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Physico-chemical characterization of water from drinking water Treatment Plants (WTPs) around Kolhapur city of Maharashtra, India

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Abstract: Quality of drinking water has always been considered important in public health paradigm. Provision of potable water to people is necessary in assuring health as well as prevention of spreading of water born diseases. Treatment of water is traditional practice in public distribution system in cities and towns all over the world. Kolhapur is industrial, educational and cultural city in the Western Maharashtra getting considerable rise in population each year. Water supply to citizens is through pumping stations located at outskirts of the city which are looked after by Municipal Corporation. Various characteristics like pH, turbidity with other chemical characteristics which are important for drinking water were analyzed for six months continuously. Samples from inlet and outlet were taken for analysis to check the efficiency of the WTPs. Further tap water analysis was also carried out to asses any influence of piped water distribution. All plants are seen to be efficient in terms of drinking water limits prescribed by different agencies with indication of requirement of supplementary water treatment with provision of advanced technology while considering the rising population of the city. The results obtained about drinking water characteristics are discussed in the paper.

Keyword: characteristics, drinking water, Kolhapur, Water Treatment.

INTRODUCTION:

Water is the most essential resource on earth surface to meet needs of living beings and to get them survived. It is most vital for continuation of biological and physical systems in routine life. It is at the same time under degradation in terms of quality and quantity due to pollution and mismanagement at all levels. Drinking water acquires first status if we consider various uses of water. Therefore, it is determinant of health of all living entities. Large number of population in the world is devoid of safe drinking water which is reason of diseases especially in poor countries. According to WHO, access to pure drinking water is a basic human right. Treatment of water before distribution is a customary practice. Physical, chemical and biological aspects of water are important in ensuring better hygienic society. Change in normal appearance of the water, specific odour and taste are signs of need to check quality of water before treatment and distribution (WHO, 2006). In general water characteristics depends upon nature of sources of water such as lake, rivers for surface water or wells and bore well in case of underground water. Geo morphological or altered environmental conditions influence quality of the water present there in. Storage and transport are also important in maintaining quality of water for potable purpose. In tropical region river water constitute principal source of drinking water (Sieliechi et al., 2010). Pretreatment of river water has become must as many of the rivers today are under the loads of pollutants which hamper natural qualities of water. The aim of water treatment process is to remove contaminants in the water and to make it fit for drinking. Human settlements near water resources are interfering quality of water by pollution due to discharge of waste. Majority of the cities are situated on river banks worldwide hence, there is rising concern about maintaining good quality of water for generations to come.

Kolhapur is the city with population about five million is situated on bank of the river Panchanganga which has flourished agriculture since long. This river is the source of water for drinking and other purposes such as agricultural, industrial and domestic works. There is ample amount of water but management of available water at all levels has led to concern about quality and quantity. Once the city was known as 'city of lakes' due to presence of 24 lakes in and around it. Self reliant sources of water such as lakes and wells are vanished due to urbanization and shrinkage of natural water supply. Patil and Raut, 2009 has studied status of open wells present in the city and concluded that wells are getting converted in garbage pits due to dumping of waste by people dwelling in their vicinity. Hence, people are dependent upon river water supplied by city Municipal Corporation. Present water demand of the city is about 120 MLD. It is meet through storage at Kalamba, Balinga, Bawda and Puikhadee with 8, 21, 41 and 50 MLD capacities respectively. Out of these Bawda water works is located at downstream of major nallahs of the city and are partial in operation (ESR, 2009). Therefore, study of efficacy of these plants gains importance to meet water requirement of growing population.

Present study was carried out to asses the quality of water from inlet and outlet of the WTPs as well as tap water in different wards of the city. Paper discusses various characteristics of water at all plants observed during the period of six months.

MATERIAL AND METHODS:

Four WTPs around Kolhapur city are Kalamba, Puikhadee, Balinga and Bawda. There capacities and locations around city are as follows.

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Code	WTP	Source (Pumping station)	Distance from the city	Capacity (MLD)	Commissioning year
I	Balinga	Bhogawati river	(10 km)	41	1949
II	Bawda	Panchaganga river	(8 km)	36	1978
III	Sambhaji nagar	Kalamba lake	(3 km)	8	1982
IV	Puikhadi	Panchaganga river	(14 km)	50	2001

Table-1 Various pumping stations and WTPs around Kolhapur city of Maharashtra, India

To procure data about WTPs and carrying samples visits in each month were organized. Simultaneously with inlet and outlet tap water from respective wards was collected in morning hours. All parameters were analysed within 24 hrs after sampling. Initial DO of water was fixed on site. pH of the water was checked with digital pH meter- Elico- 111 . All the parameters were analyzed according to standard procedures of APHA. Various physical characteristics of water studied were pH, Electrical conductivity, turbidity, Total Solids (TS), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS). Chemical parameters studied were Hardness, Chloride, Alkalinity, Acidity, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD).

Plate-1 Puikhadee WTP located at 14km from the city on Kolhapur- Radhanagari road

Plate-2 Aeration lagoon atPuikhadee WTP

RESULTS:

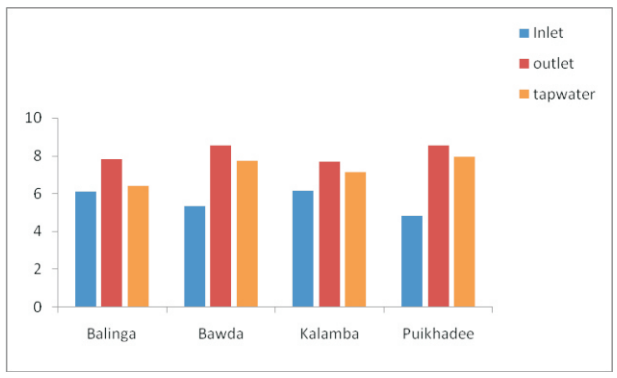
Results of the present study are summarized below. All parameters except pH and turbidity are expressed in mg/l.

Sr. no.	Characteristic	Water Treatment Plant codes and sampling points							
		I		II		III		IV	
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1	pH	±7.04	±7.24	±7.15	±7.27	±7.77	±7.74	±7.24	±7.35
2	Turbidity	±26.08	±4.71	±26.53	±4.71	±21.71	±4.55	±22.55	±4.65
3	Hardness	±76.66	±56.00	±70.66	±51.33	±153.00	±124.66	±76.00	±56.66
4	Chloride	±48.75	±20.04	±49.22	±17.51	±24.29	±19.40	±26.98	±19.88
5	Alkalinity	±66.00	±51.33	±65.33	±52.66	±146.33	±126.00	±70.66	±50.00
6	Acidity	±15.33	±10.00	14.00	±9.33	±26.30	±17.50	±17.45	±10.66
7	TS	±617.50	±147.50	±734.16	188.33	±706.66	±182.50	±745.83	±187.50
8	DO	±6.13	±7.83	±5.33	±8.53	±6.16	±7.71	±4.84	±8.55
9	COD	±14.66	±11.10	±15.99	±11.99	±14.21	±10.16	±17.33	±13.32

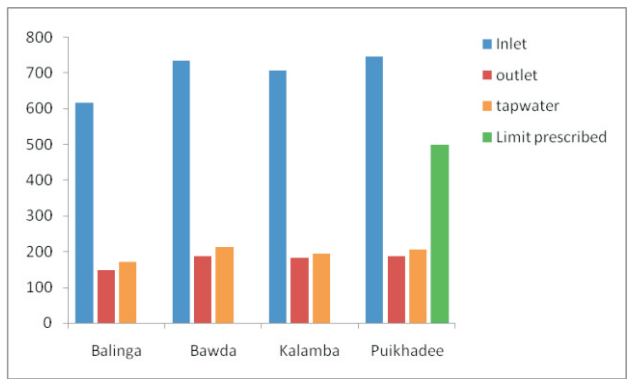
Table 1. Different physico-chemical characteristics of water at WTPs of Kolhapur city.

Sr. no.	Characteristic	I	II	III	IV
1	pH	±7.37	±7.39	±7.83	±7.42
2	Turbidity	±4.60	±4.83	±4.53	±4.80
3	Hardness	±62.00	±54.66	±128.64	±61.30
4	Chloride	±21.77	±18.93	±20.82	±19.88
5	Alkalinity	±57.33	±56.00	±130.00	±50.66
6	Acidity	±10.66	±13.33	±20.00	±10.00
7	TS	±170.00	±213.33	±193.33	±206.66
8	DO	±6.13	±5.73	±6.63	±4.94
9	COD	±14.22	±13.55	±12.00	±14.21

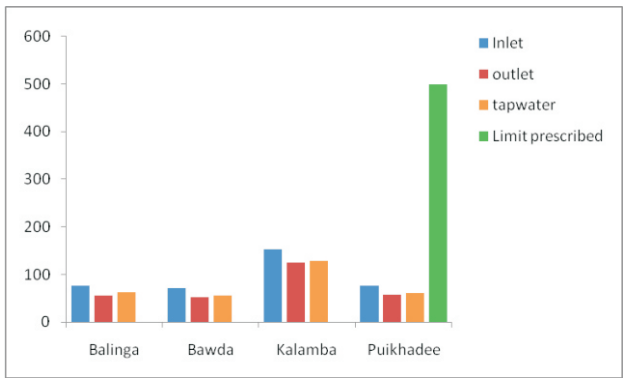
Table 2. Different physico-chemical characteristics of tap water of respective WTPs of Kolhapur, Maharashtra, India.



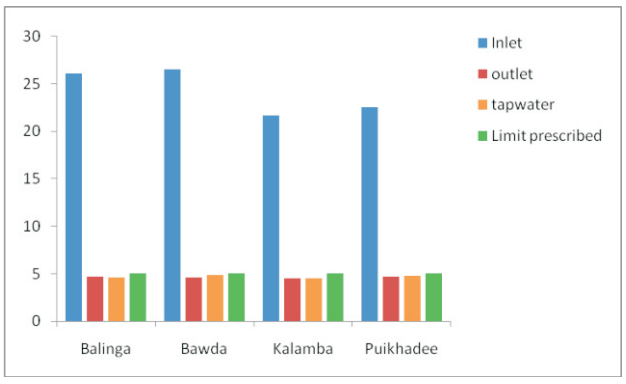
Average dissolved oxygen in (mg/l) in the water of WTPs in Kolhapur city



Average TS (mg/l) of water at WTPs in Kolhapur city



Average hardness (mg/l) in water of WTPs and taps in Kolhapur city



Average turbidity in NTU of water at WTPs and taps in Kolhapur city

From above results it is clear that all WTPs of Kolhapur city are efficient in their operation.

DISCUSSION:

Present study was carried out to characterize and asses efficacy of WTPs around Kolhapur city. Water work system consists intake, treatment and distribution which are components of infrastructure of any WTP (Rehman and Zayad, 2009). These are to be maintained in good condition to get efficient performance of the plant. In this study all plants are seen to be efficient in treating water in terms of important parameters for drinking water. Maharashtra Jeevan Pradhikaran, in the state of Maharashtra works for development and execution of the water supply projects. It also supports public distribution of water. Present water works are associated partially with this govt. agency. There are four pumping stations and treatment plants engaged in providing water to the city. All these systems are turned age old hence, there is a gap between demand and supply of the water.

Lake water of Kalamba is seen to be with highest hardness which in turn is reduced by 81% by WTP III. It indicates that this plant is highly efficient in treating water for reduction of hard water where as all other WTPs are more or less same in capacity in case of treatment of hardness of water. All plants are seen to be of similar capacities for treatment of DO of the water they receive from respective sources. All WTPs are seen to be having similar range for COD and TS treatment ie about 25% reduction than inlet water characteristic. There is insignificant rise in COD of tap water than that of outlet of the plants which may be due to secondary storage during distribution. Operation and maintenance are important in avoiding water loss along with proper designing, testing and replacement measures (Finn, 2009). It is clear from the observation during the visits to the plants that, for the city like Kolhapur to reduce water losses operation and maintenance programmes may be implemented to improve efficiency of distribution system further. Ouali et al., (2009) has stated that regular water monitoring programmes are necessary for reliable water quality. Present study for the duration of six month directs city corporate and concerned department for continuous assessment of water quality especially during flooding and summer when there is excess and less supply of water respectively. Pathak, (2012) from the study carried out to assess the characteristics of municipal water supply in a suburb of Madhya Pradesh, India has suggested that regular water checking is needed. Cantor, (2009) has observed corrosion of units of treatment plant due to lower pH and alkalinity of inlet water. These both characteristics along with dissolved Oxygen offer taste quality to water. Turbidity is measure of relative clarity of the liquid. It is due to eroding river banks and interventions in riverine system. Turbidity in present study is seen to be reduced by an average of 15% at all the WTPs. Schwartz et al., (2000) has found relation between gastrointestinal diseases and turbidity of water consumed by population in Philadelphia. There is frequent occurrence and many patients are diagnosed with same disorders in the city which attracts notion to study suspended particles and biological contamination periodically.

Hardness of drinking water is significant for taste but at higher extent it causes health problems in consumers. Raw water at all WTPs is itself having hardness in prescribed limit. There is further removal of hardness by 20% at all the WTPs after receiving raw water. WTP III and WTP IV are similar in capacity for treating pH and alkalinity. Sierakowski et al., (1979) has stated that stone incidence is related to water hardness in different geographical regions so there should be effective removal of hardness. Removal of TSS before disinfection is essential as it affects disinfection efficiency. In this study it is observed that average reduction in TS by 25% after treatment is achieved at all the treatment plants.

CONCLUSION:

Drinking water quality before and after treatment was assessed for the period of six months with carrying out sampling from WTPs around Kolhapur city. There is significant reduction in important characteristics like Turbidity, hardness and absence of E. coli after treatment. Characteristics of the treated drinking water in the WTPs are within the standard limits. At many places the main pipelines are broken or leaking wasting water. Therefore, there is a urgent need to replace these pipelines. Frequent leakages are main causes of water loss during distribution. There should be efficient and timely maintenance work of piped distribution system so as to avoid weir and tear of existing

line. Existing water treatment is inadequate to treat and meet rising demand of the water from the city. However, awareness in citizen about wise use of drinking water has added importance to quench thirst of the city.

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