

Performance Evaluation of Water Treatment Plant at Yavatmal (M.S.): Case Study

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Abstract: The objectives of any water supply system are to supply safe wholesome water in adequate quantity at convenient points and at reasonable cost to the users (**Hand book on work audit-water supply**). Potable water treatment is one of the most challenging and complex systems that municipalities need to deal with considering limited resources. The main objective of water treatment is to purify the polluted water and make it fit for the human consumption, through the removal and killing of pathogenic organisms and remove the taste, smell, unpalatable brownish discharge, some of the excess of dissolved metals and a range of items (**Ali Ahmed Mohammed**). With the increasing interest and care of the government of India to the importance of the field of water production and supply, many new water treatment plants were either constructed or extended during the past few years (**M.A.Eidib**). Performance of these plants is an essential parameter to be monitored and evaluated for the better understanding of design and operating difficulties in water treatment plants (**M.A.Eidib**). This study is carried out to evaluate the treatability performance of water treatment plant at Yavatmal.

Keywords- Water Treatment Plant, Performance evaluation

1. INTRODUCTION

Yavatmal is the city in Maharashtra state located at 20° 24'00" North latitude, 78°07'59" East longitudes. Elevation above sea level is 451 m (1479 ft). The area of the Town is 12 Sq.km. and rural area is 19 Sq.km. The population as per 2011 census record is 2, 54,853 souls. Present population is 2, 66,000. National Highway 7 passes through the district.

Study of water treatment plant at Yavatmal is carried out with all aspects and considerations including; engineering, physical, chemical & bacteriological characteristics to determine its efficiency. This study will define design and operating problems and difficulties of the case study that will allow for proper revision of these aspects to redefine and suggest recommendations for proper operations (**Sarika M. Mankar**). The findings of work may be applicable for other WTP either under design or operation (**M.A.Eidib**). Samples were collected from all WTP's units of Chapdoh, near Nilona dam, Yavatmal.

Analysis was conducted for chemical, physical, bacteriological characteristics. All experiments were done and results were determined in accordance to the Standard Methods of American Water Works Association (**AWWA**) manual, 21st Edition (2009), **CPHEEO** manuals and Bureau of Indian standards: IS 10500:2012 (**Sarika M. Mankar**).

2. WATER TREATMENT PLANT:-

The Water supply to the city is provided from Chapdoh treatment plant situated at village Nilona. Chapdoh Water treatment plant has capacity 17.40 MLD. Source of water is Chapdoh Dam at a distance 18.71 km. About 51% of total water supplied to the city is from this plant. The plant operates for 22 hours and 17.40 MLD (725 m³/hr) water is being treated and supplied to the city. Rate of water supply is 100 lpcd. The design and construction of the plant is conventional one and comprises of various units such as aerator, flash mixer, clariflocculator, rapid sand filters, chemical house, and clear water sump and pump house.

3. PROCESS DESCRIPTION:-

The brief description of all Water treatment plant units, components facilities areas follows.

3.1 INTAKE

The main source of supply to water treatment plant is Chapdoh dam which is built across Waghadi River, nearest village to dam is Chapdoh in Yavatmal District of Maharashtra. The dam is an Earth fill Dam. Catchment area is 12.266 thousand hectares. Maximum / Gross storage capacity is 13.127 MCM. Live storage is 7.65 MCM. Dead storage is 0.93 MCM.

3.2 RAW WATER SUMP AND PUMP HOUSE

The sump and pump house has been constructed in the dam. The water is first collected in R.C.C. Circular tank. In the pump house two centrifugal pumps (2 nos.) having capacity 200 hp -725000 lit/hr-Head-89 m. The diameter of pipe is 762 mm. This pipe conveys water to the Aerator. The total length of this raw water raising main is 10.40 km.

3.3 AERATION

This unit is provided for the removal of volatile substance, dissolved gases and oxidation of reducing substances like Fe, Mn etc. by the way of aeration. The type of this unit is Cascade aeration fountain. The number of Cascade aeration fountain is one. The cascade aeration fountain is made up of R.C.C. having base diameter of 8.050 m. It consists of 5 steps. Drop in each step is 250mm.

3.4 FLASH MIXER

This unit is provided for an instantaneous and through mixing of chemicals that are added to the raw water. The flash mixer is having 2 m diameter and 4.27 m deep. Design flow of raw water is 1450 m³/hr. Detention time in the flash mixer is 60 sec.

3.5. CLARRIFLOCULATOR

The object of clarifloculator is to form distinct settleable flocs during flocculation and their removal by gravitation settling in the clarifying zone. The clear water overflows leaving behind the settleable solids. One radial flow clarifier with concentric flocculator made up of R.C.C. is provided in this plant. Coagulated water enters at bottom of flocculator has a diameter of 11.79 m. Overall size of clarifloculator is 30.50 m diameter and 3.50 m depth. Detention time for flocculation zone is 30 mins. and for clarification zone 180 mins. When the sludge consistency increases beyond 1.5% to 2 % sludge withdrawal operation is done once in a day for at least 5 min.

3.6. FILTERS BEDS

The object of Filters bed is to remove the residual suspended impurities from clarified water. The type is Rapid Sand gravity filters. Numbers of filter beds are five, made up of R.C.C. Size of each filter bed is 6.9 m X 5.1 m. Filtration area of each bed is 35 m². Design capacity of each bed is 174 m³/hr. Detention time is 30 min. Rate of

filtration is 5 m³/m²/hr. Loss of head at designed flow is 1.6 m.– 1.8 m.

3.7. CHEMICAL HOUSE

Chemical house is provided for storage, preparation and distribution of chemicals that are added to the raw water for its treatment. There are three tanks made up of R.C.C. First tank is for Alum solution, second is for lime and third is for Bleaching powder.

Alum solution preparation tank:-Size of tank is 1.5m X 1.5m X 1.5m. Effective capacity of each tank is 2.80 m³. Alum to be dissolved in each tank is 280 kgs. Volume of each tank is 2.80 m³. Duration of each tank operation is 8 hrs. approx.

Lime solution preparation tank:-In this tank 25 mg/lit. Lime dose for a flow of 725 m³/hr is given. Size of tank is 1.5m X 1.5m X 1.5m. Concentration of lime solution being 5% capacity for 8 hrs is 1800 lits.

Bleaching powder solution preparation tank:-Effective capacity of tank is 1.5 m³. size of each tank is 1 m X 1m X 1.5 m. Rate of bleaching powder solution dosing is 3 ppm. Duration of tank operation for dose of 4 mg/lit bleaching powder for flow of 725 m³/hr. filtered water is 3 hrs. approx.

3.8. CHLORINATION

The object of Chlorination is to disinfect the filtered water to make it suitable for potable use. Size of chlorine contact tank (C.C.T.) is 8m X 12.47m X 3.8m. Chlorination is done using chlorine gas cylinder having wt. 900 kg. Capacity of chlorinator is 3 kg/hr.

3.9. PURE WATER SUMP AND PUMP HOUSE

The object of pure water sump is to store the filtered water and to pump it for distribution to meet the demand of potable water. Number of sump is one. It is made up of R.C.C. Size of pure water sump is 18.13m X 8.23m X 3.80m. In The pump house 3 pumps of 226 hp are used for pumping pure water out of which 1 pump is standby.

3.10. WASH WATER TANK

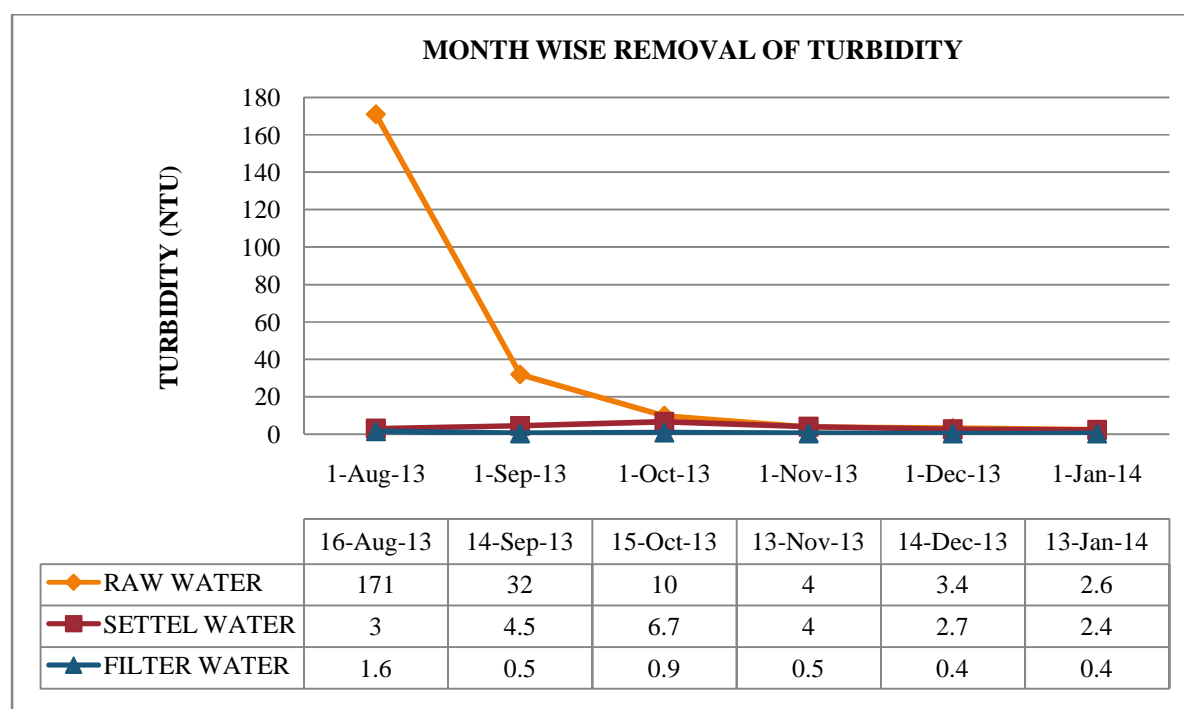
The object of wash water tank is to store water for back wash and for services like preparation for stock solution, for toilet, for drinking etc. size of tank is 18.15 m X 7.10 m X 3 m. Number of wash water filling pump are two having capacity of 10 hp each.

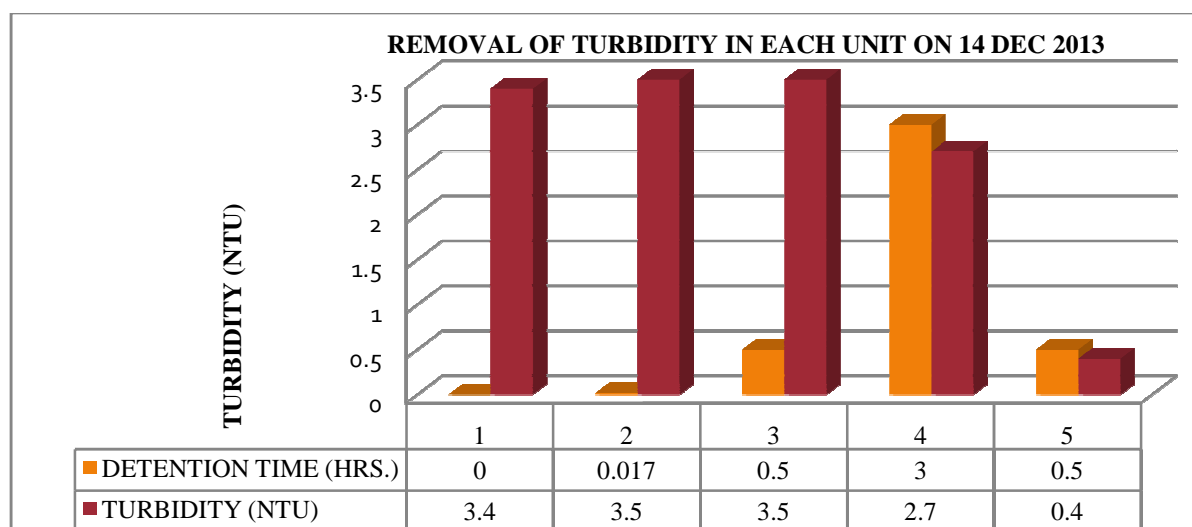
4. OBSERVATIONS

5.

Parameters	Observations		Permissible limits (IS: 10500/ 2012)		Remarks
	Before treatment	After treatment	Permissible	Desirable	
Odour	Odourless	Odourless	Agreeable	Agreeable	
pH	6.9 – 7.8	6.5 -7.8	6.5 - 8.5	No relaxation	Within the limit
Turbidity (NTU)	2.5 - 447	0.3-9.7	5	10	Within the limit
Alkalinity(mg/lit)	65 - 120	20 - 95	200	600	Within the limit
Total Solids (mg/lit)	93 -179	35 -130	-----	-----	
Total hardness (mg/lit)	84 - 160	40 - 110	300	600	Within the limit

NTU-Nephelometric Turbidity Units





Where,

- 1-Aeration
- 2-Flash mixer
- 3-Clariflocculation
- 4-Filtration
- 5-Chlorination

6. RESULT AND DISSCUSSION

From the observation, we have found that

- Raw water was odourless.
- Average Temperature of water was 22⁰C.
- Turbidity of raw water was 2.5 – 447 NTU and turbidity of water after treatment was 0.3–9.7 NTU.
- Also the result of pH of raw water was 6.9 – 7.8.
- Alkalinity of raw water was 65–120 mg/lit and after treatment it was 20 – 95 mg/lit.
- Total solid in raw water before treatment was found 93–179 mg/lit and after treatment it was found 35–110 mg/lit.
- Total hardness was 84–160mg/lit before treatment and after treatment it was found 40–103 mg/lit.

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