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Analysis of Microbiological Quality of Water at Housing Societies

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Abstract: Treated water gets deteriorated in its microbial water quality during its passage in distribution system. 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 kalian, Mumbai and 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, Disinfection, Superchlorination

INTRODUCTION

The quality of drinking water is a powerful environmental determinant of health. 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. Consequently, water borne diseases such as cholera and typhoid often have their outbreak especially during dry season.

Water distribution systems play a pivotal role in preserving and providing quality water to the public. Drinking water supplies meet all quality standards at the water treatment plants, at the entry point in water distribution system. Water quality deteriorates in distribution networks, during collection, storage and so it becomes obligatory to monitor water quality at each stage. Many systems fail to meet the quality standards at the consumer taps because of water quality deterioration in the distribution system, or during storage of water in sump tanks or overhead tanks. 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 presence of microbial pathogens in water is often associated with contamination of fecal matter. This has led to the use of fecal indicators ,such as Escherichia coli, to monitor drinking water quality.

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., Mumbai, kalyan 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 Total residual chlorine and Free available chlorine by Orthotoluidine Test (OT) and 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

For location 1 i.e from kalyan it could be seen that municipal supply water has higher values of MPN. All the samples have very less Free Residual Chlorine.

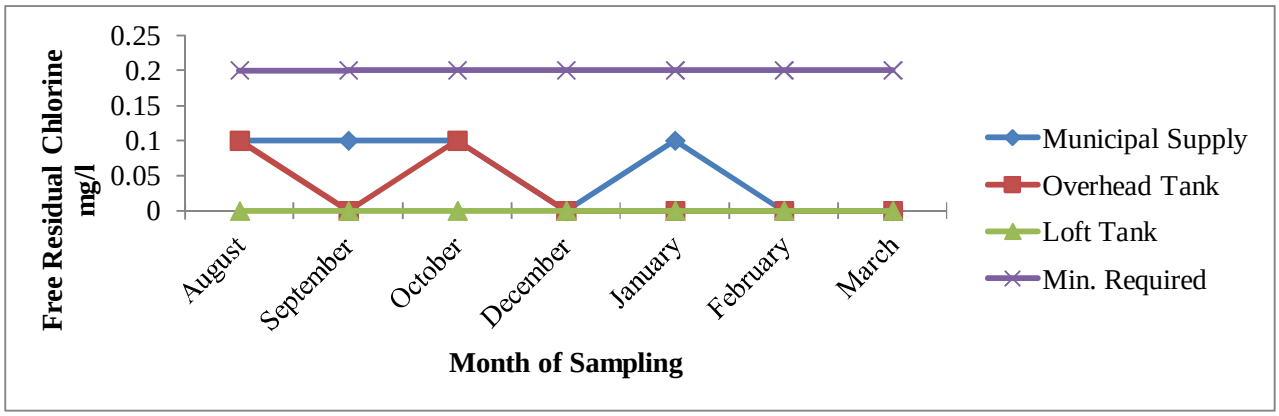


Figure 1 a. Temporal Variation of Free Residual Chlorine

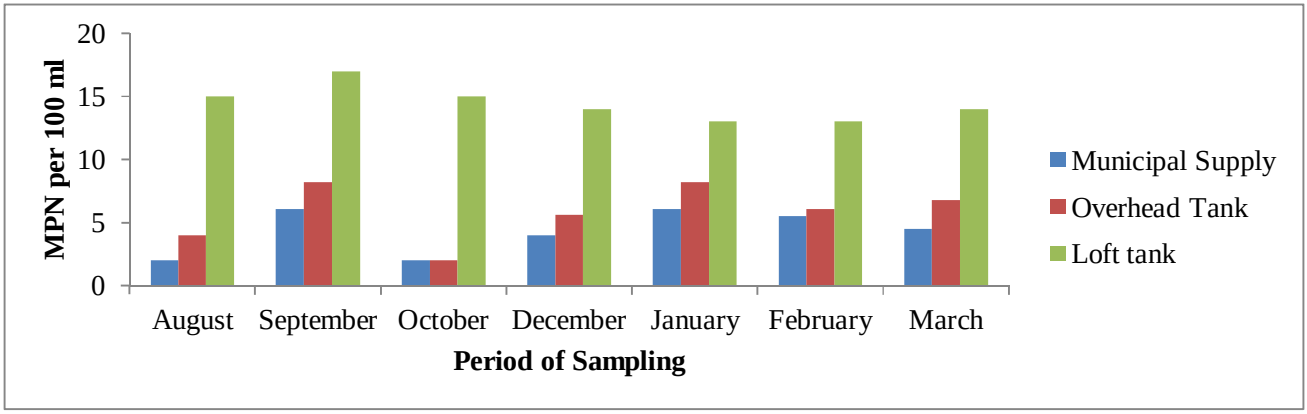
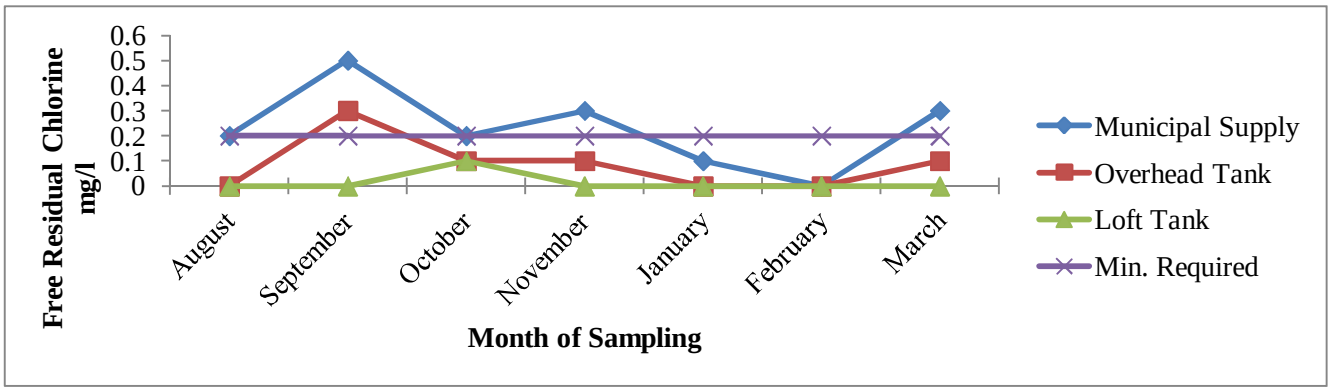


Figure 1 b. Temporal Variation of MPN

MPN values in direct supply water ranges from 0 to 6.1 per 100ml.And the loft tanks have still higher values of MPN going upto 17 per 100 ml. Cleaning of Sump tank and Overhead tank is done manually which involves cleaning of these tanks by scrubbing. The dirty water is then removed from the tanks manually.

Disinfection of the tank is not done before refilling of the tank. These leads to continued higher levels of MPN in overhead tank water. Also the MPN values in municipal supply water are higher For loction 2 i.e from Goregoan, Mumbai it is observed that none of the sample meets the minimum requirement of free residual chlorine at consumer end i.e of 0.2 mg/l.



The higher free residual chlorine is maintained in the month of September for municipal supply sample.

Figure 2 a. Temporal Variation of Free Residual Chlorine

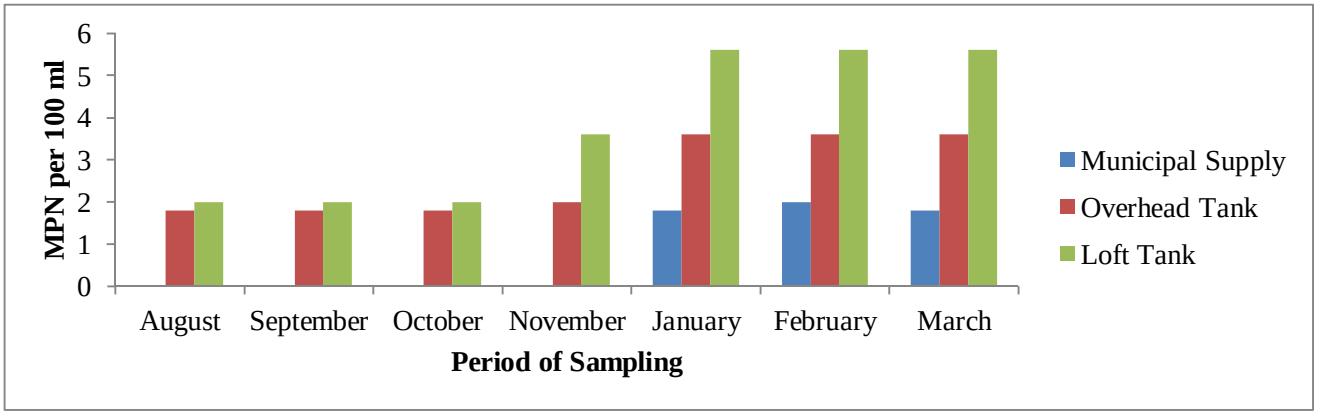


Figure 2 b. Temporal Variation of MPN

Out of seven samples taken at this location three municipal supply sample were positive for MPN. MPN value ranges from 1.8 to 2.0 per 100 ml. This value increases considerably in case of overhead tank with MPN value of 3.7 to 6.8 per 100ml. Further this value increases as water comes out from loft tank with MPN as high as 15 per 100ml.

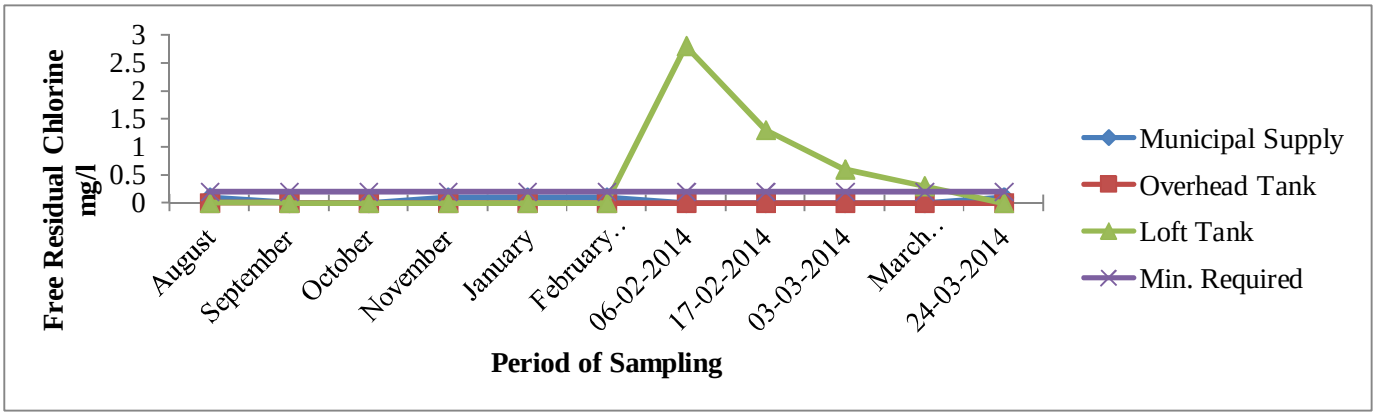


Figure 3. a. Temporal Variation of Free Residual Chlorine

It could be observed that the free residual chlorine in municipal supply water decreases from the month of December thus increasing the MPN value of water. The higher value of MPN in loft tank can be attributed to the fact that the free residual chlorine in loft tank in all cases was zero. As the cleaning of Loft tank is not taken care off despite of zero MPN values in Municipal Supply sample, Overhead tanks and loft tank samples are positive in MPN.

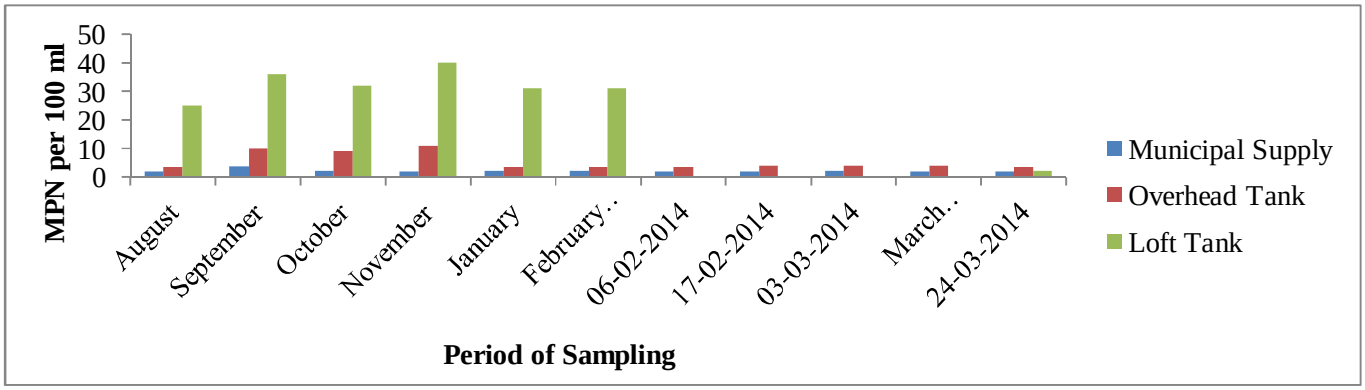


Figure 3. b. Temporal Variation of MPN

For location 3 i.e from seawoods, Navi Mumbai it is observed that none of the sample meets the minimum requirement of free residual chlorine at consumer end i.e of 0.2 mg/l. All the samples from municipal supply were positive for MPN. MPN value ranges from 3.6 to 11 per 100 ml. This value increases considerably in case of overhead tank with MPN value of 5.5 to 14 per 100ml. Very high value of MPN are observed in loft tank ranging from 25 to 40. On 5th February 2014 super chlorination is done for the loft tank water. A chlorine dose of 8 mg/l is provided. Free Residual chlorine and MPN values are recorded every 10 days. It is observed that the MPN value had dropped to zero immediately after addition of bleaching remained same till the end of March month. And again the contamination was noticed in the loft tank. The MPN value observed on 24th March 2014 is 2.0 MPN per 100ml.

DISCUSSIONS AND CONCLUSIONS

Form the set of readings of MPN at different locations for different period of time it could be observed that 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 different 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 very less number of samples 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.

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