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Performance Evaluation of Water Treatment Plant at Motijheel, Gwalior

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Abstract: ***The conventional water Treatment plant, especially in developing countries faces major challenges in term of assessing its operation and performance due to inappropriate technologies, insufficient equipment and deficiency in skilled expertise [1]. According to Central Pollution Control Board , most of the earth is sea water. About 2.5% of the water is fresh water that does not contain significant levels of dissolved minerals or salt and two third of that is frozen in ice caps and glaciers. In total only 0.01% of the total water of planet is accessible for consumption. The objective of water treatment plant is to treat the polluted water and make it fit for the human consumption. Performance evaluation of water treatment plant is an essential parameter to be monitored and evaluated for the better understanding of design and operating difficulties in water treatment plant[2].***
The main source of water in Gwalior is Tigra Dam. It is constructed on Sank river. The water is supplied from Tigra Dam to Motijheel water Treatment plant. The objective of this study is to evaluate the performance of water treatment plant at Motijheel Gwalior. In this study during the period of five month (January, February, march, April, May) samples were collected twice in a month from different units of water treatment plant and analysis of physical, Chemical and Bacteriological parameters were done. The analysis followed the standard methods on the basis of Bureau of Indian standard IS-10500, 2012. It has been found that Suspended solids is 32-60 mg/l in Raw water and after filtration, it remain in range of 5-15 mg/l. Turbidity is about 1.5-2 NTU in Raw water and after filtration it remain only 0.2-0.6 NTU. MPN in Raw water is about 4-15/100 ml and after filtration it lies in range 0-3/100ml and after chlorination MPN totally removed from drinking water. The Dissolved oxygen of raw water get reduced during the month of April-May, it change from 6.89mg/l to 4.86 mg/l, also the problem of Yellowish colour of raw water arise due to decomposition of green Algae. This can be improved by doing Aeration, adding chlorine in raw water and putting charcoal or coke on screening units. Generally, it is found that most of the parameters are within the range of Indian Standard of IS-10500, 2012 and hence water release from water treatment plant at Motijheel Gwalior is safe for drinking.
Keywords: - Drinking water, Performance evaluation, water treatment plant.

I. INTRODUCTION

Drinking water is the most important natural resources because it serves industrial, domestically and agriculture sectors. On this earth 70% is Hydrosphere, 30% land is present to live for Human, Animals and plants. All creature on earth needs water to survive. We get drinking water from well, rain, rivers etc. Drinking water is very important for survival of all species including human being. Various researches were held on analyzing the water in the world. In many cases drinking water was not properly treated resulted in the trial of epidemics diseases which threaten the health of human potential. The main objective of water treatment is to purify the polluted water and make it fit for the human consumption through removal and killing of organism pathogenic organism and remove the smell undesired chemical and harmful bacteria.

In conventional water treatment plant raw water has been release from dam and it enters in screening units first where all floating and big particles removed. After this any coagulant mixing is done. After coagulation water enter in sedimentation tank where large flocks of impurity is settle down in sedimentation tank and water move towards filtration units. In filtration units bacteria and all small size impurities of water is removed. After this, chlorination is done and water move towards chlorination chamber and after chlorination water finally reach towards distribution network

The quality of water is described by Physical parameters, chemical parameters and bacteriological parameters. In Physical parameters includes color, temperature, turbidity, taste and odor. In chemical parameters includes pH,Alkalinity,Acidity,hardness,Chlorides,Totalsolids,suspended solids,Dissolved oxygen and in bacteriological test Most probable number test called MPN is done.

Turbidity is one of the most important physical parameters which changes seasonally, the unit of measure is Nephelometric turbidity meter unit NTU ranges from 0.1 to 1000 NTU. Turbidity may increase in rainy season.

Suspended solids effects on the filtration units of water treatment plant and Dissolved oxygen is very important chemical parameters

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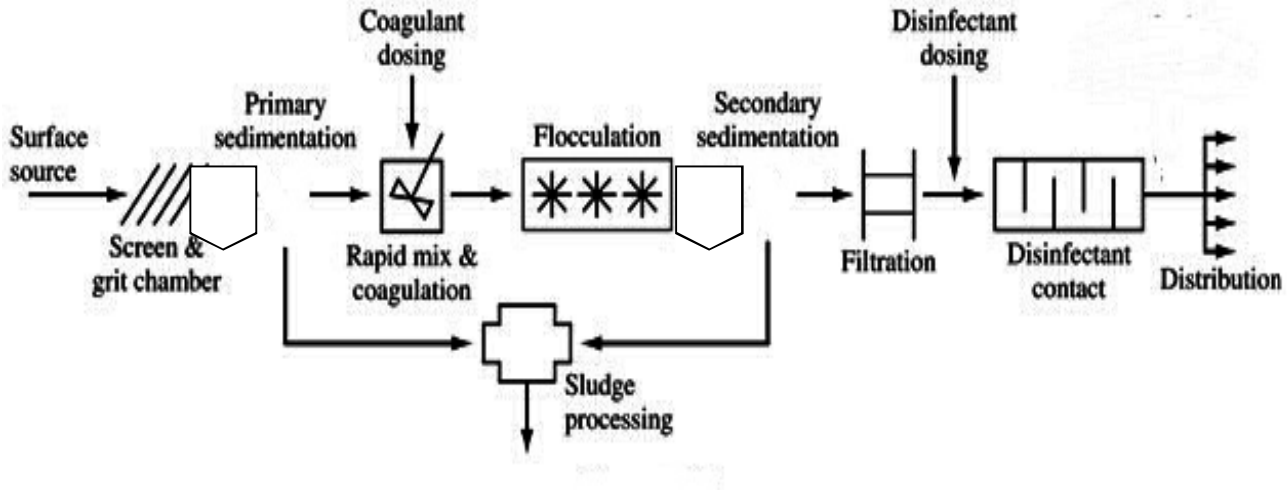
which changes according to season, temperature etc. the range of DO lies between 4 mg/l to 7mg/l mostly but varies according to temperature. If less than 4 mg/l oxygen in water then fish will die in water and may cause smell and increase impurities in tank of drinking water. Bacteriological parameters like MPN is the most probable numbers of bacteria generally its quantity should be nil in drinking water after treatment.

Analysis was conducted for Physical, chemical, and bacteriological parameters. All experiments were done and results were determined in accordance to the Bureau of Indian standard : IS 10500,2012. Study of performance of water treatment plant is essential to be assessed with all aspects and consideration so as to determine its efficiency and to produce quality of water.



Typical layout of conventional water treatment plant

II. OBJECTIVE OF STUDY

A. To determine the quality of raw water put for treatment
B. Improvement of raw water quality received from Tighra Dam.
C. To assess the efficiency of each unit separately and for overall water treatment plant.
D. Removal or improvement of objectionable parameters which is beyond the limits of IS-10500,2012

III. STUDY AREA AND METHODOLOGY

Tighra Dam, is situated about 23 k.m. from Gwalior is the main source of water supply to Gwalior city. The reservoir has a capacity of 4.8 million cubic meters. The dam is 24 meters high at its crest and 1341m long .Tighra dam is constructed on Sank river .From Tighra dam water is supplied to Motijheel (Old and New) water treatment plants. The old and new plant having capacity of 67.2 MLD (14.8 MGD) and 68.7 MLD (15.1 MGD) of water respectively.

During the time of 5 month January, February, March, April , May samples were collected from different unit of water treatment plant, at least twice in a month from raw water inlet basin, sedimentation basin, Filtration basin and Chlorination tank and analysis were done on Physical parameters, Chemical parameters and Bacteriological parameters. All 11 parameters like Total solids, Dissolved solids, Suspended solids, Turbidity, MPN, Dissolved oxygen, pH, Alkalinity, Acidity, chlorides, Hardness experiments were performed in laboratory.

IV. OBSERVATION TABLE

A. Raw water basin OR Before sedimentation

Parameters	2/1/17	22/1/17	2/2/17	22/2/17	2/3/17	22/3/17	2/4/17	22/4/17	2/5/17	Variation
Total solids (mg/l)	200	190	205	180	195	200	176	180	178	176-205
Dissolved solid (mg/l)	155	140	162	148	150	140	140	128	135	128-162
Suspended solids (mg/l)	45	50	43	32	45	60	36	52	42	32-60
Turbidity (NTU)	1	1.3	1.5	2	1.5	1.4	1.5	2	1.5	1.5-2

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MPN (per 100ml)	15	15	11	11	7	4	7	11	7	4-15
pH	7.9	8.0	8.0	8.1	8.1	8.0	8.1	8.1	8.1	7.9-8.1
Alkalinity (mg/l as $CaCO_3$)	40	38	24	30	32	30	32	30	34	24-40
Acidity (mg/l as $CaCO_3$)	4	4	4	4	4	4	4	4	4	4
Chlorides (mg/l)	28	30	28	33	28	32	28	40	42	28-42
Hardness (mg/l)	85	86	82	88	84	82	60	76	58	58-88
Dissolved oxygen (mg/l)	5.80	6.0	5.90	6.20	6.15	6.18	4.89	4.95	4.90	4.89-6.20

B. After sedimentation

Parameters	2/1/17	22/1/17	2/2/17	22/2/17	2/3/17	22/3/17	2/4/17	22/4/17	2/5/17	Variation
Total solids (mg/l)	110	100	120	148	100	112	115	105	108	100 -148
Dissolved solids (mg/l)	80	85	92	124	80	85	88	80	82	80 -124
Suspended solids (mg/l)	30	25	28	24	20	27	27	25	26	20 -30
Turbidity (NTU)	1	1.2	1.2	1	1	1.3	1.5	1	1.3	1-1.5
MPN (per 100 ml)	11	11	7	4	3	3	4	7	7	3 -11
pH	7.9	7.9	7.9	8.0	8.0	8.0	8.1	8.0	8.1	7.9 - 8.1
Alkalinity (mg/l as $CaCO_3$)	35	30	26	26	28	28	30	28	32	26 - 35
Acidity (mg/l as $CaCO_3$)	3	4	3	2	3	2	3	3	3	2-4
Chlorides (mg/l)	24	26	25	20	24	26	26	34	36	24 - 36
Hardness (mg/l)	80	82	80	82	80	82	74	66	64	64 - 82
Dissolved Oxygen (mg/l)	6.42	6.25	6.42	6.40	6.35	6.30	4.96	5.0	4.90	4.96-6.42

C. After filtration:

Parameters	2/1/17	22/1/17	2/2/17	22/2/17	2/3/17	22/3/17	2/4/17	22/4/17	2/5/17	Variation
Total solids (mg/l)	90	95	110	88	95	100	98	90	98	88 -110
Dissolved solids (mg/l)	80	90	102	82	80	90	90	85	88	80 -102
Suspended solids (mg/l)	10	5	8	6	15	10	8	5	10	5 -15
Turbidity (NTU)	0.2	0.6	0.4	0.4	0.5	0.2	0.6	0.5	0.5	0.2-0.6
MPN (per 100 ml)	0	0	3	0	0	0	0	3	0	0 -3
pH	7.8	7.7	7.8	7.8	7.8	7.9	7.6	7.7	7.6	7.6 -7.9
Alkalinity (mg/l as $CaCO_3$)	20	18	18	18	16	18	20	22	16	18 -22
Acidity (mg/l as $CaCO_3$)	3	3	2	2	2	2	2	2	2	2-3
Chlorides (mg/l)	20	20	18	18	18	18	20	24	22	18 -24

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Hardness (mg/l)	78	76	74	74	74	74	70	54	56	56 -78
Dissolved Oxygen (mg/l)	6.56	6.52	6.56	6.60	6.58	6.54	5.86	5.56	5.95	5.56 - 6.60

V. RESULT AND DISCUSSION

Parameters	Raw water basin variations	After Sedimentation variations	After filtration variations	After Chlorination variations	IS-10500,2012 Specification
Turbidity	1.5-2 NTU	1.3-2 NTU	0.6-0.2 NTU	0.6-0.2 NTU	Less than 5 NTU
pH	7.9-8.1	7.9-8.1	7.6-7.9	7.6-7.9	6.5 -8.5
Suspended solids	32-60 mg/l	20-30 mg/l	5-15 mg/l	5-15 mg/l	-----
Dissolved oxygen	4.86-6.20 mg/l	4.96-6.42 mg/l	5.56-6.60 mg/l	5.56-6.60 mg/l	-----
MPN	4-15/100 ml	3-11/100 ml	0-3/100 ml	0-0/100 ml	0/100 ml

A. From the above observation we conclude that.
B. Turbidity of Raw water range from 1.5-2 NTU and after filtration it become 0.6-0.2 NTU.
C. pH of raw water inlet is 7.9-8.1 and after filtration it lies in range 7.6-7.9
D. Suspended solids in Raw water is 32-60 mg/l, after filtration it remain 5-15 mg/l
E. Dissolved oxygen is about 4.86-6.20 mg/l in Raw water and After filtration, it increase to 5.56-6.60 mg/l
F. MPN is 4-15/100 ml in raw water, after filtration, it get reduced to 0-3/100 ml and after Chlorination MPN becomes 0-0/100 ml

VI. CONCLUSION

A. From the above observation it was observe that
1) Suspended solids and MPN became almost nil after Filtration.
2) Turbidity may increase in rainy season but normally Turbidity remains within the limit.
3) Dissolved oxygen suddenly reduce in raw water in April-May due to increase of temperature 40 ^{o}C in summer season.
4) Problem of yellow colour of raw water may arise in summer due to reduction of oxygen and decomposition of green Algae.
5) Chloride became maximum in summer and Hardness reduced in summer.
6) It is observed that mostly all parameters are within the range of IS-10500,2012 and hence drinking water release from Motijheel water treatment plant is safe for drinking

VII. RECOMMANDATION

Yellow colour of raw water can be improved by doing aeration in raw water basin, mixing chlorine in raw water and applying charcoal or coke on screening units. By providing HRT during sedimentation process microbial contamination may be reduced.

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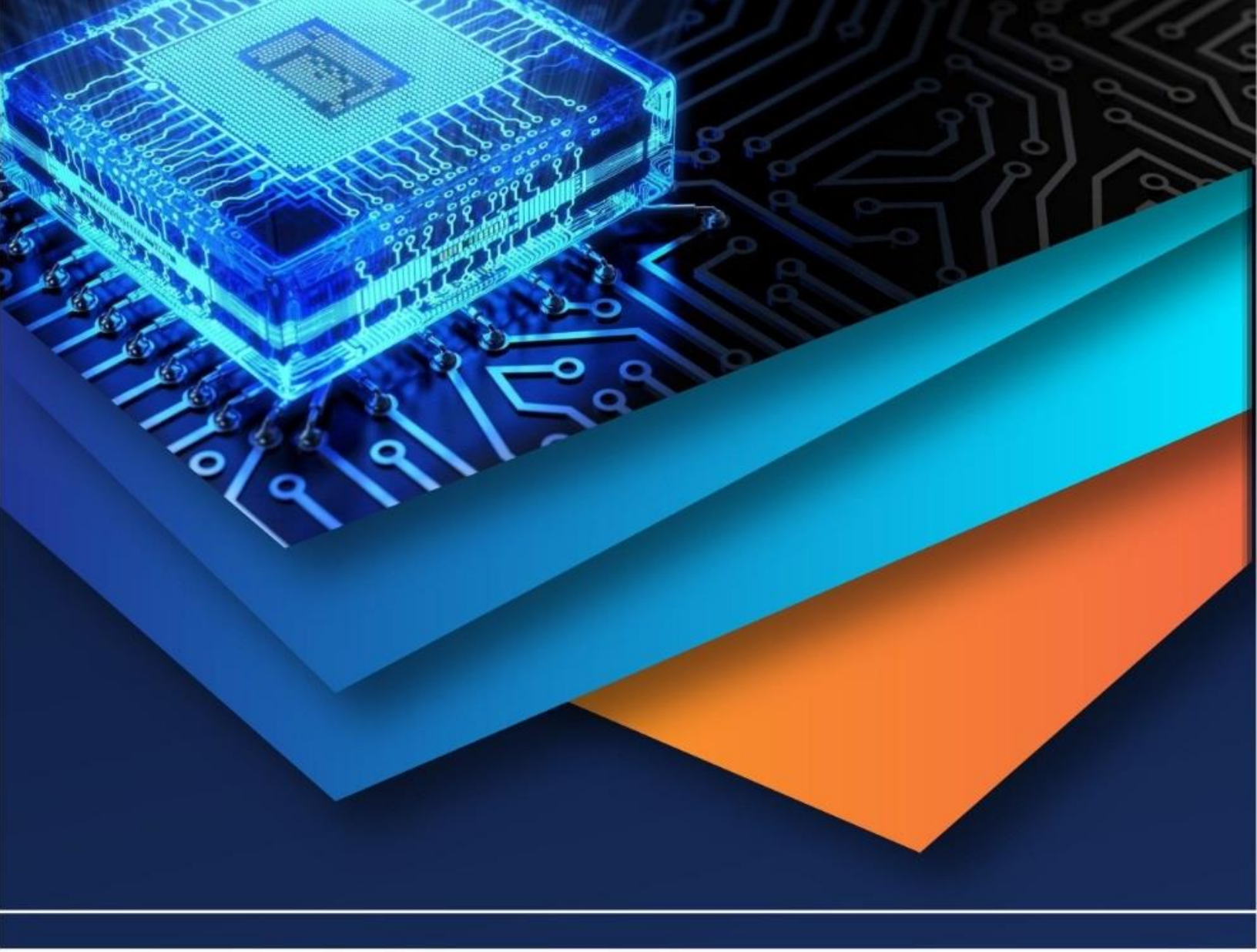

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