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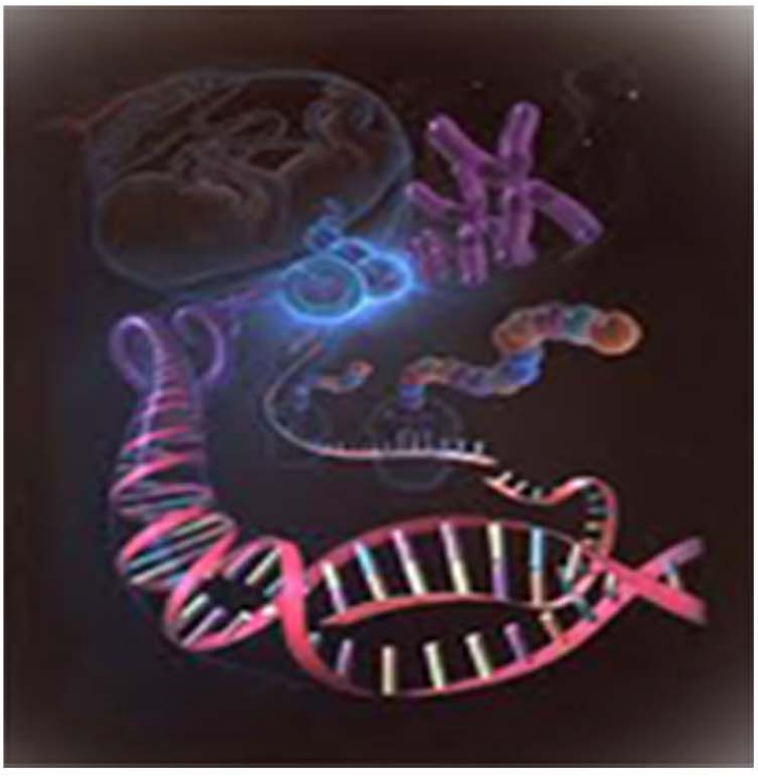

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Research Paper

QUALITATIVE ANALYSIS & TREATMENT FOR DRINKING WATER IN EDUCATIONAL INSTITUTES OF GONDIA BLOCK

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Twenty One Educational Institutes of Gondia Block were visited throughout the year to collect the drinking water samples. The different parameters such as dissolved oxygen, total solids, chlorides, hardness, alkalinity, temperature and pH were tested in the Laboratory of M.I.E.T., Gondia (M.S.). All the parameters were compared with the standards of drinking water as per ICMR & WHO. After the analysis of season wise, it is found that nearly all the parameters are within the permissible limit except the hardness in some water samples. The samples having more hardness are nearly permissible limit in bore wells water, and increase in hardness is mainly due to the location of these bore wells in rocky area. To remove the level of hardness to the permissible limit, a pilot treatment unit (lime soda process) is proposed which is economical & affordable to the institutes. The quantity of lime soda required per year & the capital cost of the installment of this process have been calculated.

Keywords: Qualitative analysis, Drinking water, Pilot plant, Water treatment, Gondia Block

INTRODUCTION

Water is one of the most basic and important natural source. Water is not only one of the most essential commodities of our day-to-day life, but the development of this natural resource also plays a crucial role in economic and social development processes. While the total amount of water available in the world is constant and is generally said to be adequate to meet all the demands of mankind, its quality and distribution over different regions of the world is uneven and causes problems of scarcity and suitability. It is therefore imperative that man develops, uses and manages this scarce commodity as rationally and efficiently as possible. In order to execute this task, accurate and adequate information must be available about quality of this natural resource under constantly changing human pressure and natural resources.

However, poor water quality continues to pose a major threat to human health worldwide around 1.2 billion people lack access to improved water

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source and 2.4 billion have no basic sanitation. 7 million people died each year of water borne diseases, including 2.2 million children under the age of five. 400 children in developing countries including India, die every hour due to water borne diseases.

OBJECTIVES

The main objective of this study is to check the quality of water supplied to the educational institutes of Gondia Block level. Also, after considering analysis of the supplied water, an economical, affordable, easy to handle and maintainable of pilot treatment unit is to be proposed. The Water Quality is assessed with the objective to evaluate the Physico-Chemical characteristics bacteriological quality of water.

MATERIALS AND METHODS

Gondia is a District place situated at the latitude of 21^{0}28' N & longitude of 80^{0}90' E of Balaghat-Kohmara state high way and Nagpur-Kolkata Railway Line. It is about 130 km. away from Nagpur by railway route. It receives maximum, minimum & average rainfall of 1640 mm, 1007 mm and 1580 mm respectively. It was created a Municipality in the year 1967. The present population of Gondia city is 1, 20,902 as per 2001 census.

The main source of water supply to the city is from Wainganga River located 15 km. away in North side. The existing source of water supply scheme in the village Dangorli & from this source the water comes through rising main to filter plant near Kudwa village & after the treatment from the treatment plant, the water collected in two ESR which are situated in Rail-toli area.

The qualitative analysis of drinking water in twenty-one educational institutes of Gondia Block considering more than 500 students capacity, out of 21 institutes, 7 are in Gondia city and 14 Institutes in rural areas of Gondia district. All institutes are using drinking water from bore well sources, i.e., ground water. Figures 1 and 2 shows the location map of Educational Institutes in Rural and Urban area of Gondia district respectively.

Figure 1: Location Map of Educational Institutions in Gondia Tahsil (Rural Area)

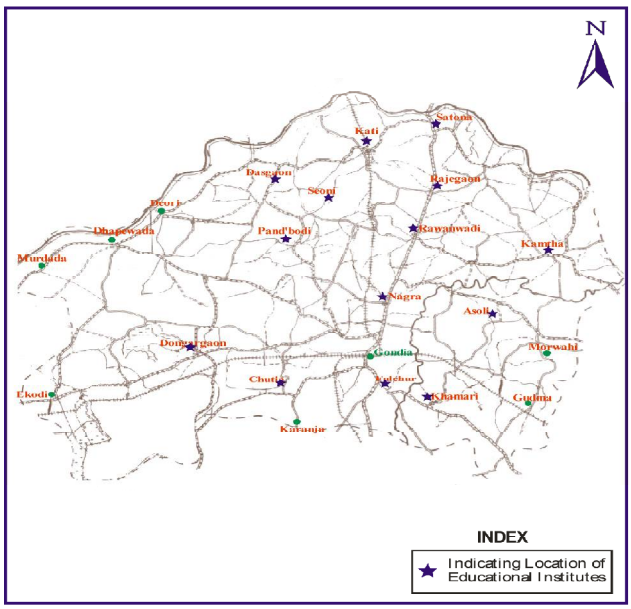
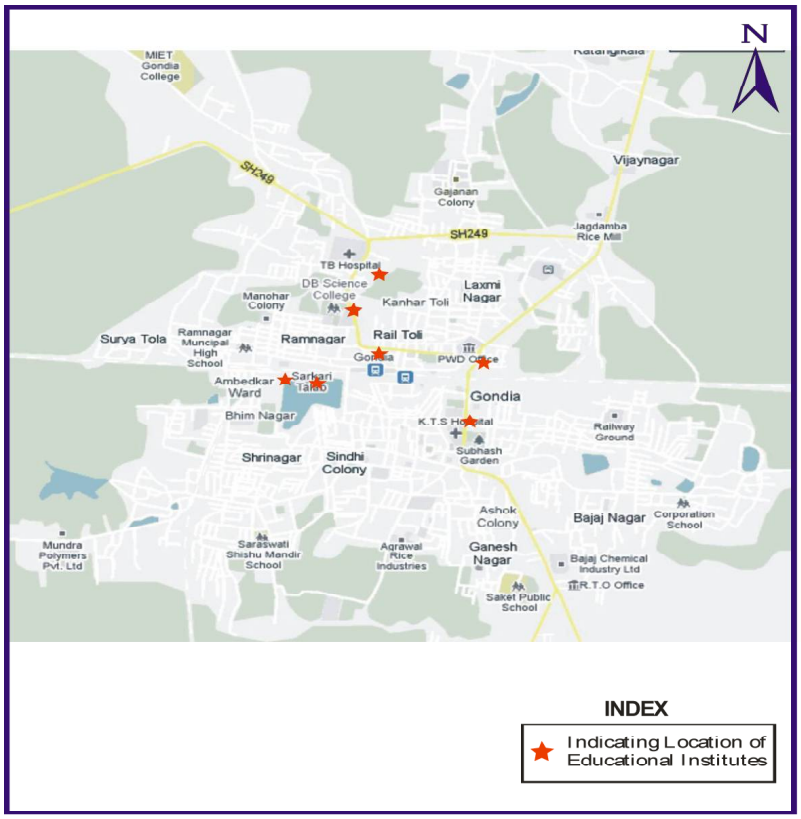


Figure 1: Location Map of Educational Institutions in Gondia Tahsil (Urban Area)



TYPES OF EXAMINATION

Test carried out in the laboratory are intended to analyze and access the quality of drinking water used in various educational institutes. The water was tested according to the standard methods. All the parameters were checked in the Environmental laboratory of Civil Engineering Department in MIET, Gondia. The laboratory examination comprises following parameters.

1) **Physical:** The physical parameter includes temperature, taste, colour, odour.
2) **Chemical:** Chemical parameters includes pH, Alkalinity, Hardness, Chlorides, DO, Total solids, Conductivity
3) **Biological:** Biological parameters.

ANALYSIS

All the samples were collected from tap of drinking water tank of different twenty-one educational institutes in Gondia Block. Prior to filling the sample bottle were raised out two or three times with water to be collected prior care were taken to obtain a sample that is truly representative of existing condition and to handle it in such a way that it does not become contaminated before it reached the laboratory. All the samples were tested in MIET. Laboratory using standard methods for temperature, pH, conductivity, DO, alkalinity, total solids, hardness, total coli form parameters. All these parameters and methods of analysis are given in following Table 1.

Table 1: Various Parameters and Analysis Techniques

S. No.	Parameters	Method
1.	Temperature	Thermometer
2.	pH	Digital pH Meter
3.	Conductivity	Conductivity meter
4.	Dissolved Oxygen	Winkler Method
5.	Alkalinity	H_2SO_4 Titration method
6.	Total Solids	By Evaporation
7.	Hardness	E.D.T.A. Method
8.	Chloride	Mohr's Method
9.	Total Colli form	M.T.D.T.

PILOT TREATMENT UNIT

The water quality analysis for twenty one educational institutes in Gondia Block, has been carried out and it is evident from the results that hardness in most cases is near or very close the permissible limit (ICMR and WHO). The proposed design is based on considering low cost alternatives and lesser maintenance because the institutes have limited resources. The treatment unit is designed for 500 student capacity of each institute.

REQUIREMENT OF WATER

Assumptions made in Design:

i) Total student capacity = 500 Nos.

ii) Consumption of water/Day = 3.5 Lit/student

iii) Shape of Softening Chamber = Rectangular

iv) Velocity of settling in chamber = 0.10 mt/s

v) Free board for softening chamber = 0.30 mt

vi) Rate of filtration = 250 Lit/hour/m^2 of the filter area

Total required Quantity of water:

Total Student Capacity = 500 Nos.

Consumption of Water per Day

= 3.5 lit/student

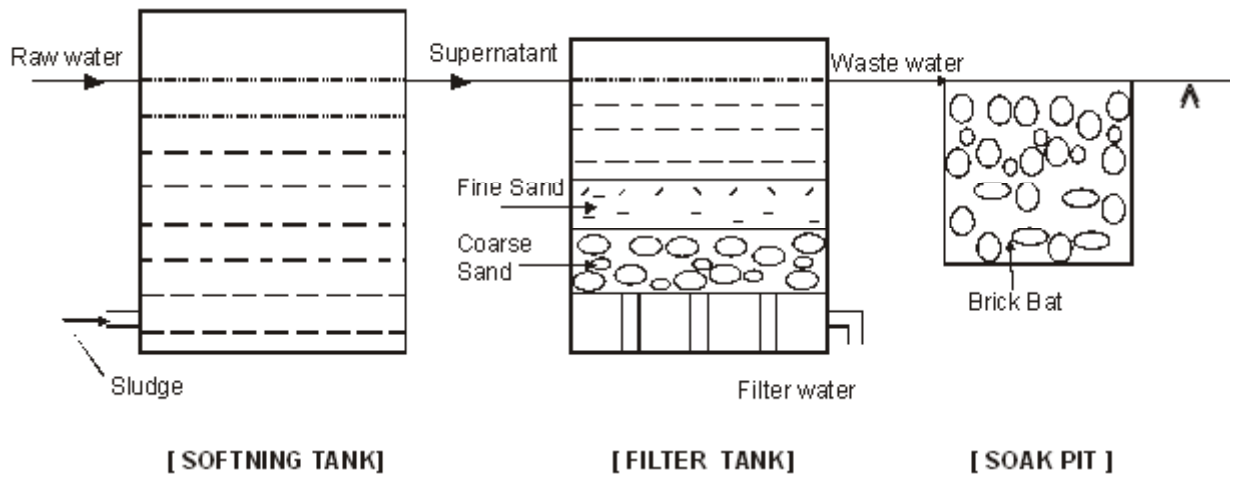
Total Qty. of required water = 500 x 3.5 l

= 1750 l. Say @ 1800 l

DESIGN OF SOFTENING TANK

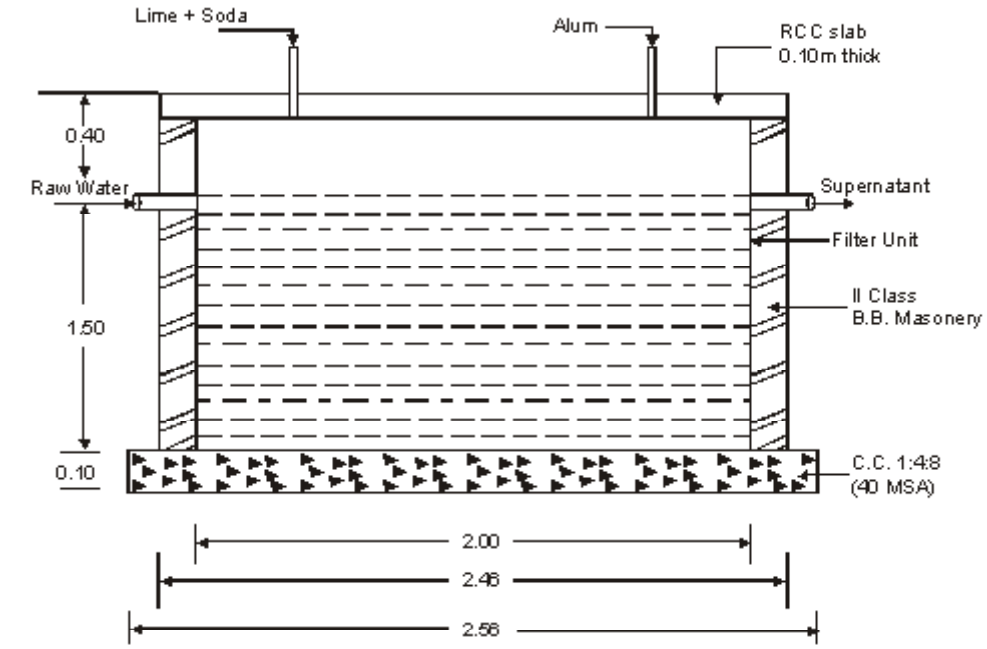
The requirements of water for each Educational Institutes are 1800 liters per day. So provide the tank size (2.00 x 1.20 x 1.80 m.) and bottom depth

Figure 3: Flow Diagram of Pilot Treatment Unit (Lime, Soda Process)

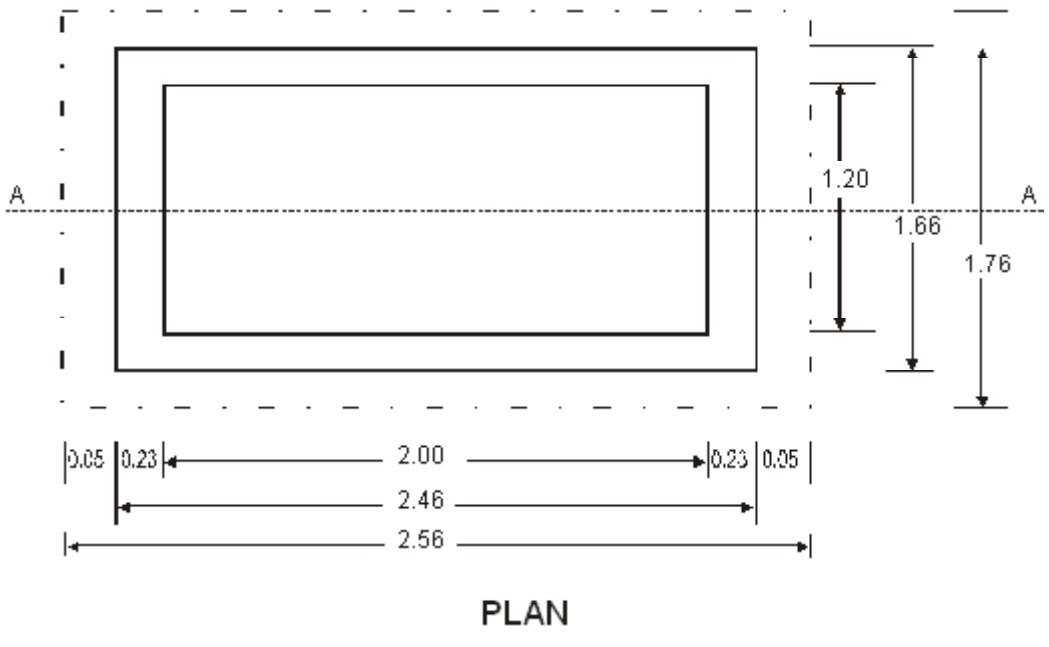


including 0.50 m. as removal for sludge. Consider the tank of softening chamber is rectangular shape. The velocity kept as 0.10 m/s for setting purposes. Figure 3 shows the flow diagram of pilot treatment unit and Figure 4 shows the Softening Tank.

Figure 4: Softening Tank



LONGITUDINAL SECTION (A - A)



PLAN

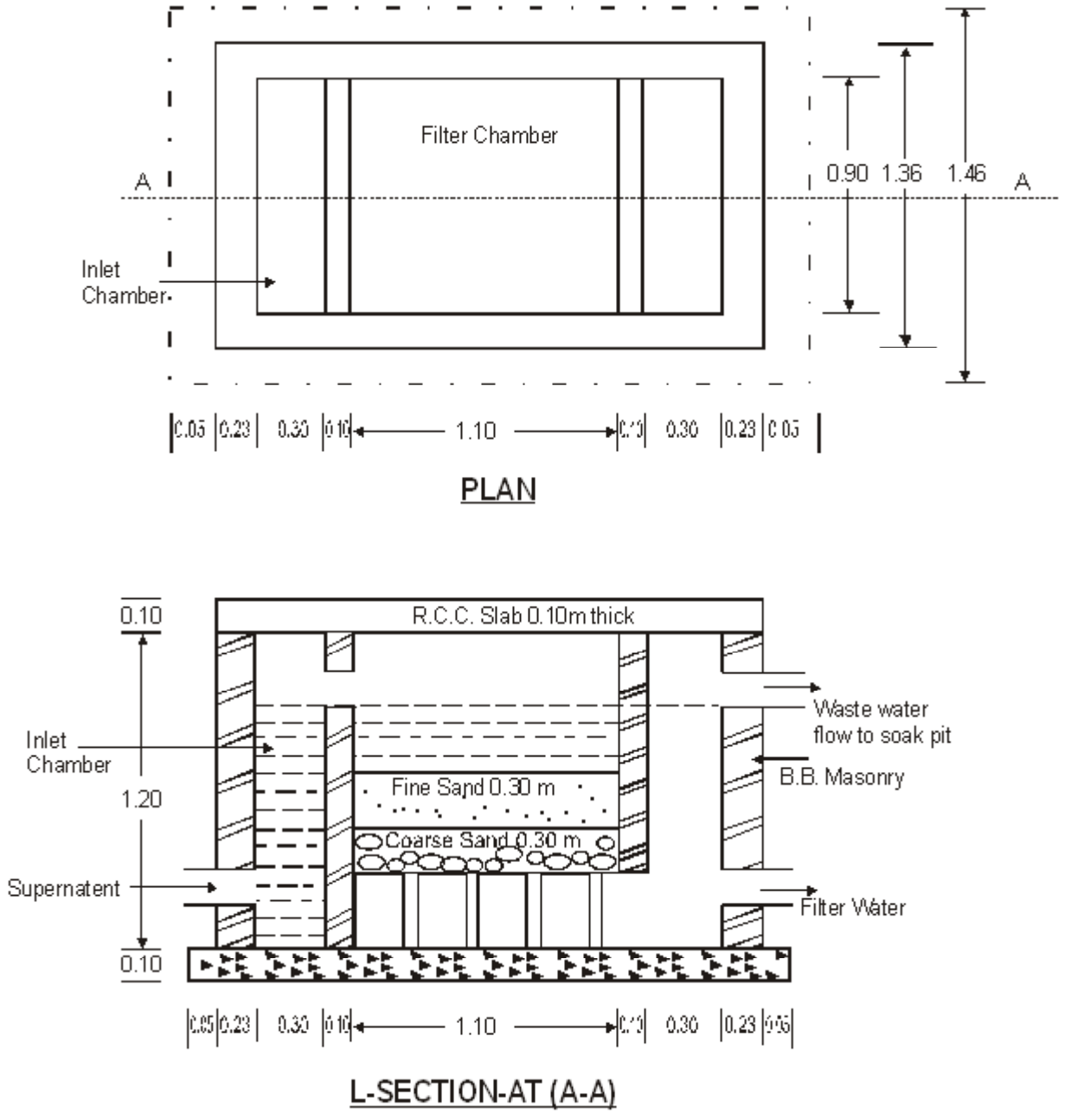
DESIGN OF SLOW SAND FILTER

- Total capacity of water is 1800 lit/day and span of period is 8 hours.
- Rate of filtration @ 250 ltr. / hour / Sq.mt. of filter area.
- Hence, Required area for filter tank = 1800/(8 x 250) = 0.90 m^2 @ 1.00 m^2

Provide 1.10 x 0.90 m. rectangular size and depth of tank is kept 1.50 m.

Filter Tank: Figure 5 shows the schematic diagram of Slow sand Filter.

Figure 5: Slow Sand Filter



TOTAL REQUIREMENT OF LIME, SODA AND ALUM

From the table it is necessary to remove 100 ppm hardness for its normal range. For the total demand of water is 1800 litre per day. The material such as lime, soda and alum are calculated as below:

a) Lime: Amount of lime required = 2.33 kg/ million litre of water.

(Refer Standard Value for Lime, Soda and Alum, B.C. Punmia, Env. Engg.-I. Page no. 398)

\ Required for 1800 litre of water per day = $2.33x100x1800/10^6$ = 0.466 kg or 466 gm / day

\ Total quantity for one year = 0.455 x 365 Days=170.00 Kg.

b) Soda Ash: As per our observations nearly 100 ppm hardness is to be removed. So amount of Soda ash required = 1.06 Kg per million litre of water

\ Required for 1800 litre of water per day

$1.06 \times 100 \times 1800/ 10^6$ = 0.212 kg or 212 gm/ Day

\ Total quantity for one year = 0.212 x 365 Days = 77.38 Kg.@ 77.00 Kg

c) Alum: The Quantity of Alum is taken 16 mg/ L.

For 1800 litre per day filtered water the quantity of Alum is

$16x1800/10^6$ = 0.032 kg or 32 gm/Day

\ Total quantity for one year = 0.032 x 365 Days = 11.68 Kg. @ 12 Kg.

TOTAL COST OF LIME SODA PROCESS UNIT

The total cost of lime soda process is based on detailed measurement of various unit given as per drawing and abstract carried out. The schedule of rates is taken from PWD CSR 2009-10.

Categorized of Total Cost as

i) Construction cost of Process = Rs. 21624.00

ii) Material used yearly

(Lime + Soda + Alum) = Rs. 2276.00

iii) Maintenance Cost yearly = Rs. 2500.00

Total: = Rs. 26400.00

RESULTS AND DISCUSSION

The observation has been given for the various parameters of twenty-one educational institutes situated in Gondia Tehsil of district Gondia having strength of students more than 500. The result of various parameters has been given season wise in following Table 2a to 2c.The proposed pilot treatment unit is very economical, feasible and affordable for each Educational Institutes. The cost of material and maintenance is very less and easily manageable with no electrical appliances with the requirement of less area of land. Considering the above mentioned positive facts, the pilot treatment unit must be implementing for all Educational Institutes in view of safe drinking water provision to the Nation's growing students.

Table 2a: Water Quality Result (Rainy Season)

S. No.	Location No.	pH	E C MHOS/cm	Temp ^{0}C	DO mg/L	Total Solids mg/L	Total Alkalinity mg/L	Total Hardness mg/L	Chloride mg/L
1	1	6.3	0.014	12.5	6.3	0.255	123	274	212.325
2	2	7.58	0.024	11.5	7.75	0.305	115	217.5	169.235
3	3	7.98	0.109	10.5	7.86	1.05	110	271.5	252.54
4	4	7.31	0.042	10.5	7.45	0.44	107.5	218	150.12
5	5	7.97	0.010	9.5	6.90	0.92	108	266	150.25
6	6	7.87	0.104	10.5	753	0.65	94	231	137.35
7	7	7.82	0.010	10.5	7.18	0.53	91	227.5	123.65
8	8	7.30	0.060	10.5	6.65	0.35	67	152	46.70
9	9	6.81	0.047	11	7.14	0.32	76.5	157	47.75
10	10	7.24	0.044	10.5	7.81	0.13	71	171.50	123.70
11	11	6.58	0.018	11.5	7.45	0.15	55	184	103.575
12	12	7.22	0.023	10.5	6.87	0.375	86	218	127
13	13	7.38	0.017	10.5	6.66	0.40	61	156.50	87.05
14	14	6.91	0.032	11	7.19	0.31	47	207	73.20
15	15	6.76	0.060	10.5	7.31	0.295	92	169	46.55
16	16	7.16	0.065	10.5	6.28	0.21	66.50	174	47.30
17	17	7.92	0.030	10.5	7.75	0.40	119	214	153.125
18	18	7.72	0.016	11	7.29	0.465	83.50	188	131.150
19	19	7.36	0.042	10.5	6.95	0.535	115.50	211	133.060
20	20	7.40	0.037	10.5	6.85	0.670	100	200	127.750
21	21	7.16	0.060	10.5	6.86	0.210	77	169	133.975

Table 2b: Water Quality Result (Winter Season)

S. No.	Location No.	pH	E C MHOS/cm	Temp ^{0}C	DO mg/L	Total Solids mg/L	Total Alkalinity mg/L	Total Hardness mg/L	Chloride mg/L
1	1	7.10	0.014	10.5	7.50	0.275	114	288	216.075
2	2	7.76	0.023	11.5	7.25	0.225	119	210.5	191.265
3	3	7.81	0.106	10.5	7.54	0.965	103	271	24.31
4	4	7.49	0.038	10.5	7.41	0.60	119	234.5	283.35
5	5	7.91	0.015	10.5	6.74	0.775	110	268	142.175
6	6	7.72	0.112	9.5	7.65	0.60	83	246	145.65
7	7	7.75	0.018	11.0	7.36	0.50	82.5	240.5	133.825
8	8	7.00	0.064	10.5	6.82	0.385	72	143.5	52.375
9	9	7.94	0.055	11.0	6.97	0.235	70.5	164	38.300
10	10	7.14	0.050	10.5	7.64	0.170	80	187.5	119.175

Table 2b (Cont.)

S. No.	Location No.	pH	E C MHOS/cm	Temp °C	DO mg/L	Total Solids mg/L	Total Alkalinity mg/L	Total Hardness mg/L	Chloride mg/L
11	11	7.13	0.017	9.5	7.30	0.175	62	163	86.30
12	12	6.95	0.026	9.5	7.11	0.285	82.50	229	123
13	13	7.04	0.017	9.5	6.86	0.360	73	150	97.20
14	14	7.12	0.032	11.5	7.33	0.350	54.5	220.5	84.10
15	15	7.60	0.068	11.5	7.40	0.270	85	160	38.25
16	16	7.30	0.059	10.5	6.90	0.300	74	182.5	42.375
17	17	7.79	0.043	11	7.67	0.340	119	208	160.125
18	18	7.55	0.018	10.5	7.45	0.565	77	179	144.850
19	19	7.50	0.035	10.5	7.07	0.470	94	223	137.375
20	20	7.53	0.032	12	7.18	0.485	91	210	134.675
21	21	7.37	0.060	12.5	6.74	0.220	86.5	192	136.825

Table 2c: Water Quality Result (Summer Season)

S. No.	Location No.	pH	E C MHOS/cm	Temp °C	DO mg/L	Total Solids mg/L	Total Alkalinity mg/L	Total Hardness mg/L	Chloride mg/L
1	1	7.53	0.14	14	7.0	0.245	98.5	282	212.225
2	2	7.48	0.18	13	7.12	0.210	128.50	218.50	185.850
3	3	7.69	0.125	13.5	7.53	0.90	97.0	289	230.340
4	4	7.31	0.044	14	7.27	0.47	100.0	224	141.735
5	5	7.76	0.017	14.5	6.83	0.70	107	280	135.350
6	6	7.79	0.105	14.5	7.73	0.735	90.5	247	130.275
7	7	7.64	0.015	14	7.38	0.44	94.5	244	254.50
8	8	7.11	0.059	14.5	6.95	0.39	63.5	136	44.65
9	9	7.70	0.050	14	7.09	0.25	68	153.50	44.925
10	10	7.33	0.050	13.5	7.59	0.205	75.50	181	114.125
11	11	7.16	0.012	13.5	6.95	0.23	59	154	81.30
12	12	7.08	0.029	14.5	7.27	0.33	63	211	111.50
13	13	7.19	0.020	13.5	6.77	0335	67	162	99.25
14	14	7.19	0.025	14.5	7.11	0.270	46	218	77.375
15	15	7.48	0.066	14	7.340	0.210	89	150	46.885
16	16	7.37	0.069	13.5	6.74	0.200	60.50	167.50	52.275
17	17	7.68	0.051	14	7.720	0.400	133.50	214	160.075
18	18	7.44	0.028	14	7.410	0.635	77	172.50	153.275
19	19	7.40	0.042	14.5	7.160	0.365	93.50	216	141.225
20	20	7.27	0.026	14.5	7.380	0.440	86	219	140.900
21	21	7.43	0.061	15.5	6.93	0.260	77	192	123.825

CONCLUSION

The samples of twenty one educational institutions were tested for physical, chemical and biological parameters and their results were compared with ICMR and WHO drinking water standards. Variation has been found in few parameters during the season wise with acceptable permissible limit. The stable limit was found in temperature, pH, EC and Alkalinity. The excess amount of DO was found since ground water concern. No seasonal variation has been noted. The total solid was found in negligible amount.

The total hardness was found to be in permissible limit, but in some sample the value was near the maximum permissible limits, almost at the level of exceeding. Chlorides content was also found to be in permissible limit, but in some samples it was close to the maximum permissible limit. The coli form content by most probable number was found to be absent in all the samples.

SUGGESTIONS

The parameters such as temperature, pH, EC, Total solids, Alkalinity and Most Probable Number (MPN) are ranging within the permissible limit, there is no harmful effects coming out for the drinking water on the health of students in Educational Institutes. Though the dissolved oxygen is more than maximum permissible limit, it does not affect the health of users. But the higher DO causes corrosion to the pipes of distribution systems. It should be within the permissible limit. As there is no distribution system in any educational institutes under consideration, there is no need to bother about the dissolved oxygen. Chlorides are not harmful as such, but when it exceeds beyond the 250 mg/L, it imparts a peculiar taste to water rendering & it is unacceptable from aesthetic point of view for drinking purpose. Considering the economical condition of institutions and water quantity, the lime soda process is suggested for treatment unit.

Though the lime soda process is cheaper, they required frequent maintenance. But in spite of high capital cost of RO. It is not suitable for educational institutions to install of RO system for maintenance point of view. So, it is suggested that each institute should equipped their institution with lime soda treatment unit for removal of hardness & other parameter also. In future if contamination occurs, chlorination process will necessary as per requirement and preventing diseases in student.

Almost all the educational institutions in present study are depending on the ground water. Now it is the known fact that the level of ground water depleting day by day. So it is need of time to give emphasis on water management. Water management includes the best possible use of water and to increase the level of ground water. The water harvesting is the best method to increase the ground water level. In rain water harvesting the surface run off is prevented from flowing and are collected in suitable trench and allowed to precipitate in to the ground there by increasing the nearby ground water level. It is necessary to take the campaign towards the awareness to the students and staff for safe drinking water and utilization of drinking water. It has been observed that after the use the most of students kept tap opened, due to which most of water get wasted. In awareness programme students should also be included, so that they also familiar with the scarcity and importance of water. If this practice becomes successful, then

each student can raise the slogan of Central Government from school to school as "Safe Drinking Water to All".

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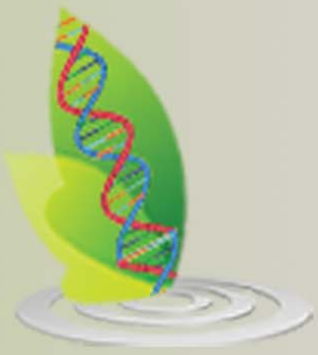

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