STUDY OF PERFORMANCE EFFICACY OF SERAMPORE WATER TREATMENT PLANT,WEST BENGAL

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Abstract—The performance efficacy study was undertaken at individual unit of 20 MGD Serampore Water Treatment Plant, West Bengal. Water samples were collected at different stages of treatment units once in a week during study period and analyzed for the major water quality parameters such as pH, turbidity, total dissolved solid, residual chlorine, total hardness, carbonate hardness, magnesium hardness, iron, nitrate, sulphate, total coliform, fecal coliform. Samples from selective points of distribution mains and consumer's end were also collected to assess the quality of supply water. Based on the analysis for physico-chemical parameters, the finished water was conforming to Indian standard for drinking water (IS: 10500,2012) prescribed by APHA guideline in the study period. Result revealed that turbidity removal of clarified water ranging between 81% and 90% have been found. Similarly total coliform and fecal coliform were determined by membrane filter technique. Residual chlorine having 0.2 mg/l was found at the end stage so no bacteria was observed considering post disinfection has been made properly in the treatment system. This research work concludes turbidity values were found satisfactory at different stages except residual chlorine at few points in the distribution system were found less than 0.2 mg/l. Thus, it is concluded that proper disinfection needs to be done including backwashing of rapid sand filter at regular interval.

Keywords— water treatment, TDS, rapid sand filter, pH, turbidity, total dissolved solid, residual chlorine, total hardness, carbonate hardness, magnesium hardness

I. INTRODUCTION

River is the main inland water resources for all civilizations on earth. They are used by the people for domestic, industrial and irrigation purpose. It must not be polluted. Coming to India ,Ganga is the longest river basin . The water quality of the river has deteriorated due to discharge of pollution load from different sources. The major sources of pollution of the river Ganga are generally the discharge of untreated and partially treated waste water from cities or towns, discharge of untreated and partially treated wastewater from industries, mixing of surface runoff carrying pesticides, agricultural wastes etc. discharge of cattle-shed liquid waste and bathing of cattle in the river and mainly direct disposal of solid waste in the river or mixing of leachate from solid waste dumps. In order to protect the river from contaminations activities relating to abatement of Ganga pollution was taken up by the National River Conservation Directorate under the programme GAP Phase-I and Phase-II.

Kolkata Metropolitan Area (KMA) has got its twofold water source viz: (a) Surface water from the only source of river Hooghly and (b) Ground water source. Out of these two sources, the water from river Hooghly is being treated and supplied to a very limited areas of KMA through the treatment plants and infrastructures that has so far been constructed leaving the vast majority of remaining KMA to depend on the source (b) i.e. Ground water

The Hydraulics of the treatment plant is designed in such a way that water flows by gravity from the collecting well to the clear water reservoir and the sludge generated from the inclined plate settler flows by gravity to sludge sump and ultimately in to the nearest drainage canal.

The overall objective of the proposed research work is to assess the performance of individual unit of Serampore Water Treatment Plant through qualitative analysis.

II. STUDY AREA

Plant Location

The Serampore Water Treatment Plant is located at Chowdhuri Para Lane under Serampore Municipality. The Plant is located at 2-2.5 km East of Serampore Railway station while its intake point islocated about 0.5 Km North of the plant. Both the plant and the intake

point are located by the side of river Hooghly.

Figure 1 Clariffloculator

Figure 2 Rapid Sand Filter

The 20MGD Serampore Water Treatment Plant (SWTP) consists of the units which are presented in layout of the

plant

Figure 3 Area served by the Water treatment plant

III. METHODOLOGY

Sample collections for Raw and Finished water from the plant were carried out once in a month for a period of 5 months (November,2018 to March ,2019). Samples from clarifier and filter were also collected for the selective physic –chemical parameters during study period. Samples for metals were collected from sludge pocket in month of March, 2019. The samples so collected were preserved properly and brought back to laboratory for further analysis. Samples from selective points of distribution mains were collected for physico-chemical parameters in the month of March, 2019. Samples from selective points of consumer's end were collected for physico-chemical parameters in the month of March 2019.

Samples for Bacteriological parameters such as Total Coliform, Fecal Coliform were collected from Raw water (after pre –chlorination), Clarified water, filtered water and Finished water (after post chlorination) during monthly sampling.

Samples from the selective points of Distribution mains (take off points) were collected for the determination of Total Coliform and Fecal Coliform during supply hours for the month of March,2019.

Samples from the selective points of consumers' end were collected for the month of March, 2019.

Samples so collected were properly preserved and were brought back to School of Water Resources Laboratory for analysis.

Serampore water Treatment plant has two clariflocculators and the clarified water is distributed to ten numbers of filter beds for filtration.

IV. RESULT AND DISCUSSION

- Raw water , clarified water, filter water before chlorination and filter water after chlorination were collected from Serampore Water Treatment Plant for each month and also twice in every month during the study period (from November,2018 to April,2019) for estimation of physic-chemical and bacteriological quality. These results reflect the overall performance of the plant and assure the drinking water quality.

- Water sample from distribution mains and consumer point were also collected to assure the drinking water quality. Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.

- Physico –chemical and Bacteriological quality of Raw Water (RW), Clarified Water (CW), Filter water Before Chlorination (FWBCL) and Filter water after Chlorination (FW) are summarized in Table I.. to Table V.

TABLE I.

Date of Collection: 16.11.2019		Month: November, 2019	
PARAMETERS	*RW*	*CW*	*FWBCL*
Turbidity, NTU	46	8.1	0.8
pH	8.2	7.6	7.5
Conductivity, μmhos/s	338	357	354
Temp., ℃	22	21.9	21.8
Residual chlorine, mg/l	-	<0.2	<0.1
TDS, mg/l	169	178.5	177
Date of Collection:29 .11.2019		Month: November, 2018	
PARAMETERS	*RW*	*CW*	*FWBCL*
Turbidity,NTU	28	4.3	0.3
pH	8.9	7.6	7.5
Conductivity,μmhos/s	226	342	329
Temp,0C	24.8	24.8	24.8
Residual chlorine,mg/l	-	<0.2	<0.1
Total Hardness,mg/l	100	120	120
Calcium Hardness, mg/l	50	60	60
Iron(as Fe), mg/l	0.05	-	0.05
Chloride(as Cl), mg/l	10	10	10
Alkalinity, mg/l	70	80	80
TSS, mg/l	500	400	300
TDS,mg/l	113	171	164.5
Total Coliform	690/100ML	absent	Absent

TABLE II.

TABLE III.

Date of collection: 07.01.2019		Month: January, 2019		
PARAMETERS	*RW*	*CW*	*FWBCL*	*FWR*

Turbidity, NTU	24	7	0.5	0.5
pH	7.9	7.8	7.5	7.5
Conductivity, µmhos/s	460	477	456	450
Temp.°C	21	22	20	20
Residual chlorine, mg/l	-	<0.2	<0.1	0.8
Nitrate, mg/l	-	Nil	Nil	Nil
Sulphate, mg/l	-	Nil	Nil	Nil
Hardness, mg/l	380	374	378	378
TDS, mg/l	89	87	88	85
TC, MPN/100mL	16×10^4	5×10^4	absent	absent
FC, MPN/100mL	11×10^4	4×10^4	absent	absent

TABLE-IV.

Date of collection: 26.02.2019		*Month: February, 2019*		
PARAMETERS	*RW*	*CW*	*FWBCL*	*FWR*
Turbidity(NTU)	46.1	8	0.8	0.7
pH	8	7.8	7.2	7.2
Conductivity, µmhos/s	355	346	323	321
Temp.°C	23.1	23	22	22
Residual chlorine,mg/l	-	<0.2	<0.2	0.7
Nitrate mg/l	-	NIl	NIl	Nil
Sulphate, mg/l	-	NIl	NIl	Nil
Hardness,mg/l	178	162	154	152
TDS,mg/l	150	150	150	150
TC, MPN/100mL	8×10^4	4×10^4	absent	absent
FC, MPN/100mL	2×10^4	1×10^4	absent	absent

TABLE V

Date of collection: 23.03.2019	Month: March,2019		
PARAMETERS	*RW*	*CW*	*FWBCL*
Turbidity,NTU	82	8	0.7
pH	8.15	8.36	8.31
Conductivity,µmhos/s	357	353	356
Temp.°C	25	25	25
Calcium(as $CaCO_3$), mg/l	74.5	70.6	78.4
Chliride(as Cl),mg/l	19.2	21.2	23.1
Magnesium(as $CaCO_3$),mg/l	51	51	47
Nitrate, mg/l	2.21	1.17	1.6
Sulphate, mg/l	17	20.3	18.5
Iron(as Fe),mg/l	7.71	0.18	0.1
Hardness, mg/l	125.4	121.5	129.4
TDS, mg/l	198	194	196
TC, MPN/100mL	4900	absent	absent

Discussion

On the basis of secondary data which are collected from the plant laboratory (Jan,2018 to Oct,2018) and some primary data which is collected throughout the study period (from Nov,2018 to March,2019), Turbidity values of Raw water were observed in the range of 35 - 380 NTU Throughout the study period it was observed that during

monsoon turbidity value is increases as well as coagulant dosing also increased and during dry season Turbidity level is decreased as well as dosing also decreased. Jar test is conducted to know the dosing value once in a month for dry season and weekly for rainy season.

pH values for Raw Water were observed to be in the range of 8.2 to 7.8 and filter water were 6.5 to 8.31 throughout the study period. It is observed that pH level is increased after coagulant dosing but pH values are under acceptable limit as per IS:10500:2012 specified limit.

Conductivity values for Raw water were observed to be in the range of 465 to 226 µmhos/s and filter water were 456-301 µmhos/s throughout the study period. Conductivity indicates the concentration of ions present in water. These conductive ions come from dissolved salts and inorganic materials present in the water. It is observed that when turbidity value is increased, dosing of chemical is also increased, simultaneously conductivity is also increased

TDS values for Raw Water were observed to be in the range of 198-89 mg/l and filter water were 196-85 mg/l throughout the study period. TDS is a measure of the dissolved combined content of all organic and inorganic substances present in the water. All values were well below the IS :10500:2012 specified limit.

Chloride values for Raw Water of Serampore Water Treatment Plant were in the range of 19.2 to 10 mg/L throughout the study period. Chloride values for filter water were 23.1 to 30 mg/L. Chloride increases the electrical conductivity of water. Chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water. All values were well within IS:10500 2012 specified limit

Total Hardness values of Raw water were observed to be in the range of 100-133 mg/L throughout the study period and for finished water were in the range of 120-129 mg/L. These range of values are well below the ISI prescribed limit of 200mg/L

Nitrate and sulphate values for Raw Water were observed to be very low for Serampore Water Treatment Plant.

Total coliform and faecal coliform were determined by membrane filter technique. Residual chlorine having 0.2 mg/l was found at the end stage so no bacteria was observed.

TABLE-VI.

PARAMETERS	*CONSUMER POINTS*	
	CS-1 (near TS-3)	*CS-2(near TN-10)*
TC, MPN/100mL	9	9
FC, MPN/100mL	absent	absent

V. CONCLUSION

Based on the analysis for Physico-chemical parameters, the finished water was conforming to Indian standard for drinking water (IS: 10500,2012) in the entire study period.

Bacteria was present in Raw water above permissible limit which is prescribed in IS: 10500, 2012, though it can be used safely with adequate treatment followed by disinfection in appropriate dose. Total coliform and fecal coliform were determined by membrane filter technique. Residual chlorine having 0.2 mg/l was found at the end stage so no bacteria was observed. Pre-chlorination @ 2.5 mg/l is usually applied in the plant.

These studies were carried out to evaluate the performance of different units of water Treatment Plant and these are summarized hereunder

Though Pre-chlorination is being done at a rate of 2.5 mg/l to the raw water, residual chlorine was observed 0.2 mg /l. No coliform was found at clarifier water.

All rate of Flow water measuring devices in a plant should be checked periodically.

Turbidity removal ranging of clarified water is 81 % to 90 % and coliform reduction ranging for clarified water is 99% to 100 %. Hence it was confirmed that clari-flocculators in the Serampore Water Treatment Plant are working properly

Serampore Water Treatment Plant is supplying potable water to Serampore and adjoining six Municipalities through distribution mains. Data reveal that residual chlorine is below 0.1 mg/l in distribution mains far away from the plant and Total Coliform was found in 2 nos distribution mains out of 4 nos selected distribution mains. Total coliform was also found in two selected consumer end. It indicates post chlorination dosing should be revised.

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