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INVESTIGATION WORK CARRIED OUT AT NIDUBROLU WATER TREATMENT PLANT

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ABSTRACT: Development of urbanization in India is exerting stress on civic authorities to provide basic necessities such as safe drinking water, sanitation and infrastructure. The rapid growth of population has exerted the portable water demand, which requires exploration of raw water sources, developing treatment and distribution systems. There is a need to study the water treatment plants for their operational status and to discover the best feasible mechanism to ensure proper drinking water production with least possible rejects and its management. This case study has been conducted to evaluate the process of treatment and to find out the problems of drinking water treatment process in the plant situated at Nidubrolu, Ponnur. In general, conventional treatment is provided having a sequence of alum addition, coagulation, flocculation, sedimentation; filtration and disinfection by chlorination. Water treatment plants are playing an important role in purification and supply of pure water to the people. In this present study the operation and maintenance of water treatment plant located in Nidubrolu, Ponnur mandal Guntur(District) is carried out and the needs to be updated for the current requirements of the people is discussed.

1.INTRODUCTION

Water is a universal solvent. Most of the water comprising on earth's surface is salt water. Only 2.5% of the water present earth surface 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 the planet is accessible for consumption. Clean drinking water is a basic human need. Unfortunately, more than one in six people still lack reliable access to this precious resource in developing world.

Study of water treatment plant is carried out with all aspects and considerations including physical, chemical and bacteriological, to determine its efficiency and to produce water quality. Importance of continuous monitoring and analysis laboratory works to evaluate performance before and after each treatment unit has been illustrated.

1.2. Importance of water demand in India

India accounts for 2.45% of land area and 4% of water resources of the world but represents 16% of the world population. With the present population growth-rate (1.9 per cent per year), the population is expected to cross the 1.5 billion mark by 2050The Planning Commission, Government of India has estimated the water demand Increase from 710 BCM (Billion Cubic Meters) in 2010 to almost 1180 BCM in 2050 with domestic and industrial water consumption expected to increase almost 2.5 times. The trend of urbanization in India is exerting stress on civic authorities to provide basic requirement such as safe drinking water, sanitation and infrastructure. The rapid growth of population has exerted the portable water demand, which requires exploration of raw water sources, developing treatment and distribution systems.

1.3. Study area details

Ponnur is a town in the Guntur District of Andhra Pradesh bounded by Krishna district and Bay of Bengal in the East while on its south lies Prakasam district, in the west Mahabubnagar district and Krishna and Nalgonda districts in the North. The rivers Krishna, Chandravanka, Naagileru, and GundlaKamma flow through the district. The National Highway No. 5 (NH-5) is 28kms away from Ponnur town. Ponnurtown is connected to district Head Quarter Guntur and major towns like Bapatla and Chirala by GBC Road. The nearby railway station to ponnur town is Nidubrolu, around 36 trains has halt at this station. The town is located on the South-East coast of India around 30kms from the Bay of Bengal.

Geography

Ponnur is located at 16.20° N 80.27° E. It has an average elevation of 33 meters (108 feet) and situated on the plains. There are a few hills in the surrounding suburban areas. The town is located around 40 miles (64 km) to the north of the Bay of Bengal on the east coast of India. The Krishna Delta lies partly in Guntur district. There are other smaller rivers and channels in the region such as Guntur Channel, Chandravanka, Naagileru, and Guntur Branch Canal etc. Rain storms and hurricanes are common in the region during the rainy season, which starts with monsoons in early June. The hurricanes could occur in any time of the year, but commonly between May and November.

Demography

The population of the Ponnur town under GMC is 62,354 as per 2011 census and estimated designed population for prospective years is of 84,452(according to 2026). Therefore, as per increasing population the water demand will also increases day by day.

1.4. About Treatment Plant in Ponnur

The town of Guntur draws its raw water for drinking water requirements from the following sources as tabulated below.

Table 1.4 :At Present, the Town of Guntur Draws its Raw Water for Drinking Water Requirements from the following Sources as:

HYDAULIC DESIGN OF RAW WATER PUMP AND PUMPING MAIN

Population as per 2001 Census	:	57640	
Present Population (2015 AD)	:	62724	
Prospective Population in (2021 AD)	:	80000	
Ultimate Population in (2036AD)	:	102000	
As per CPHEEO Mannual water demand with UGD	:	135	LPCD
Transmission losses at 15% of water demand	:	20.25	LPCD
Total clear water demand	:	155.25	LPCD
Filtration losses at 5% of total clear water demand	:	7.76	LPCD
Total Raw Water Demand	:	163	LPCD

The plant situated at Nidubrolu, Ponnur.with a capacity of 90MLD. The source of water is collected from kommamuru canal of Krishna river which is 36 Km far away from the water treatment plant. Present study has been conducted to observe and access the existing methodologies used for treatment of drinking water at water treatment plant or Ponnur Head Water Works ,Nidubrolu, Ponnur.

Photograph 1.4.2: Water Treatment Plant Satellite Map.

2.METHODOLOGY

A case study has been conducted to evaluate the process of treatment and to find out the problems of drinking water treatment process in the plant situated at Nidubrolu, Ponnur. In general, conventional treatment is provided having a sequence of alum addition, coagulation, flocculation, sedimentation, filtration and disinfection by chlorination. Guntur district is situated between 16̊18 N and 80̊27 E latitude and longitude. The district is an important district of Andhra region of the state of A.P, India. The population as projected for the year 2011 is 57, 43,144. The major rivers of the district are the Krishna, the Naagileru, the Chandravanka and the Gundlakamma.

2.1Raw water collection

The raw water collects from kommamuru Canal. kommamuru canal originates from Buckingham canal which is originated from Krishna River. Raw water is intakes from the kommamuru canal and stored in the intake well having the dimensions of 12 m diameter and 5 m water depth. The stored raw water is pumping to the water treatment plant by using the centrifugal pumping system. The raw water pipe line from intake well water treatment plant as 700 mm diameter mild steel pipe and 595 mm diameter glass reinforced plastic pipes with sluice valves having dimensions of 600 mm diameter to control the flow of water through pipes. In addition to, use the air relief valves having the dimension of 150 mm diameter to remove the accumulated air from the pipe lines. The distance of the pipeline from the intake well to Water treatment plant, the raw water enters directly into the old plant then after the water sent to various treating units.

Photograph 3.2.1: Raw water Collection sump at Treatment plant

Photograph 3.2.1: Raw water pumping by centrifugal pumps

2.2 Quality Standards

The objective of water works management is to ensure that the water supplied is free from pathogenic organisms, clear, palatable and free from undesirable taste and odour, of reasonable temperature, neither corrosive nor scale forming and free from minerals which could produce undesired physiological effects. The establishment of minimum standards of quality for public water supply is of fundamental importance in achieving this objective. Standards of quality from the yardstick within which the quality control of water supply has to be assessed.

Considering the standards prescribed the earlier manual and further development in the international standardization and the conditions in the country, the following guidelines are recommended as per **IS 10500-2012.**

Recommended guidelines for Physical and Chemical quality of Drinking Water.

The following guidelines are recommended as per IS **10500-**2012

Table 1. Guidelines for physical and chemical parameters:

S.no	Characteristics	Acceptable	Cause of Rejection
1	Turbidity in N.T.U	3.5	10
2	Color(Units on Platinum Cobalt scale)	5.0	25
3	Taste and Odour	Unobjectionable	Unobjectionable
4	p^H	7.0 to 8.5	<6.5 or>9.2
5	Total dissolved solids(mg/l)	500	1500
6	Total hardness (mg/l)	200	600
7	Chlorides(Cl) (mg/l)	200	1000
8	Sulphate (SO_4)	200	400
9	Fluorides(F) (mg/l)	1.0	1.5
10	Nitrates(No_3) (mg/l)	45	45
11	Calcium(Ca) (mg/l)	75	200
12	Magnesium(Mg) (mg/l)	>30	150
13	Iron (Fe) (mg/l)	0.1	1.0
14	Manganese(as Mn) (mg/l)	0.05	0.5
15	Copper (as Cu) (mg/l)	0.05	1.5
16	Zinc (as Zn) (mg/l)	5.0	15.0
17	Phenolic compounds(as phenol)	0.001	0.002
18	Anionic detergents (mg/l)	0.2	1.0
19	Mineraloil (mg/l)	0.001	0.3
Toxic Materials			
20	Arsenic (mg/l)	0.05	0.05
21	Cadmium(Cd) (mg/l)	0.01	0.01
22	Chromium(Cr) (mg/l)	0.05	0.05

23	Cyanides(CN) (mg/l)	0.05	0.05
24	Lead (Pb) (mg/l)	0.1	0.1
25	Selenium(Se) (mg/l)	0.01	0.01
26	Mercury(Hg) (mg/l)	0.001	0.001
27	Poly nuclear aromatic hydrocarbons (PAH)	0.2μG/L	0.2 μG/L
Radio Activity			
28	Gross Alpha activity	3_p Ci/l	3_p Ci/l
29	Gross Beta activity	30_p Ci/l	30_p Ci/l

2.3 Bacteriological Standards

The recommended guidelines for water quality standards as per **IS 10500-2012**

Table 2 Guideline values for Bacteriological Quality

S.no	Organism	Unit	Guideline value
1	Treated water entering into the distribution system	Faecal coliform number/100ml Coliform organisms number/100ml	0 0
2	Untreated water entering the distribution system	Faecal coliform number/100ml Coliform organisms number/100ml Coliform organisms number/100ml	0 0 3
3	Water in the distribution system	Faecal coliform number/100ml Coliform organisms number/100ml Coliform organisms number/100ml	0 0 3
4	Un piped water supplies	Faecal coliform number/100ml Coliform organisms number/100ml	0 10
5	Emergency water supplies	Faecal coliform number/100ml Coliform organisms number/100ml	0 0

3. Experimental work

The analysis of water of the source is done to determine the various impurities present in it. On the basis of these impurities, the treatment plant will be designed. Therefore, the analysis of water is very necessary before designing any water supply scheme. Similarly after the treatment of water, its analysis is again done to ascertain that water has been purified or not. Treated water before supply to the public is checked for its quality whether it fulfills the requirements of the standards laid down by the public health department. As the quality of source water varies daily and every season, it is necessary that the water samples for analysis should be collected frequently and over a long period of time. According to the quality of water it should be treated. The following are the tests which are done during water analysis.

- Physical tests.
- Chemical tests.
- Biological tests.
- The tests are done in the water treatment plants laboratory, by carrying out a series of tests in the systematic manners.

List of Tests on Raw Water

The following tests are to be conducted for knowing about of the quality of treated water, they are

- P^H
- TURBIDITY
- TOTAL DISSOLVED SOLIDS
- JAR TEST
- ALKALINITY
- HARDNESS
- ELECTRICAL CONDUCTIVITY

3.1. P^H

P^H means potential of hydrogennie. The P^H value indicates the logarithm of reciprocal of hydrogen ion concentration present in water.P^H Can be measured in two methods, they are

- Colorimetric method
- Electrometric method

In Our project view, we are using the Electrometric method.

Observations

The observations of P^H values of the water samples at different stages are tabulated below.

Table 3 the P^H value of the Water Samples at Different Stages.

S.No	Water sample	value
1	Raw water	7.86
2	Coagulated water	7.74
3	Sediment water	7.35

4	Filtered water	7.05
5	Chlorinated water	6.98

3.2.Turbidity

The turbidity of the sample is measured from the amount of light scattered by the sample taking reference with the standard turbidity suspension.

The observations of the turbidity of the water samples at different samples are tabulated below.

Table 4 the Turbidity of the Water Samples at Different Stages.

S.No.	Water Sample	Turbidity
1	Raw Water	9.3
2	Coagulated Water	8.2
3	Sediment Water	7.6
4	Filtered Water	7.1
5	Chlorinated Water	6.5

3.3 Total Dissolved Solids

Total solids are determined as residue left after evaporation to 103° to 105° and subsequent drying of the unfiltered sample. The main objective of this, the total solids present in the given sample and to distinguish between dissolved and suspended solids.

Observations

The observations of total dissolved solids of the given water samples at different stages are tabulated below.

Total 5 Dissolved Solids of the given Water Samples at Different Stages.

S.No.	Water samples	Volume of the sample taken	Weight of suspended solids	Weight of Dissolved solids
1	Raw water	50	0.13	0.190
2	Coagulated water	50	0.11	0.520
3	Sediment water	50	0.10	0.09
4	Filtered water	50	0.02	0.07
5	Chlorinated water	50	0.02	0.06
6	Drained water	50	0.09	0.19

3.4 Jar Test

The objective of the jar test is to estimate the optimum concentration of aluminium sulphate for the removal of suspended matter.

Inference

By conducting the number of tests on raw water samples, the following standard table has been prepared for the concentration of alum dosage. From this table the alum addition can be selected based on the turbidity value directly. The table has been given below.

Table 6 Probable Dosage of Alum for various Ranges of Turbidity Evaluation as per Laboratory Bench Flocculator Test in 45 MLD Capacities.

S.No	Turbidity range in N.T.U	Alum dosage required in mg/l	Alum dosage required in kg/day	Alum dosage required in kg/hr	Alum dosage required in each tank/8hr
1	0-5	2	90	4	30
2	5-10	4	180	8	60
3	10-15	6	270	12	90
4	15-20	6.5	315	14	105
5	20-30	7	360	15	120
6	30-40	10	450	19	150
7	40-50	15	675	21	225
8	50-60	18	810	34	270
9	60-70	21	945	40	315
10	70-80	25	1125	47	375
11	80-90	29	1305	55	435
12	90-100	32	1440	60	488
13	100-110	39	1755	74	585
14	110-120	45	2205	94	
15	120-140	52	2496	104	832
16	140-160	59	2882	120	960
17	160-180	65	3089	129	1029
18	180-200	73	3285	137	1095
19	200-220	79	3555	147	1185
20	220-240	85	3604	150	1200
21	240-260	91	3808	158	1269
22	260-280	99	4012	167	1337
23	280-300	109	4105	171	1368
24	300-320	116	4221	175	1406
25	320-340	123	4332	180	1444
26	340-360	129	4421	184	1473
27	360-380	137	4556	189	1518
28	380-400	142	4612	192	1537

3.5 Alkalinity

Alkalinity may be defined as the power of a solution to neutralized hydrogen ions. The principle of alkalinity of water is a measure of its capatown to neutralized acids. Alkalinity is usually imparted by bicarbonates, carbonate and hydroxide. Alkalinity is measured volumetrically by titration with 0.02 N H_2SO_4 and is reported in terms of CaCO_3equivalent.

Observations

The observations of Alkalinity of the raw water sample when Phenolphthalein indicator and Methyl orange indicator added is tabulated below.

Table 7: V_1- Table for Alkalinity when Phenolphthalein Indicator added.

S.no	Volume of the sample taken in ml	Burette readings		Volume of the rundown in ml
		Initial	Final	
1	50	0	4.3	4.3
2	50	0	4.5	4.5
3	50	0	4.5	4.5

V_2- Table

Table 8: V_2- Table for Alkalinity when Methyl Orange Indicator added

S.no	Volume of the sample taken in ml	Burette readings		Volume of the rundown in ml
		Initial	Final	
1	50	4.3	9	5.7
2	50	4.5	9.5	5
3	50	4.5	9.5	5

3.6 Hardness (By EDTA Method)

Hardness of the water is due to the presence of dissolved salts of calcium, magnesium, and metal ions. Hard water does not given lather easily with soaps. As the hardness causing ions react with soap to form insoluble soap.

Observations

The observations of the Hardness of the raw water and clear water as tabulated below

Table 9.Hardness of the Water by EDTA Method

S.No	Type of water samples	Volume of the sample taken in ml	Burette readings		Volume of the EDTA rundown in ml
			Initial	Final	
1	Raw water	50	0	6.6	6.6
2	Raw water	50	0	6.7	6.7
3	Raw water	50	0	6.6	6.6
4	Clear water	50	0	5.7	5.7
5	Clear water	50	0	5.6	5.6
6	Clear water	50	0	5.7	5.7

3.7 Electrical Conductivity

The electrical conductivity is a total parameter of dissolve and dissociated substances. Its value depends on the concentration and degree of dissociation of the ions as well as the temperature and migration velotown of the ions in the electric field.

Observation

The observations of the water samples at different stages are tabulated below.

Table 10 Electrical Conductivity at Different Stages of Water Samples

Water samples	Electrical Conductivity in µmhos/cm
Raw water	0.96
Coagulated water	0.96
Sediment water	0.95
Filtered water	0.94
Chlorinated water	0.93

4.Conclusion

The following are the conclusions:

- The collection of raw water from Kommamuru canal to treatment plant had been studied.
- The qualitative assessment of raw water for various tests such as P^H (7.86), turbidity (9.3), total dissolved solids (3.8 mg/l), Jar test (180 Kgs), Alkalinity (100 mg/l), Hardness (128.04 mg/l) and Electrical Conductivity (0.96 µmhos/cm) are under safe permissible limits comparative to the IS 10500-2012 acceptable range. The acceptable ranges are described in the earlier chapters
- After the raw water collection, the coagulation and flocculation had been done in the sedimentation tank by the addition of 180 Kgs/day. According to the plant standards as described in the earlier chapters III and IV.

- The qualitative assessment of coagulation and flocculation in the sedimentation tank for various tests such as P^H (7.35), turbidity (7.6 N.T.U), total dissolved solids (1.8 mg/l), Jar test (180 Kgs), and Electrical Conductivity (0.95µmhos/cm) are under safe permissible limits comparative to the IS 10500-2012 acceptable range. The acceptable ranges are described in the earlier chapters 3.5.2.1 and 3.4.2.2.
- Filtration can be carried out sedimentation water works for the removal of impurities by using 12 beds of rapid sand filters with treating capacity of 7.5 MLD of each filter with a continuous operation mode.
- The qualitative assessment of filtration in the sedimentation tank for various tests such as P^H (7.05), turbidity (6.8 N.T.U), total dissolved solids (1.4 mg/l), Jar test (180 Kgs), and Electrical Conductivity (0.94µmhos/cm) are under safe permissible limits comparative to the IS 10500-2012 acceptable range. The acceptable ranges are described in the earlier chapters 3.5.2.1 and 3.4.2.2.
- The next step after filtration is disinfection by chlorination. Gaseous chlorine process had been done in the plant 100Kgs/day for the safe drinking purpose.
- Finally the treated water can be distributed to the zones.
- The distribution can be carried out from two tier reservoir (ELSR) to the above zones supplied by the intermittent grid pattern system through gravity.
- The total requirement of the water supply is 119.57 MLD in which 90MLD capatown can be supplied by the Ponnur Head Water Works, Nidubrolu. It is almost 75% of total requirement.

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