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Assessment of water quality of river and municipal water in urban area

Thakare Mahendra G

Head, Department of Environmental Science, Arts, commerce and science, college, Tukum, Chandrapur
Email: mahendra72.thakare@gmail.com

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ABSTRACT

Water is essential for living things, including human being. It plays an important role to balance ecosystem by circulation from atmosphere to land and vice versa. Pure, safe and potable water makes its suitability for various uses. Water falls on land surface and drain into water bodies, including river carries heavy sediments which can be categories as physical, chemical and biological. The raw water of the river and its treatment in municipal water treatment plant is the way where quality can be assessed for potability. An attempt has been made to investigate the water quality of the river before and after treatment. Physical and chemical analysis of water shows reduction in water quality parameters viz., conductivity, acidity, total hardness and, sulphate. The result also shows the presence of residual chlorine in household tap water sample

Key words: Municipal, pure, potable, residual chlorine, raw water

INTRODUCTION

About 70% of planet earth is covered with water and rest is land surface (Dara, 2007). Only 2.5–2.75% is considered as fresh water (De, 1994). Industrial and agricultural sectors consume appreciable quantities of water (Sharma, 2000). Polluted water coming out from these sources is other side which account for deterioration of fresh water resources. River water contains impurities so its use before treatment is not so good for human health. Water from the river is pumped through the intake tower and carried by a network of pipelines to municipal water treatment plant for removal of impurities. Raw water passes through various treatment units' viz., screening, equalization, grit removal, coagulation, filtration, disinfection and final distribution through overhead tanks. It is essential to see that water received at tap of each house should comply physical, chemical and biological standards as prescribed by the statutory authority from time to time. In addition to this, the treated water received in houses must contain 0.2 mg/l free residual chlorine to ensure suitability of water for drinking.

METHODOLOGY

Sampling site for the collection of raw river water and municipal water treatment plant sample was selected with consideration of continuous water passes from the river via pipeline to municipal water treatment plant. Domestic houses with a spacing of one kilometer were selected for collection of composite water samples. The analysis methods as described in Standard methods for analysis of water and wastewater (APHA, 2005) were used for container handling and treatment prior to the collection of water sample, water sample preservation and analysis of physical- chemical constituents. Determination of residual chlorine in tap water samples was performed by chloroscope (Device developed by NEERI).

RESULT AND DISCUSSION

pH: pH is a negative logarithm of hydrogen ion activity. It is useful to calculate acidity and alkalinity of water. It can also control the process of coagulation, disinfection and demineralization. At present investigation pH of the river water (7.9) and treated water (7.5) are well within the permissible limit and indicate natural characteristics of water (Table 1). The pH of treated water is less than raw water because in the coagulation process considerable amount of dilute sulphuric acid is produced due to use of alum which reduces the pH of treated water.

Temperature: The values of temperature of water samples (29 °C) correspond to the atmospheric temperature. Temperature is a crucial factor for biota in river water. At elevated temperature solubility of Oxygen and Carbon dioxide is affected.

Electrical Conductivity: Electrical conductivity denotes water capacity to carry an electrical current. Surface water shows less conductivity than ground water. Treated water shows less conductivity (1.21 µs/cm) than raw river water (1.45 µs/cm). In the present investigation, ions are removed in coagulation and filtration process to a lesser extent.

Total acidity: Acidity of water is simply defined as the water's capacity to donate H positive ions. It is caused by free carbon dioxide in water. Carbon dioxide mixes with water and carbonic acid is formed (H_2CO_3). Excess acidity of water may lead to body imbalanced. In present investigation acidity values of treated water (18 mg/l) are slightly higher than river water (10 mg/l), the reason as described in pH section is equally applicable here as well.

Total alkalinity: It is a measure of water capacity to neutralize acids. Alkalinity in water is caused by bicarbonate, carbonate and Hydroxide compounds of calcium, magnesium and potassium According to the World Health Organization, health effects are most pronounced in pH extremes. Drinking water with an elevated pH above 11 can cause skin, eye and mucous membrane irritation. In present investigation alkalinity values are well within limit (Table 1), if, comparison is made between raw river water values (82 mg/l) and treated water (75 mg/l) after coagulation unit operation, it can be said that coagulant addition reduces total alkalinity concentration.

Table 1: Physical-chemical analysis of raw river water and treated water of the municipal treatment plant

Sr. No	Parameters	Raw river water sample	Treated water (MWTP)*	Drinking water standards BIS, IS 10500 : 2012
1	pH	7.9	7.5	6.5-8.5
2	Temperature	29 °C	29 °C	--
3	Electrical Conductivity	1.45 µs/cm	1.21 µs/cm	--
4	Acidity	10	18	--
5	Alkalinity	82	75	200
6	Total Hardness	150	140	200
7	Dissolved oxygen	6.5	7.8	--
8	Sulphate	22	10	200
9	Phosphate	BDL	BDL	--
10	Iron	0.1	BDL	0.3
11	Free Residual chlorine	NIL	0.1	0.2

* Municipal water treatment plant

All parameters are expressed in mg/l except pH, Temperature and Electrical conductivity

Total Hardness: Total hardness in water is caused by divalent cations namely calcium and magnesium (Reva, 1995). Surface water generally shows less total hardness as compare to ground water. Total hardness is removed to some extent in filtration process; its concentration is less in treated water (140 mg/l).

Dissolved oxygen: The solubility of oxygen in water depends on the temperature, pressure of air and the amount of dissolved solids present in the water. Dissolved oxygen of treated water (7.8 mg/l) is higher than raw river water (6.5 mg/l), the reasons being turbulence created during aeration of water in water treatment plant. Aesthetic quality of treated water w.r.t. D.O. concentration is good as compare to raw river water.

Sulphate: Sulphate can cause bitter taste in water if water treatment is not proper. It can create digestion related problems in humans and young livestock. Coagulation process is effective to remove sulphate in water treatment process. Sulphate concentration is considerably low in this study (10 mg/l).

Phosphates: Phosphate in the water is non toxic within permissible range. It can upset digestion if concentration crosses limit. Its concentrations are minimum and don't pose any threat to potability.

Iron: Iron occurs in water in the soluble ferrous and insoluble ferric iron. Dissolved ferrous iron gives water a disagreeable metallic taste, unacceptable taste. Iron is removed by aeration in water treatment plant. Iron concentration below 0.3 mg/l is acceptable, in this study it is within permissible limit (0.1mg/l).

Free Residual chlorine: Chlorine is applied in solid, liquid and gaseous forms in water treatment plant to kill disease causing microorganisms. In the present investigation, liquid chlorine was found used for treatment purpose. Composite samples collected from domestic places and analyzed on the spot by chloscope shows concentration of 0.1 mg/l, are acceptable from a drinking point of view.

CONCLUSION

Raw river water carries heavy load of impurities, such water if used for drinking purpose can pose threats to human life. Physical-chemical analysis of raw river water and water treatment plant sample clearly indicates the need to treat raw river water prior to its use for drinking purpose. Water samples analysed from the taps of houses for free residual chlorine also shows effective water treatment of raw water in municipal water treatment plant in urban areas.

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