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# Water Characterization for Designing a WTP at Rural Village

Mandar J. Pawari
*Asst. Professor, Department of Civil Engineering, VPM'S Maharshi Parshuram College of Engineering, Velneshwar, India,*

***Abstract:*** ***Many places in rural areas of Maharashtra are severely affected by water problems due to lack of efficient water supply system. It can be overcome by careful monitoring of water sources and proper treatment of water with efficient water supply systems. So it is planned to set up an efficient water treatment plant suitable for drinking water. For the WTP the site has been selected as Velneshwar, Guhagar, Ratnagiri. Preliminary survey, site survey, survey about current water sources in Velneshwar, waste water management, medical survey and population survey were taken for the information required while designing WTP. Also the various test are conducted to as experimental analysis. It deals with the design of various water features of water treatment plant at Velneshwar, Guhagar, Ratnagiri. Water from the 'Wadadai' well will be directed to the WTP near the site and by building an intake structure into which the water from the well will be drawn i.e. constructing intake, the water is properly treated by other components before being send. For design of WTP required units are intake, sedimentation cum coagulation and flocculation unit, slow sand filter, disinfection unit and elevated storage water tank will be designed.***
***Keywords: Water, water treatment plant, intake, sedimentation, coagulation, flirtation, disinfection , elevated water tank, etc.***

## I. INTRODUCTION

Though the father of our nation Mahatma Gandhi said that "development of nation we must go towards the villages". It means entire development of nation will be depending on development of villages. All the technology are implemented in city areas not in villages so the people are migrate towards city no one can think about this vision of development of village. Every small implementation is also enough for success of country

Availability of water resources has been a major issue on the national agenda for the past few decades. Water of suitable quality and adequate availability of water has always been the most important issue. Water loss management is a part of human existence on earth due to acute scarcity of water resources and rapid increase in water demand. The availability of fresh water is very important factor in daily life. In present it is in most of the time it is not safe to directly use the water from rivers, reservoirs and lakes as it contains various micro-organisms, pathogens, and other contaminants that adverse effects on the health of human, plant and animals. Drinking or consuming polluted water can cause various health effects and diseases like dysentery, gastroenteritis, cholera, asthma, skin disorders and even death. Water treatment plant can improves the quality of water and removes 97% of contaminants in the water. To avoid health effects due to

The aim is to design water treatment plant for Velneshwar by studying different sources of water and improving the quality of water by water treatment plant. To design the WTP the selected site is Velneshwar village .The distance from Guhagar to Velneshwar 17 km. & Chiplun to Velneshwar 50 km. In Velneshwar village population is about 3737 but the water supply is very challenging. The site of WTP is at a distance of 7 km from Gram Panchayat. To design that WTP the surveys are conducted such as primary survey, site survey, topographic survey, survey of water sources, population Survey, medical Survey. In primary survey the graphical area, Velneshwar village location and other factors are considered. In site survey the site for WTP is decided the site. The site of WTP is at a distance of 7 km from Gram Panchayat Velneshwar-Wadadai. In Velneshwar village there is no one main source for the entire village. Individual sources are available for the individual wadi. For design of water treatment plant the main source is decided is Wadadai well. The medical survey is conducted from local doctors . As per information 60% to 70% of the diseases like are due to poor water quality in Velneshwar village. Waste water management is critical in Velneshwar there are no proper sewers for waste water, most of the waste is thrown into the small river. The present population of Velneshwar is 3737 By using the population forecasting methods the population is calculated. The population will be calculated for the next 10 years as WTP will be constructed for a period of 10 years.

An experimental analysis will be done to find out the range of characteristics of water from various sources in Velneshwar. Based on the results obtained, the required units for WTP such as intake, sedimentation cum coagulation and flocculation unit, slow sand filter, disinfection unit and elevated water storage tank are designed.

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### A. *Aim*

To study different sources of water and increase the quality of water by water treatment plant in Velneshwar.

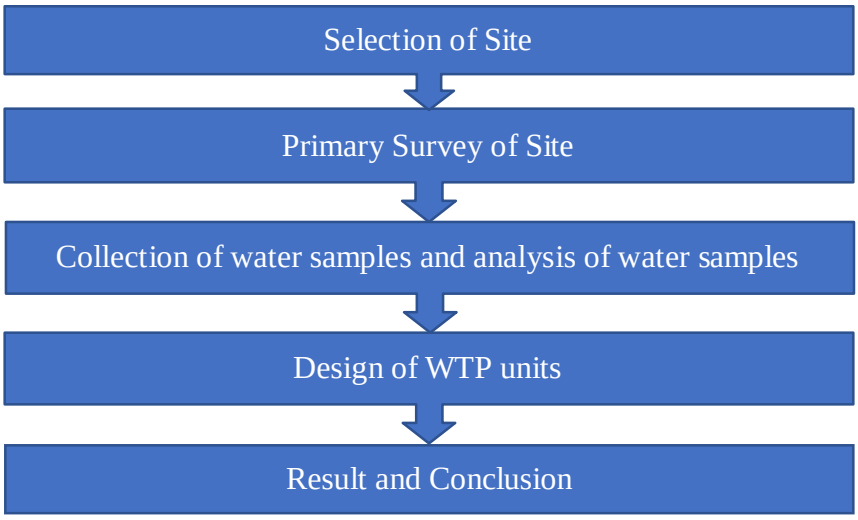
### B. *Objectives*

1) To understand and identify the different types of process in Water Treatment Plant.
2) To study the different sources of water in selected area.
3) To identify the quality of water.
4) To design water treatment plant for selected site.
5) To improve the water quality and minimize impact on society and the environment.

### C. *Problem Statement*

Designing WTP to prevent various water borne diseases and remove Solids from water at Velneshwar.

## II. METHODOLOGY




Flow chart of Methodology

### A. *Selection Of Site*

The selected site name is Velneshwar. According to the 2011 census, the location code of Velneshwar is 565432. The location of the site of water treatment plant is at velneshwar-wadadai village which is 7km away from the velneshwar-wadadai grampanchayat

### B. *Primary Survey of Site*

The total geographical area of village is 847.99 hectares. There are about 727 houses in Velneshwar Village. As per 2019 statistics, Velneshwar village comes under Guhagar Assembly Constituency and Raigad Lok Sabha Constituency. Chiplun is the nearest town to Velneshwar for all major economic activities, which is approximately 45 km away.



Fig 1. Group Gram Panchayat Velneshwar

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Fig. 2 Health Sub centre Velneshwar

*C. Topographical Survey*

Topographic survey are used to identify and map the couture of the ground and existing features on the surface of the earth or slightly above or below the earth's surfaces, (i.e. trees, building streets, walkways, manholes, utility poles, retaining walls, etc). in that topographic survey we included the average weather condition in Velneshwar village.

*D. Population Survey*

According to sense 2011 the population of Velneshwar village is 3347 persons. The design of water treatment plant by considering the future growth in population. So with the help of population forecasting method increase in population will be as follows. Population of village 2022 is 3737 persons. Population of village after 10 years by arithmetic. Population after 10 years by using arithmetic mean population forecasting method

Pn=P+nC

Pn= Population after n years P= present population

n= No. of year

C= per year increase rate So, P=3737, n=10 and C=37 P10= 3737+10*37 P10=4107

*E. Current Water Sources in Velneshwar*

We conducted a survey in Velneshwar village, we observed that there is no main water source in the village but there are public and private water sources for each wadi and the houses in each wadi are supplied water from the same private and public source. Since direct water supply from the source and there is no storage tank, water scarcity remains. During the medical survey, the doctor informed that 60% to 70% of the diseases are due to poor water quality in Velneshwar village. The peoples in Velneshwar daily using the water for drinking and other purpose. So due to this they are facing much more problem below are the figures and table of sources and location latitude, longitude in Velneshwar village are respectively.



Fig. 3 Water Source Velneshwar

*F. Medical Survey*

The medical survey done in Velneshwar village. During the medical survey, the doctor informed that 60% to 70% of the diseases are due to poor water quality in Velneshwar village after that the following result are obtained,

TABLE I MEDICAL SURVEY

| Name of the Doctor | Date | Type of Disease | | | | | |
|---|---|---|---|---|---|---|---|
| | | Cold | Fever | Malaria | Dengue | Dysentery | Cholera |
| Dr.Akshay Shirgavkar | 27/08/2022 | 12 | 20 | 02 | 03 | 04 | - |
| | 13/09/2022 | 09 | 15 | - | - | 01 | - |
| | 20/09/2202 | 11 | 10 | 05 | - | - | 03 |
| Dr. Druv Gokhale | 27/08/2022 | 08 | 13 | 01 | - | - | - |
| | 20/09/2202 | 05 | 14 | - | - | 01 | - |
| | 13/09/2022 | 11 | 09 | - | 01 | 11 | |

*G. Waste Water Management*

At the selected site there is no any proper waste and sewage management. The local people throw the garbage into the nearest natural vessel (small river). The source of natural water is polluted. The polluted river is shown following fig.




Fig. 4 waste Water management Velneshwar

*H. Water Consumption*

Water required in the houses for drinking, bathing, cooking, washing etc. Mainly depends upon the habits, social status, climatic conditions and customs of the people. As per IS: 1172-1963, under normal conditions, the domestic consumption of water in India is about 135 litters/day/capita. In Velneshwar water consumption rate is 105 litters/day/capita. 135 liters per capita per day per person (LPCD) water consumption rate.

## III. DESIGN OF NEW WATER TREATMENT PLANT

It is necessary to design a new water treatment plant to purify water according to the current situation of water, water supply and wastewater treatment problems as well as medical survey of the selected site. So that all the people in the village can get drinking water in proper quantity and good quality. The new water treatment plant is shown in following fiIg



Fig 5 Water source for WTP

## IV. DESIGN AND ESTIMATION

*A. Design parameters Design period-10 years Population- 4107*

Water supply- 105 lit/head/day Average discharge: 431235 liters/day Peak factor - 1.8 Maximum discharge = 776223 liters/day i.e. 32342.625 liters/hour

*B. Intake Structure*

Capacity of tank = 431235 liters = 435000 liters
Volume of tank =435 $m^3$
Depth of tank = 5 m
Area of base required = 435/5 = 87 $m^2$Internal diameter of the tank = D Using, $(\pi \times D^2)/ 4 =87$
D = 11 m
.

*C. Sedimentation cum Coagulation and Flocculation*

Rectangular
Detention period: 3 hours
Capacity of tank : 97.03 cubic meterDepth
= 3.0 meters
Width = 3.0 meters Length =
11.0 meters
Extra depth for sludge storage i.e., provide depth at one end as 3.3 m and that at the other endas (3.3+ 11.0/60)
= 3.5 meters
The floc chamber at the entry in addition to 11 m length.
Detention period = 15 minutes
Capacity of chamber = 4.04 cubic meterDepth =
2.5 meters
Width = 3.0 meters , Length = 1.35 meters

*D. Slow Sand Filter*

Total Surface Area of Filter required = (Max. Discharge/ rate of filtration per day)Assume, Rate of filtration =150 liters/hour/square meter
Total area required for slow sand filter = 216 square meters

*E. Elevated Storage Tank*

Capacity of tank = 431235= 435000 lit/day Use M30 grade concrete and Fe415 grade steelDesign = Elevated Circular Tank
Diameter = 12 m, H = 4 m

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*1)* Intake Structure
Total cost = ₹719904/-
*2)* Sedimentation cum Coagulation and Flocculation
Total cost = ₹2,31,049.3/-
*3)* Slow Sand Filter Slow Sand Filter
No. of filter beds 2 and 1 as stand by
16 m x 8 m x 1.5 m of each filtration beds
Total cost = ₹1252010.4/-

*a) Disinfection Unit*
5 m x 1.225 m x 3
Total cost = ₹61520/-
*b)* Elevated Tank
For p.c.c work
Total cost = ₹1346950/-
For base and spherical dome
R.C.C = 25.88 $m^3$
Steel requirement =1632 Kg,
M20 Ratio= 1:1.5:3, Sum of ratio =4.5
/-Total cost = ₹692285/-
Excavating cost = ₹50000/- Total cost
of ESR = ₹2737809/-Cost pumping

- Cost of WTP Units
- Intake structure: ₹719904/-

Sedimentation cum Coagulation and Flocculation : ₹231049/-Slow sand filter:
₹1252010/-
Disinfection tank : ₹61520/-Elevated tank: ₹1252010/-
Total cost of all WTP units = ₹5006912/-

➢ Analysis of Sample

TABLE II
LABORATORY ANALYSI S SAMPLES

| Sr. No. | Sample Details | Characteristics | Results | | | | |
|---|---|---|---|---|---|---|---|
| | | | 19 Jan 23 | 20 Jan 23 | 21 Jan 23 | 22 Jan 23 | 23 Jan 23 |
| 1 | Velneshwar Bajarpeth Bore well | pH | 8.35 | 8.15 | 7.93 | 8.19 | 8.45 |
| | | Chloride | 107.24 | 105.89 | 150.3 | 120.6 | 122.08 |
| | | Hardness | 151.10 | 152.63 | 149.36 | 130.63 | 161.23 |
| | | Turbidity | 4 | 4 | 5 | 4 | 4 |
| | | Alkalinity | 130 | 128.36 | 122.36 | 130.89 | 133 |
| | | Total Solids | 450.20 | 450 | 456.36 | 420 | 469 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | Agarwadi well | Ph | 6.61 | 6.89 | 6 | 6.30 | 6.76 |
| | | Chloride | 23.93 | 26.39 | 22 | 27.63 | 25.36 |
| | | Hardness | 180 | 150.36 | 190.59 | 140 | 131.56 |
| | | Turbidity | 5 | 4 | 5 | 5 | 5 |
| | | Alkalinity | 89 | 95 | 88 | 86 | 92 |
| | | Total Solids | 490.20 | 480 | 491.86 | 463.96 | 486.96 |
| 3 | Well near Thakur stop | pH | 8 | 7.45 | 7.69 | 7.50 | 7.86 |
| | | Chloride | 26.94 | 22.36 | 30.96 | 29.36 | 26.1 |
| | | Hardness | 75.9 | 69.36 | 79.36 | 79.36 | 71.3 |
| | | Turbidity | 4 | 4 | 5 | 5 | 4 |
| | | Alkalinity | 100 | 116.36 | 110 | 13.45 | 98.36 |
| | | Total Solids | 440 | 456.36 | 460.26 | 453.91 | 440. |
| 4 | Wadadai Well | pH | 8.50 | 7.91 | 8.86 | 8.9 | 7.72 |
| | | Chloride | 181.86 | 175.63 | 189.36 | 180 | 186.51 |
| | | Hardness | 161.20 | 269.36 | 156.36 | 162.85 | 260 |
| | | Turbidity | 3 | 4 | 3 | 3 | 3 |
| | | Alkalinity | 110 | 105.69 | 110.36 | 110.36 | 176.54 |
| | | Total Solids | 400 | 410.26 | 450 | 400 | 416.56 |

## V. CONCLUSIONS

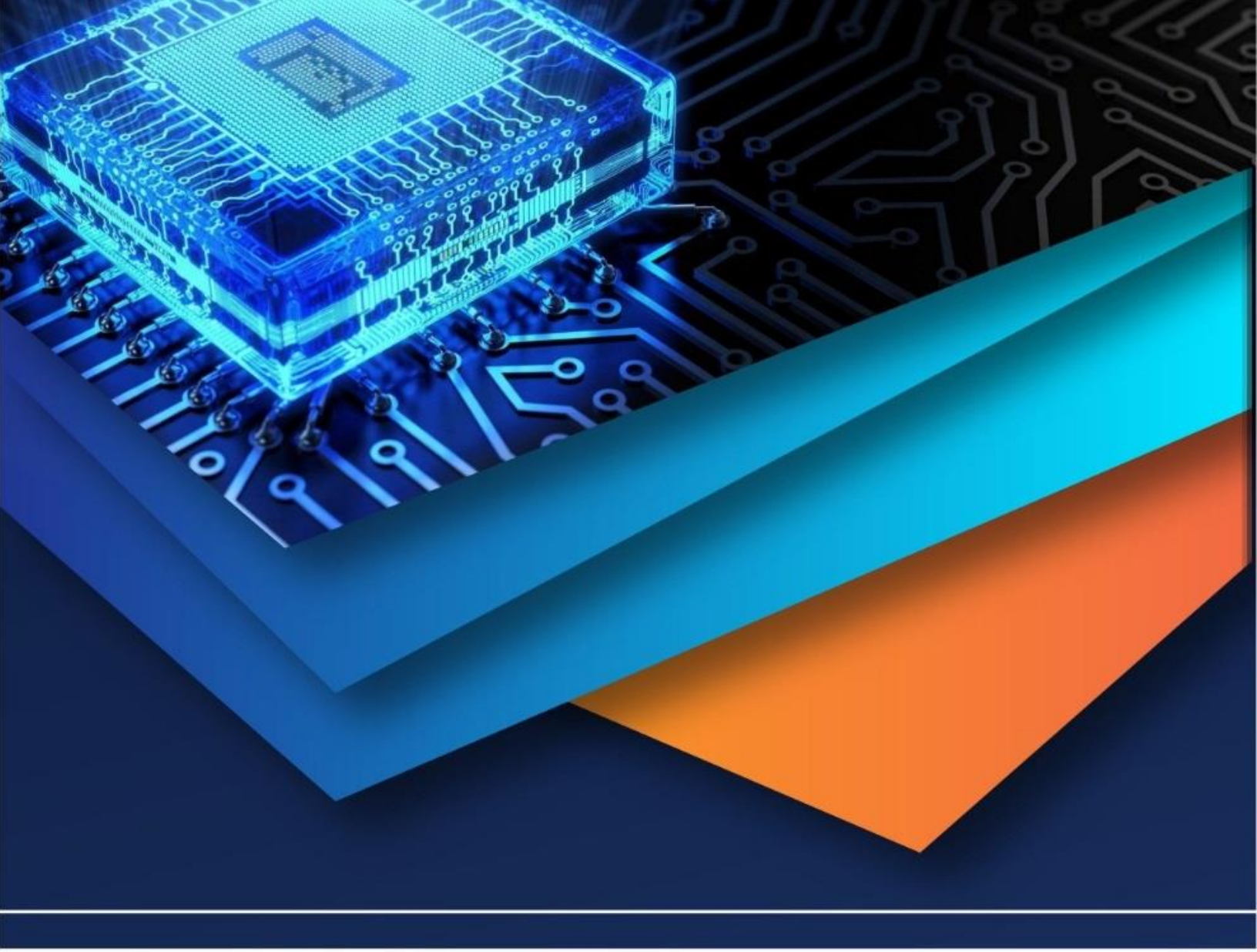
The design of water treatment plant for Velneshwar village is done. Surveys, tests, procedures, detailed calculations, drawings were illustrated for project. The average discharge of 431235 liters/ day and the population of 4107 were used in design of WTP. As per result from the performed research are the average characteristics obtained. The excessive characteristics of water can be removed for clean water by using WTP. WTP improves the quality of water by sedimentation cum coagulation and flocculation, Slow sand filter, Disinfection units. The intake structure at the beginning of this unit is designed for withdraw of water from water source. At the end of this units the elevated water storage tank is designed for storage and distribution of the water. The construction cost of all WTP units is approximately is ₹5006912/- With this project the scarcity of utilizable water and related problems of the people of Velneshwar village will be eliminated and water borne diseases will also be reduced.

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