft tanks. Disinfection of tank can prove to be one of the measures to check the increase in MPN values in water.

Keywords: Water quality, MPN, Free Residual Chlorine (FRC), Disinfection, Superchlorination

INTRODUCTION

Water plays an indispensable role in sustenance of life and it is a key pillar of health determinant, since 80% of diseases in developing countries are due to lack of good quality water. Poor water quality continues to pose a major threat to human health. Diarrhoeal disease alone amounts to an estimated 4.1 % of the total Disability-Adjusted Life Years (DALY) global burden of disease and is responsible for the deaths of 1.8 million people every year [1]. Consequently, water borne diseases such as cholera and typhoid often have their outbreak especially during dry season. High prevalence of diarrhea among children and infants can be due to the use of unsafe water and unhygienic practice. Thus, many infectious diseases are transmitted by water through fecal oral contamination. Diseases due to drinking of contaminated water leads to the death of five million children annually and make 1/6 of the world population sick [2].

Water which is treated by different Municipal bodies, meets all drinking water quality standards at treatment plant and at the point where the water enters the distribution system. Water quality deteriorates in distribution networks and during collection, storage so it becomes obligatory to monitor water quality at each stage. Apart from all monitoring and surveillance, drinking water at tap may not be potable. By the time water reaches the consumer, its quality might be very different from what it was when it left the plant. The management of distribution systems has become one of the most difficult challenges to providing safe drinking water as pipes are buried and not subject to the direct control of water utilities.

Microbial contamination in distribution systems is a potential threat to public health. Pathways for the entry of contaminants into distribution systems include: organisms that survive the treatment process; contaminated ground-water that flows in from outside when pressure in a pipe drops; contamination during the installation or repair of water mains; and backflow from non-potable systems connected to potable water system. Whereas the chemical contamination can occur in the distribution system as a result of corrosion reactions, the accumulation of contaminated sediments, and the intrusion of chemical compounds into the pipes. Intentional contamination is also a potential threat.

The water through the treatment plant is supplied to the consumer through Continuous water supply system or Intermittent water supply. The water passes through sump tanks and overhead tanks before reaching the consumer tap. In some cases due to irregular or insufficient supply of water, additional storage of water is done in loft tanks in individual household. Cleaning of these tanks is often neglected. Since the tanks are not regularly or properly cleaned, there is an accumulation of organic matter in the tanks due to which the different microorganisms grow in water which leads to spread of various diseases. The water quality doesn't change much in other chemical and physical characteristics, but there may be variance in the microbial quality of water coming out of distribution system and finally that of consumer tap. The objective of the study is to assess the bacterial quality of water which actually reached the people through their taps. This study also aims to analyze the degree of deterioration in the bacterial

quality of water due to its storage in sump tank, overhead tank and loft tank. Further the purpose of this study also extends to get the seasonal variation in quality of water which is passing through distribution system, sump tanks and overhead tanks before reaching the consumer.

MATERIALS AND METHODS

Sampling Locations

Study was carried out by collecting samples from selected locations of Navi Mumbai. From each location three samples are collected. One is from the direct supply (before entering the sump tank), second from the tap connected to the overhead tank and the third is from the tap connected to the loft tank. These samples are collected once a month from the period of August to March.

Questionnaire Survey

Detail information regarding the supply hours of the water is collected. Information regarding the cleaning of tanks, cleaning schedules and cleaning method is collected.

Sampling

Samples are collected from the selected sites in plastic bottles. 500 ml of samples are collected from each location. Samples have been collected from the taps allowing water to run waste for two to three minutes or to sufficient time permit the cleaning of service line. While collecting the sample from direct supply care is taken that sample is collected before entering the sump tank. Care is taken to avoid splashing of water during filling of sampling water from the tap. The sampling bottles were not filled up to the brim and two to three centimeter space was left for allowing shaking of bottle before analysis.

Chemical and Bacteriological Analysis

All the samples collected are analyzed for Free available chlorine (FRC) by Orthotoluidine Arsenite test (OTA) as described in the Manual on Water Supply and Treatment (CPHEEO).

Bacteriological characteristics of the water samples were determined using multiple tube fermentation method (most probable number) for enumeration of total coliform count. Lauryl Tryptose Broth (LTB) along with fermentation tubes (Durham tubes) was used. A serial dilution of the water sample to be tested was made and inoculated into LTB growth media. Samples were then incubated at 35 ± 2 °C for 24 h. The analysis was conducted as procedure given in Standard Method for the Examination of water and Wastewater.

Disinfection of loft tanks

Superchlorination is done in the loft tanks at location 2 and location 3. Solution of bleaching powder is added to the loft tank such as to provide the chlorine dose of 8 mg/l. Samples from loft tank are analyzed after 24 hrs and then after every 10 days.

RESULTS

The test results for bacteriological quality of water and for the residual chlorine for different locations indicate that there is a steep increase in the MPN value of the water coming from consumer tap as compared to the direct supply tap. Also there is considerable reduction in the Free Residual Chlorine as the water comes to consumer tap.

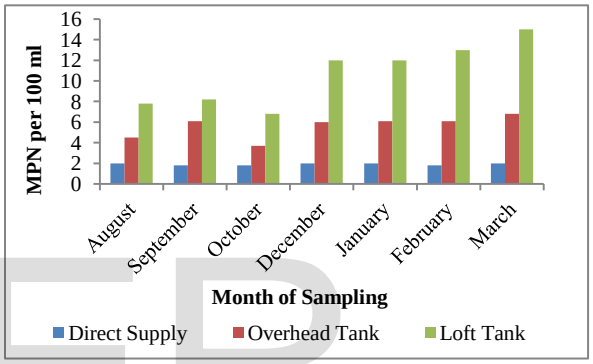

Figure 1 Temporal Variation of MPN for sample 1

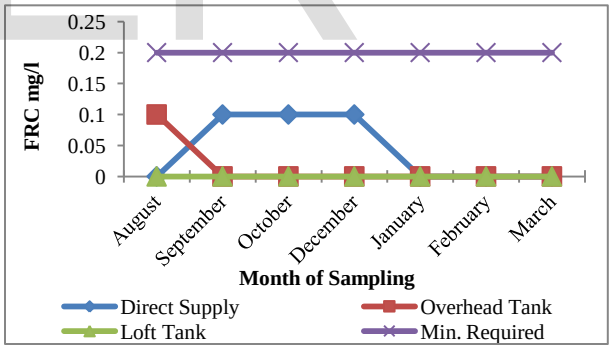

Figure 2 Temporal Variation of FRC for sample 1

For location 1 the results for bacteriological quality and free residual chlorine are given below. The values of MPN range from 1.8 per 100ml to 15 per 100 ml. Maximum value being in loft tank. In all set of samples loft tanks have MPN value is more as compared to overhead tank. This indicates increase in microbial contamination in overhead tank and loft tank. Moreover the microbial contamination increases

successively from august to march in the overhead tank and loft tank.

For location 2 the MPN value ranges from 0 to 14 per 100 ml. The maximum value of free residual chlorine in direct supply water is found to be 0.3 mg/l in the month of august and for this period the MPN value is zero. Disinfection of loft tank is done by doing superchlorination by providing a chlorine dose of 8 mg/l in loft tank. It could be observed that the MPN value in the loft tank after addition of chlorine has come down to zero.

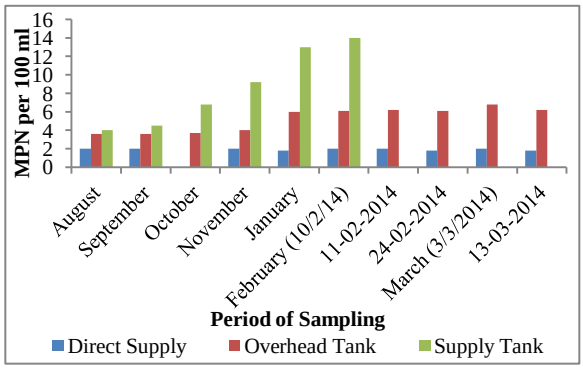

Figure 3 Temporal Variation of MPN for sample 2

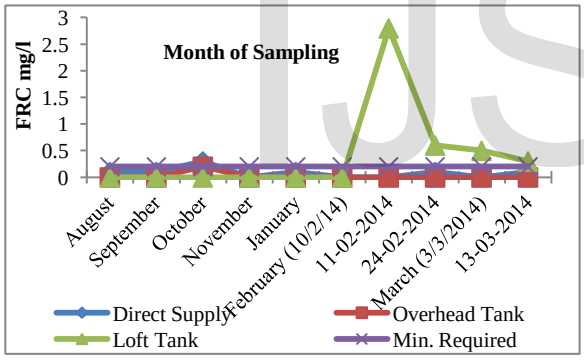

Figure 4 Temporal Variation of MPN for sample 2

For location 3 the MPN value ranges from 1.8 to 24 per 100ml.

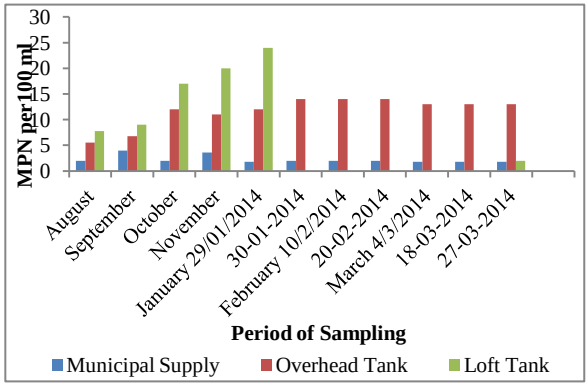

Figure 5 Temporal variation of FRC for sample 3

Maximum value of MPN is observed in loft tank in the month of January.

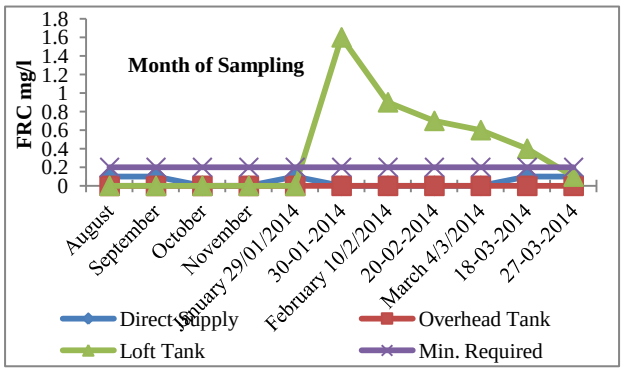

Figure 6 Temporal Variation of FRC for sample 3

Disinfection of loft tank is done in the month of February by doing superchlorination by providing a chlorine dose of 8 mg/l in the loft tank. It could be observed that the MPN value in the loft tank after addition of chlorine has reduced to zero. But after a period of approximately 2 months microbial contamination started to increase again. In case of direct supply water in none of the water sample the free residual chlorine is more than 0.2 mg/l which the minimum amount of chlorine required as per CPHEEO standards.

DISCUSSIONS AND CONCLUSIONS

The study of MPN values at different locations for different period of time indicates that the microbial contamination increases as the water moves from sump tank and overhead tank. And further there is significant rise in MPN values in the water from loft tank.

From the questionnaire survey carried out at above locations it is noticed that the cleaning of storage tanks (sump tanks, overhead tanks and loft tanks) is often neglected. Generally the cleaning of the tanks is done once a year which is not sufficient and may lead to accumulation of organic matter in the tanks. This may finally cause rise in microbial contamination in the storage tanks. Loft tanks which are placed in the household to combat the irregular supply of water are rarely cleaned after their installation. Thus cleaning of storage tanks

is of utmost importance and should be done regularly and with proper care.

Results indicate that when the free residual chlorine in the direct supply water is at least 0.2 mg/l the MPN value is zero. But of all the samples taken only one sample has the free residual chlorine of 0.2 mg/l. Therefore care must be taken by municipal bodies that the free residual chlorine at the farthest consumer end must be 0.2 mg/l. If the MPN value at entry level is less or more precisely zero than its further increase can be vetoed.

When super chlorination is done for the loft tank, the free residual chlorine content of the water was as high as 2.8mg/l and thus the MPN value has reduced to zero. The zero MPN value of water in loft tank after superchlorination continued for the period of one and half month to two months. But as, when the free residual chlorine content of water again felled below 0.2 mg/l there started rise in the MPN value. Thus the loft tanks which are not usually cleaned should be disinfected by providing superchlorination using bleaching powder at a interval of 2 months. But in no case the water from loft tank should be used for drinking.

Thus it could be concluded that the minimum free residual chlorine dose of 0.2 mg/l must be provided at consumer end. Also regular and proper cleaning of storage tanks along with disinfection is very much important for safeguarding water from increasing microbial contamination.

References

[1] WHO, Guidelines for Drinking-Water Quality. Recommendation, 3 ed., vol. 1, Geneva, 2006.

[2] A. I. Mustafa, A. A. Ibrahim, Y. I. Haruna and S. Abubakakar, "Physicochemical and bacteriological analyses of drinking water fromwash boreholes in Maiduguri Metropolis, Borno State, Nigeria," *African Journal of Food Science*, vol. 7, no. 1, pp. 9-13, 2013.

[3] A. P. H. Association, Standard Methods for examination of water and waste water, 20 ed., Washington, 2003.

[4] CPHEEO, Manual on Water Supply and Treatment.

[5] B. O. I. Standards, "Specification for Drinking Water IS 10500," New Delhi.