Performance Evaluation of Water Treatment Plant at Midc Hingna, Nagpur: A Case Study in India

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Abstract— The water treatment plant is important for quality of water supplying to the society. There is necessity to evaluate performance of water treatment plant (WTP) for proper treatment of water. The study was carried on performance evaluation of water treatment plant located at Maharashtra Industrial Development Corporation (MIDC), Hingna, Nagpur , Maharashtra state India. Performance was analyzed through the physico-chemical parameters viz. turbidity, temperature,total solids, suspended solid, Total Dissolve Solid, pH, D.O and Residual Chlorine. The parameters were analyzed and monitored on weekly basis. The result showed that Dissolve oxygen was increased after aeration unit up to 50 %. overall turbidity removal in clariflocculator in 77.30% but, and filtration unit is 60%.

Key words: Drinking water, Physico-chemical characteristics, Operation and Maintenance, Water Treatment Plant

I. INTRODUCTION

Safe and potable water is of paramount significance in promotion of health and wellbeing of the people[1].It is suddenly observed that most of the conventional water treatment plant (WTP) in urban area are unable to perform this task [1].The many problem causes along with the unsuitable quality in sufficient amount of water supply due to rapidly growing population and industrialization as water borne disease [1]. Already there are acute shortages of both surface and ground water in many part of country like India [8]. Water pollution are generally divided into the three categories such as ground water, surface water ,sea water pollution. Generally surface water viz. river and lake water are treated in treatment plant [4]. Quality of water system used be analyzed through intake, raw water ,treatment and transmission. Every treatment plant for proper treatment it need to consider unit operations unit processes depending upto the raw water quality. Further proper operation and maintenance should be done. [3,4]. In raw water because of changes in seasons the physic-chemical characteristics are changed. All treatment plant should be considered as a equal case before designing and deciding the different unit processes and operations to be used to treated the water[1,3,5]. Analysis was conducted as physical, chemical and bacteriological characteristics all results are determined according the standard and Bureau of Indian standards IS 10500:2012[9]. Several water-borne diseases such as cholera, typhoid, paratyphoid, and amoebic dysentery were presence of micro-organisms in raw water [7].The treatment of these water treatment plant involves aeration, pre-chlorination, alum dosing, clariflocculator. rapid sand filter and post chlorination.[1]

A. Objectives

- To do physico-chemical characterization of various units of WTP.
- To evaluate efficiency of each unit of WTP through analyzing inlet and outlet samples.

II. METHODOLOGY

The performance evaluation of water treatment plant located in Maharashtra Industrial Development Corporation (MIDC) Hingna, Nagpur ,Maharashtra state, India. Raw water rising main M.S,pipe line inserted in ground. The capacity of water treatment plant is 13.5 MLD. The source of water from Ambazari lake is located near the Southwest border of Nagpur area. The water was used for drinking purpose for over 30 years proper treatment on water should be given and operations and maintenance. The total area was covered by Amabazari lake 15.2 km. In water treatment plant source of water Amabazari lake 3.2 Km long from the water treatment plant MIDC Hingna, Nagpur. The rate of flow was 625 m^3/hr.It has been observed that different treatment units provided in water treatment plant such as aeration, pre-chlorination, clariflocculator, rapid sand filter, post chlorination , underground sump and all treated water finally storage to main balancing reservoir. This WTP supply water to the society and MIDC area.

The various samples were collected from the different unites on weekly basis for 1st August, 2015 to 31st March, 2016 at regular interval of seven days from the water treatment plant and results has been compared to IS 10500:2012. The samples were collected in plastic one litre bottle, collected from each unit's inlet and outlet. Typical area of sampling are showed in the fig.2.1. Capacity of water treatment plant is 13th thousand m3/day. The various water quality analysis techniques used showed in table 2.1:

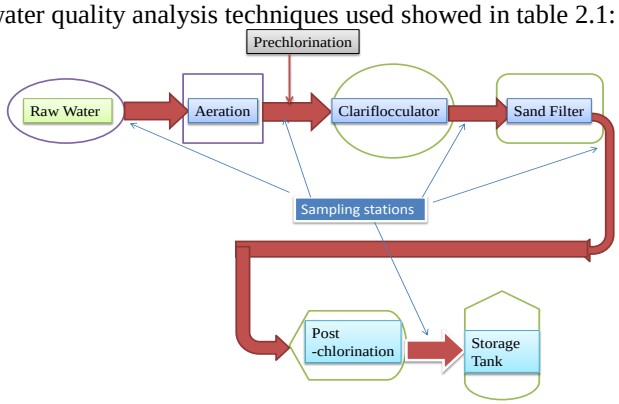

Fig. 1: Location of sampling stations

Parameters	Techniques
Turbidity	Nephelometric Method
Total Dissolve Solid	Gravimetric Techniques
Total Solid	Analytical Method
pH	Electrometric method

Dissolve Oxygen	Winkler Method
Temperature	Digital Thermometer
Residual Chlorine	Stabilized neutral Orthotoludine

Table 1: Water quality analysis used to standard techniques

III. RESULTS AND DISCUSSIONS

A. *PH*

Fig 3.1 showed that pH of raw water as well as treated water during the purification process and after treatment is above 7. No issues regarding pH of water has been observed. The standard range of pH in between surface water systems is 6.5 to 8.5 as per IS 10500:2012. pH after coagulation is generally lowered, due to consumption of alkalinity.

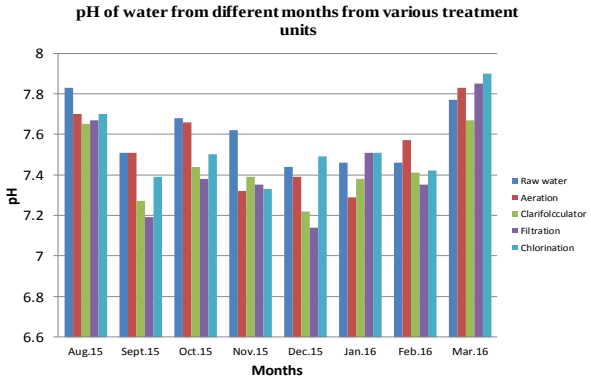

Fig. 2: pH of water for different months from various treatment units

B. *Temperature*

Fig 3.6 showed that water temperature is normally in between 200C ± 3 0C .There was no effect on water body temperature it does not have any effect on water it directly proportionate with temperature.

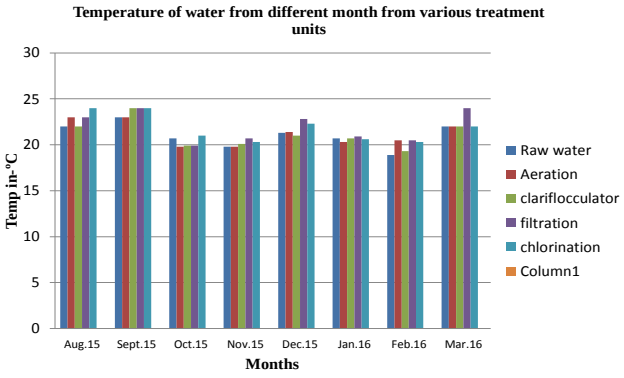

Fig. 3: Temperature of water for different months from various treatment unit

C. *Dissolve Oxygen*

Fig 3.3showed that DO of raw water was DO content 4 ± 0.5 mg/lit as it was lake water. generally normal water temperature has remove carbon dioxide is remove up to 5 mg/lit. The decreasing in DO is present in oxidation some changes variation is done due the all treatment but more and required amount of DO balance after aeration. From the observation it was concluded that the DO content was increased after aeration up to 8 ± 0.2 mg/lit. DO increased to 50% after aeration . The DO in may be due to oxidation of present organic matter in underground sump. The underground sump DO remains decreased 7 ± 0.4 i.e reduced (20%).

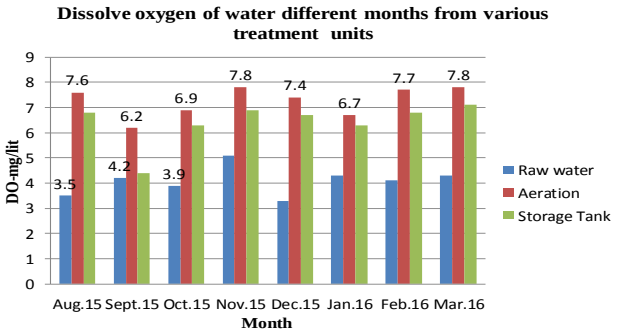

Fig. 4: DO of water for different months from various treatment units

D. *Turbidity*

Fig 3.2 showed that turbidity measured at various stages of purification. The turbidity in mansoon period is generally high as compared to the other part of the year ,same think was observed during the sampling. The efficiency of turbidity removal of clariflocculator was observed between 77.30% and 37.5% .While the efficiency of filter was observed between 60% and 33.87% .Higher value were observed during high turbid raw water to be treated while lower value were observed during lower turbid raw water to be treated. Removal efficiency of the clariflocculator as showed in Table 3.1. More the amount of coagulant used to Poly Aluminum Chloride (PAC) doses was 7-10 mg/l.

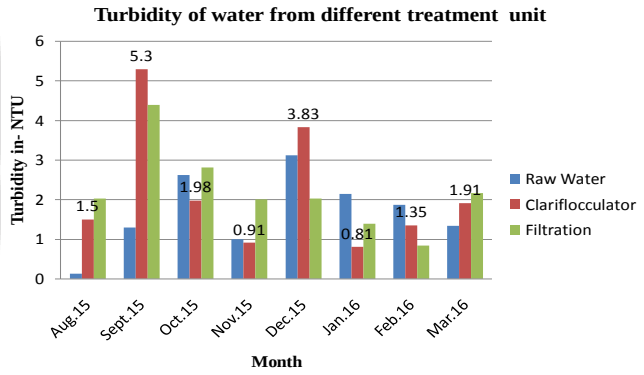

Fig. 5: Turbidity of water for various months from raw water, clariflocculaton and filtration

E. *Total Dissolve Solids*

Fig.3:5 showed The Dissolved solids present in water up to 400 mg/lit. The permissible limit of potable water 500 mg/lit or less as per IS 10500:2012.

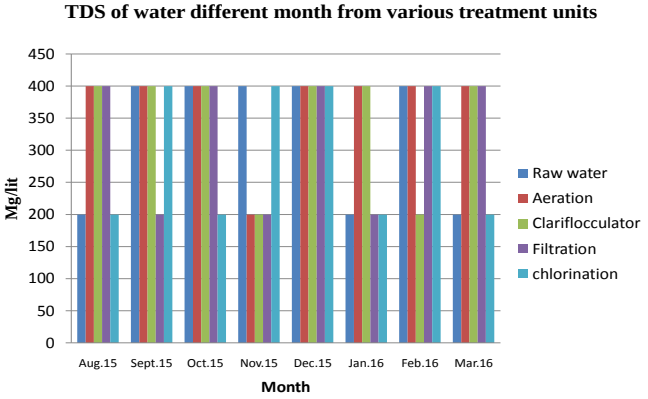

Fig. 6: TDS of water different months from various treatment units

Fig. 3.1 showed that for clariflocculator unit before and after clariflocculator basin results comes in percentage of removal efficiency shows in table 3.1, Settaleble floc during remove by gravitational settling. Turbidity was removed by after and before clariffloccculator units (37.5-77.30 %)

F. Residual Chlorine

Fig .3.4 showed that the chlorine in water after post chlorination has more increased up to 2 mg/lit in water. The doses of Chlorine has been adjusted that water residual chorine in water 0.1 to 0.5 p. p. m.

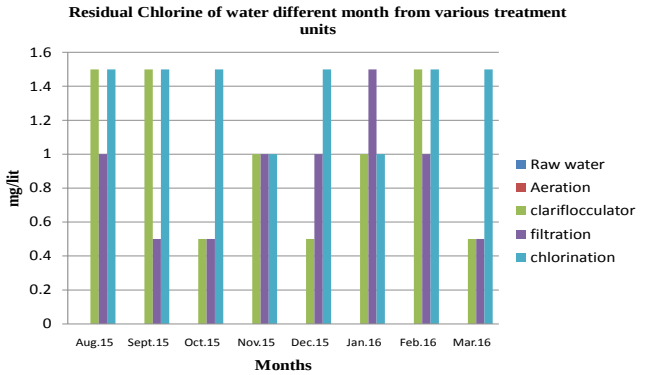

Fig. 7: Residual Chlorine of water for different month from various treatment units

Before Clariflocculator				After Clariflocculator			
Date	pH	Temp ºC	Turbidity NTU	pH	Temp ºC	Turbidity NTU	Removal efficiency %
Aug 2015	7.65	22	0.08	7.67	23	0.05	37.5
Sep 2015	7.27	23	5.07	7.19	24	3.07	39.44
Oct 2015	7.44	19.9	3.55	7.38	19.4	1.98	44.22
Nov 2015	7.39	19.8	4.01	7.35	20.7	0.91	77.30
Dec 2015	7.22	21.4	2.05	7.14	20.3	1.09	56.4
Jan 2016	7.38	20.3	1.73	7.51	20.8	0.81	53.17
Feb 2016	7.41	20.5	1.98	7.35	20.5	1.03	47.97
March 2016	7.67	22	3.1	7.85	24	1.91	38.38

Table 2: % Removal efficiency of the clariflocculator

The objective of filter beds were to fillip sand in water treatment plant. There was rapid sand filter provided. The rectangular tank provided at bottom of tank has fill up by gravels and sand particles the size of sand particles are 0.4 to 0.6 mm as a diameter. The removal efficiency was carried out (33.87-60 %) filtration basin results as showed in Table 3.2.

Before filtration				After filtration			
Date	pH	Temp ºC	Turbidity NTU	pH	Temp ºC	Turbidity NTU	Removal efficiency %
Aug 2015	7.67	22	0.05	7.67	23	0.02	60
Sep 2015	7.19	24	1.69	7.19	24	1.03	39.5
Oct 2015	7.38	19.9	1.98	7.38	19.4	1.08	45.45
Nov 2015	7.35	20.1	0.91	7.35	20.7	0.47	48.53
Dec 2015	7.14	21	3.07	7.14	20.3	2.03	33.87
Jan 2016	7.51	20.7	0.81	7.51	20.8	0.395	51.85
Feb 2016	7.35	19.3	1.03	7.35	20.5	0.64	39.04
March 2016	7.85	22	1.91	7.85	24	1.17	38.74

Table 3: % Removal efficiency from filtration unit

IV. CONCLUSIONS

- Aeration units is Working because of Disslove Oxygen has increased to 50 % .
- Coagulant doses (PAC) required more in rainy season 70-80 ppm
- The removal efficiency of clariflocculator from 77.30% to 37.55 it was decrease during the study period
- The removal efficiency of filtration basin from 60% to 33.87 has gradually decreases during study period in WTP
- Chlorine demand was increased during the rainy season, Temperature was strongly influenced by the temperature of atmosphere ,however, its didn't effect on property of water

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