MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

GOVERNMENT POLYTECHNIC, KARAD.

MICROPROJECT REPORT

For Micro-Project
'Report On Water Treatment Plant'

Course: -

Environmental Studies (22447)

Submitted By:-

2255	Swati Ananda Sanap	2100100057
2257	Sakshi Subhash Mohite	2100100059
2267	Madhura Mansing Patil	2200100657

Under the guidance of: -

Prof. K. K. Gaikwad

Academic Year 2023-2024

Department Of Computer Engineering

Maharashtra State Board of Technical Education

Certificate of Completion

Of Micro-Project Assessment at the end of the Semester

(By respective Head of the Department and Head of the Institute)

ROLL NO	ENROLLMENT NO.	NAME OF STUDENT
2255	2100100057	Swati Ananda Sanap
2257	2100100059	Sakshi Subhash Mohite
2267	2200100657	Madhura Mansing Patil

has successfully completed **"Report On Water Treatment Plant"** Micro-project for course **Environmental Studies (22447)** of fifth semester in the Diploma in computer engineering from **Government Polytechnic Karad, Institute** with **Institute code (0010).**

Prof. K. K. Gaikwad	Prof. S. B. Patil	Dr. R. K. Patil
Subject Teacher	Head of Department	Head of Institute

Seal of the institute

ACKNOWLEGMENT

We take this opportunity to thank all those who have directly and indirectly inspired, directed and assisted us towards successful completion of this project report.

We express our sincere thanks to **Dr. R. K. Patil** Principal of **Government Polytechnic Karad** and the Head of Department **Prof. S.B. Patil**, for having us allowed to submit this report as a part of our academic learning.

We express our sincere thanks to **Prof. K. K. Gaikwad**, Lecturer in Department of Computer Engineering, Government Polytechnic Karad for encouragement throughout the project report and guideline in designing and working out this project. We are also grateful to team of **'Report On Water Treatment Plant'** project.

Yours Sincerely,

2255- Swati Ananda Sanap
2257-Sakshi Subhash Mohite
2267- Madhura Mansing Patil

- ## Rational:

Water is the basic resource for guaranteeing the life of all living beings on the planet. Access to water, sanitation and hygiene is a fundamental right and yet billions of people throughout the world are battling daily against enormous difficulties accessing the most basic services. Although 2.1 billion people have, since 1990, gained improved access to better water and sanitation services, the decreasing availability of quality drinking water is an important problem afflicting all continents. It is estimated that at least 1 out of every 4 people will be affected by water scarcity by 2050. Water treatment is a way of ensuring an access to clean water and avoiding contamination of rivers and seas.

Water treatment is a process involving different types of operations (physical, chemical, physicochemical and biological), the aim of which is to eliminate and/or reduce contamination or non-desirable characteristics of water. The objective of this process is to obtain water with the right features for the use intended for it. This is why the water treatment process varies as a function of the properties of the water being supplied and its final use. Water treatment is increasingly necessary due to drinking water shortages and the growing needs of the global population. Of the planet's total water reserves, only 2.5% is freshwater - and of this amount only 0.4% is water fit for human consumption.

In this project, we are going to collect all information regarding to Water Treatment Plant.

In this project, we have done following tasks:

1. Visited Water Treatment Plant.
2. Studied the Water treatment in Water Treatment Plant.

- ## Aims/Benefits of Microproject:

1) To analyse working of Water Treatment Plant.
2) To address importance of proper Water Treatment Management.
3) To gain the practical knowledge about how raw water is treated and how water is distributed in different locations.
4) To study the types of water treatment plant used.

1. Course Outcomes Achieved:

- CO a. Develop public awareness about environment.
- CO c. Conserve Ecosystem and Biodiversity.
- CO d. Apply techniques to reduce Environmental Pollution.
- CO e. Manage social issues and Environmental Ethics as lifelong learning.

2. Literature Review:

- We met some persons who is works in water treatment plant in malkapur.
- To gather all the information in our microproject we used following books, articles and concepts about Environmental Studies, also we met some persons who is works in water treatment plant in malkapur.

1] Malakapur 24*7 Water Supply Scheme
2] All Scheme_English Tipani [Malakapur Nagar Parishad]
3]Water and Wastewater treatment textbook by civilenggforall

3. Actual Methodology Followed:

a. We collected all necessary information and knowledge important for our microproject.
b. We decided together how we make this micro-project. We decided which concept we should use to do one specific task.
c. We collected all necessary resources for visit Water Treatment Plant. We decided place and time for activity.
d. We gathered all information and combined it. We created proposal, report together.
e. We completed our task in time and do all other work which is important for our micro-project.
f. We take help of our subject teacher, if we have need it for completing our tasks. Also, we have use internet and online content related to our subject.
g. We created micro-project report after completion of our project.

4. Actual Resources Used:

Sr. No.	Name of resources	Specification	Qty
1.	Hardware	Laptop: HP15s, i5 12th gen, 8 GB RAM, 512 GB SSD, Windows 11	1
2.	Software	Word processor: MS Word	1
3.	Reference book	Basic Environmental Science by M. Allaby, Routledge Publication.	1

5. Outputs of the Micro-Project:

❖ Definition of Water Treatment:

Water treatment is any process that improves the quality of water to make it appropriate for a specific end-use. The end use may be drinking, industrial water supply, irrigation, river flow maintenance, water recreation or many other uses, including being safely returned to the environment. Water treatment removes contaminants and undesirable components, or reduces their concentration so that the water becomes fit for its desired end-use. This treatment is crucial to human health and allows humans to benefit from both drinking and irrigation use .

Drinking Water Treatment

The journey of drinking water starts from the source. It can be anything- a lake, river, or other stream of water except seawater. Treatment of seawater costs too much to make it feasible for drinking, hence it is avoided.

Drinking water treatment means the removal of the pollutants present in the water and the inactivation of the microbes that may cause harm.

Drinking Water Quality Standards

Every country has decided to drink water quality standards. It includes the lower and upper limits of various ions and elements present in water.

Also, it sets the limitations up to which certain contaminants like turbidity, odour, color, and other physical characteristics can be tolerated.

Objectives of the Water Treatment Process

- To remove color and odour from water
- To remove the hardness of water
- To remove the harmful microbes that cause diseases from water
- To remove murkiness and turbidity of the water
- To remove dissolved gases present in water
- To make the water suitable for various purposes like drinking, industrial and many others as per the demand

Types of Drinking Water Treatment Process

Water Treatment Plant

The Processes Involved in Water Treatment

The following are the types of processes involved in water treatment,

1. Physical Water Treatment Process
    - Sedimentation
    - Filtration
    - Dissolved Air Floatation
2. Chemical Water Treatment Process:
    - Pre-chlorination
    - Aeration
    - Disinfection
3. Physio-Chemical (Conventional) Water Treatment Process:
    - Coagulation
    - Flocculation
4. Biological Water Treatment Process:
    - Slow Sand Filtration

Stages In Water Treatment Process

Let us see the drinking water treatment process in detail here and the various processes involved in the same. The water treatment process starts with the collection itself.

There are two types of sources of water. One is the surface water source like a river, reservoir, etc. the other one is a groundwater source like a bore well. The water treatment process differs for these systems considerably.

The impurities present in both the sources belong to a different category and hence the treatment process is different too.

Surface water has a large number of suspended particles and other physical impurities while groundwater has the presence of ions.

These ions make groundwater- hard. However, the ions are lacking in surface water. So, the groundwater required chemical treatment more than physical.

1. Collection of Water

The water is collected from the sources like a lake, rivers, or reservoirs. The water is to be transported from this source to the water treatment plant for the water treatment process. This is included in the collection of water.

Generally, water treatment plants are built near the water source itself.

Collection of Water

2. Screening

Screening is done to remove the floating matter from the water during the water treatment process. Surface water contains a large number of suspended particles that increase the unnecessary load on the treatment plant units.

Screening is mostly done at the intake point itself. The large-sized suspended particles like dried leaves, fallen twigs, and other floating debris.

Two types of screens are used for screening:

1. Coarse Screens/ Bar screens

Coarse Screens

Bar grills are installed and water is allowed to pass through them in this process. 25 mm bars are installed at 75 to 100 mm center-to-center distance. This traps particles of large size as the water flows through them.

Mostly the bars are kept in an inclined position so that they can be cleaned easily with racks to remove the trapped particles.

2**. Fine Screens/ Automatic Strainers**

An automatic device is fitted in the screens so that the trapped materials can be removed on their own. Such type of screens is called automatic strainers.

3. Microstainers

A stainless steel wire is used to make the cloth designed specially and it is mounted on t periphery of the revolving drum afterward. It has an arrangement for backwashing too. This ensures that it does not get clogged.

3. Sedimentation

The sedimentation process removes the heavy particles that can settle down under gravity. The weights of the particles increase as they aggregate and then settle down.

A sedimentation tank is so designed that the velocity of the flowing water is reduced. As the water is discharged into the sedimentation tank, the cross-section area of the water flow is in the case and therefore, velocity reduces.

Sedimentation is also of two types: One is Plain sedimentation without the addition of chemicals while the other is sedimentation with coagulation in which chemicals are added.

The efficiency of the sedimentation tank depends upon the following factors:

- Design considerations for the tank
- Shape and size of the sedimentation tank
- Detention period
- Size of suspended particles
- Characteristics of suspended particles
- The flow velocity of water

i. **Plain Sedimentation**

In this type of sedimentation, the particles aggregate on their own nature and settle down under the force of gravity.

ii. **Sedimentation with Coagulation**

To speed up the process of sedimentation and to increase efficiency as well, sometimes, chemicals are added to the water. These chemicals are called coagulants.

Coagulants help in the aggregation of the particles, which increases the size of aggregated particles and hastens their settling in the water treatment process.

Types of Sedimentation/ Settling Tank

Settling Tank

There are two types of sedimentation or settling tanks as described below:

1. Fill and Draw Type

The water is filled in the fill-and-draw type first and then allowed to remain for a particular duration. Detention time is normally kept 24 hours for the fill and draw-type tank. The suspended particles settle down to the tank bottom in this detention period.

The above-mentioned tank is also known as the Quiescent Tank.

As the retention period is over, the clear water from above is taken out by opening the outlet valve, and the tank is cleared for the suspended particles settled down earlier. To clean the tank, 6-12 hours is required.

Thus, one operation cycle to obtain clear water takes around 30 to 36 hours for the fill and draw-type tank.

2. Continuous Flow Type Tank

The fill and the draw-type tank take up too much time to get one batch of filtered water. This is not feasible when a large population is to be supplied with water.

Taking a look at the factors mentioned above-affecting sedimentation, the velocity of incoming water can be managed without extensive effort.

Hence, in a continuous flow type tank, the water is allowed to move continuously under much less velocity. The suspended particles settle down as the water flows and reach the outlet at the bottom of the tank.

Continuous flow type tanks can be further constructed of two types based on the flow direction of water as follows:

Horizontal flow tank- A rectangular tank is used and the length is generally kept twice its width. The flow of water is in the horizontal direction. Maximum permissible velocity = 0.3 seconds.

Vertical flow tank- A circular or rectangular tank with a hopper bottom. The dimension of these tanks is generally more in the depth. The flow of water is in the vertical direction. Water enters the tank through a centrally located inlet pipe and then it is deflected downwards.

4. Clarification or Sedimentation with Coagulation

The sedimentation with coagulation is termed clarification. It is required to increase the efficiency of sedimentation as stated above during the water treatment process. Plain sedimentation consumed too much time.

How does clarification work?

The **c**olloidal particles suspended in the water have a negative or positive charge around them. Coagulants neutralize this charge and allow these particles to coagulate.

Steps in Clarification in Water Treatment Process:

- Addition of measured amount of chemicals to the water
- Thorough mixing of water
- Formation of precipitates in water
- Formation of flocs which is formed by coagulation initiated by the precipitates
- Sedimentation

Types of Coagulants used in Water Treatment Process:

- Alum
- Ferrous sulfate and lime
- Magnesium carbonate
- Polyelectrolytes
- Sodium aluminate

Alum is most commonly used as a coagulant.

Devices used for Carrying out Mixing of Coagulants:

- Centrifugal pump
- Compressed air agitation
- Mixing basin

5. Filtration

Filtration is one of the most crucial steps of the water treatment process.

The flocs formed during flocculation are not removed entirely by sedimentation. Hence, to remove the finely sized particles and flocs, filtration is required. And the particulate matter which was retained in the sedimentation tank previously is removed, especially the non-settleable particles.

Types of Filters

The following type of filters are available based on the time taken for filtration:

i. Slow Sand Filter

These filters were introduced as early as the 1800s. Slow sand filters are named so because they have taken too much time for filtration. The filtration time is one-twentieth as compared to that of the rapid filters.

The components of a slow sand filter comprise an enclosure tank, fitter media, base material, an under-drainage system, and appurtenances.

An enclosure tank is an open basin tank with a bed slope of 1 in 100 or 1 in 200. The surface area varies from 50 to 1000 cubic meters.

Filter media is formed of sand which should be free from loam and suspended or organic matter.it is laid in 90 to 110-centimeter thickness.

The base material is formed of gravels laid in a 30 to a 75-centimeter thick layer. Under drainage system is formed of a number of lateral drains.

Some appurtenances are also installed for various purposes, like measuring head loss through filter media, controlling the depth of water above filter media, etc.

ii. Gravity Type Rapid Sand Filter

The components of a rapid sand filter comprise an enclosure tank, fitter media, base material, an under-drainage system, and appurtenances.

The enclosure tank is smaller in size compared to that the slow sand filter. Other components are similar in characteristics to that of the slow sand filter.

However, the appurtenances consist of wash water troughs, air compressors, and rate control devices.

Rapid sand filters may be logged frequently, which is why the sand has to be cleaned at frequent intervals. For this, backwashing and surface wash methods are applied.

iii. Pressure Filters

The pressure filter is also a rapid sand filter, however, instead of an open basin, the closed container is used for this, and water is allowed to pass through the filter in pressure. The pressure may be about 3 to 7 kg/cm^3

These filters are either horizontal or vertical type based on the direction of water flow.

Automatic pressure filters are also available at present. In this type of filter, backwashing is done automatically.

Issues in Filters:

Because of poor design or lack of proper operation of the filter, many filtration problems arise over sue course of time.

Some of the issues in filters include:

1. Cracking and Clogging of Filter Bed in Filters used in Water Treatment Process

This mostly occurs when the solids accumulate on the top surface of the filter media. The coating on sand grains cracks and the head loss is observed to have been increased.

This results in the penetration of dirty water into the filtered media up to the gravel layer. This decreases the efficiency of the filter.

2. Mud Balls Formation

Conglomerates of floc sand and other binders are termed mud balls. Mud balls are formed near the top of filter media and are resulted from the insufficient washing of filter sand grains.

Mud accumulates on the sand surface forming a dense mat and reducing the effectivity of the filter. This can be avoided by backwashing the sand at regular intervals.

3. Binding of Air

When dissolved gases of water are released in the form of air bubbles, air binding occurs. These air bubbles clog the voids of the filter media and the water may not be able to flow as earlier.

This condition of air binding can be avoided by preventing the warming of water before it is allowed to pass the filter media, control of algae, or avoiding the supersaturation of water with air.

4. Sand Boils

When the water follows the path of least resistance during backwashing, sand balls may be formed. The sand may boil like quicksand, and lifts up sand, and even gravel to the surface. Surface washing or air scouring before backwashing can eliminate fluidity.

5. Sand Leakage

When the layer of fine gravel is displaced during backwashing, sand leakage may take place. Sand leakage is the downward migration of the fines.

With the proper proportions of the level of sand and gravel, sand leakage may be prevented.

6. Disinfection

After filtration, the next step of the water treatment process is disinfection. Disinfection includes the inactivation of pathogenic bacteria and other microorganisms that can cause diseases. This step is essential to control water-borne diseases.

A disinfectant is added in this step to filtered water. Skilled operators are required to carry out the process of disinfection so as to maintain the appropriate dosage.

Some of the Important Characteristics of A Disinfectant

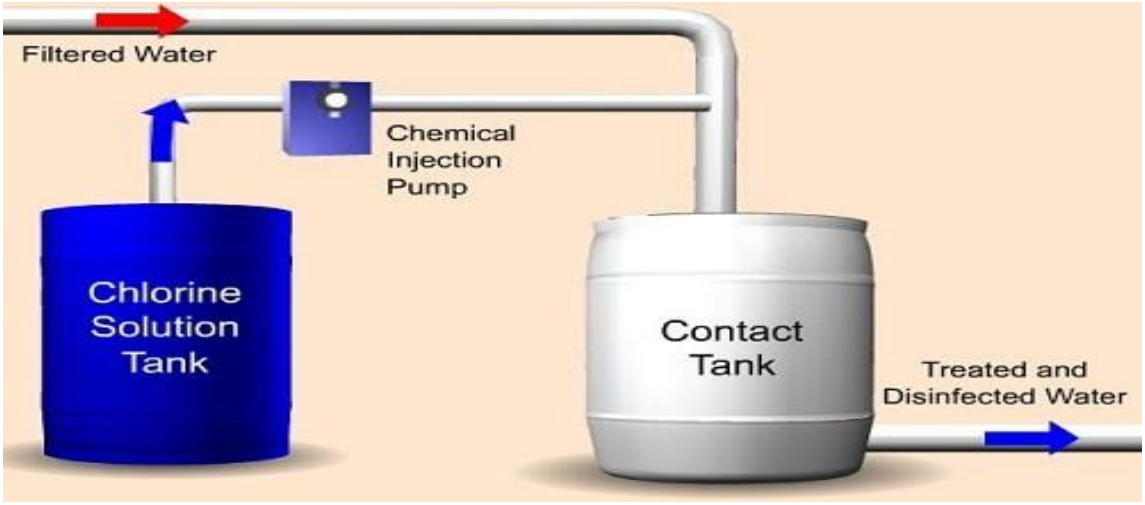
- It should be effective in killing the microorganisms in the contact time provided.
- It should be easily available in the market.
- It should not be expensive.
- It should not make the water toxic
- Its application should not be complicated involving a series of processes
- It should not impart any objectionable color to the water
- It should have the ability to remain in the water for a residual amount so that the water is not contaminated again

Types of Disinfectants used in the Water Treatment Process

- Physical treatment- Application of ultrasonic waves, heat, or other physical agents
- Radiation- Application of gamma radiation
- Metal ions- copper, silver
- Alkalis and acids
- Oxidants- Addition of chlorine, bromine, iodine, ozone, chlorine dioxide, etc

The most commonly used disinfection method is chlorination.

Chlorination- Most widely used Disinfection Method



Chlorination

The chlorination process for disinfection has become the most popular method because it is cheap, easily available, and easy to handle.

Chlorine is dissolved in water at a temperature of 49-212 °F. Chlorine gives hypochlorous and hypochlorous acid through the hydrolysis process. Ionization takes place and hypochlorous acid dissociates into hydrogen and hypochlorite ions. These compounds- hypochlorous acid and hypochlorite ions aid in disinfection.

Forms of Chlorine Application to Water:

As bleaching powder ie in hypochlorite form: It was used when chlorination was first introduced, however, it is not stable and its power of disinfection is lost when stored or exposed to air.

As chloramines: These are compounds of chlorine and amino acids. Chloramines were discovered to be disinfectants following the instability of bleaching powder.

The residual of chloramines is more stable than the chlorine residual. These also reduced the objectionable taste in water. Ammonia is added to water before the addition of chlorine.

As Free Chlorine: It can be applied in liquid, gaseous, or even solid form. It is the most popular form of chlorine tablets that are also available.

As Chlorine Dioxide: Chlorine dioxide is more effective in leaving the microorganisms inactive as compared to free chlorine. However, it is only used in special water treatment processes.

i. Pre-chlorination

It is done before the water enters the treatment units, especially the filter unit. In pre-chlorination, a little amount of chlorine is applied so that the organic matter can be oxidized and a less amount of coagulant is required.

ii. Post chlorination

Post-chlorination is the amount of chlorine added after the water is completely treated and ready to be distributed.

Post-chlorination prevents the contamination of water in the route and also ensures no harmful microbes are introduced to the drinking water.

7. Water Softening

Water softening is done to make the hard water soft. Surface water usually does not contain much hardness.

However, the water taken from underground sources like bore wells contains hardness due to the presence of ions.

The hardness of water prevents the water from forming lather and also causes problems in the plumbing system.

It even affects the taste of water and even food cooked with hard water tastes tough or rubbery.

There are two types of hardness of water and their treatment methods also vary with it.

Types of Hardness and Their Removal

i**. Temporary Hardness**

Cause: calcium bicarbonate and magnesium bicarbonate ions

Methods of Removal of Temporary Hardness:

- by boiling
- by the addition of lime

ii. Permanent Hardness

Cause: calcium sulfate, magnesium sulfate, calcium chloride, and magnesium chloride ions

Methods of Removal of Permanent Hardness:

- By Lime Soda process
- Zeolite process
- Demineralization or Deionization process

8. Other Treatment Methods

There are a few other characteristics of water to be adjusted as per the quality standards set by the guidelines.

Some of these characteristics of water to be brought under the limit are:

To Remove Color, Odour, and Taste:

This is necessary when objectionable color, odour, or taste is imparted to the water, which may be because of one of the following reasons:

- Organic and vegetable matter
- Dissolved gases beyond a certain limit
- Dissolved mineral matter
- Industrial waste
- Microbes like molds, bacteria, etc.

Some of the methods used to remove this objectionable color, odour, and taste are:

1. Aeration

In aeration, air and water are mixed intimately.

It mostly removes the taste because of dissolved gases. It also increases the content of dissolved oxygen in the water.

Free Fall Aerators

There are three types of aerators as follows:

1. Cascade Aerators

It is the simplest type of free fall aerator. A series of steps are constructed and water is allowed to fall through a height of 1 to 3 meters.

2. Slat Tray Aerators

These are not commonly used. It has a series of closely stacked wooden slats in a closed room. It is either circular or square in shape. Water flow is from top to bottom.

3. Gravel Bed Aerators or Trickling Beds:

In this type of free-fall aerator, water is supplied to the top and allowed to fall downwards while air is blown upwards. The water trickles down from the beds of gravel of thickness 1 to 1.5 meters.

4. Spray Aerators

Water is divided into fine streams and droplets in the case of spray aerators and it is allowed to come in intimate contact with the air. Water is sprinkled in the form of a jet with the help of nozzles.

5. Air Diffusion

A perforated pipe network is present in the bottom of the aeration tank through which compressed air is blown. The water travels upwards in this case and the retention time is about 15 minutes.

6. Copper Sulphate Application

Besides removing color, odour, and taste, it also removes algal growth if present in water.

It is available in powder or crystal form and is directly applied to the water when it enters the distribution system.

7. **Desalination**

It is required when the water contains excessive saline concentration. Very less water on the surface of the earth is fresh water and if freshwater is not available, and saline water is to be used, then this step is necessary.

Desalination methods are costly. Some of them are listed below:

- Distillation
- Reverse Osmosis
- Electrodialysis
- Solar evaporation

Water Treatment Process at a Glance

The water treatment process includes various treatments of water so that it meets the quality standards specified.

There are various types of processes involved in the water treatment process and each process plays a significant role.

It starts with the collection of water from the source. Then it is screened for larger-sized articles. After that, it is allowed to flow through the sedimentation tank where the heavier particles settle down under gravity.

If the particles have a relatively large size, then an appropriate coagulant is added and then sedimentation is carried out which is called clarification.

After that, water is filtered and disinfected as well. For hard water, the water softening process is also carried out depending upon the type of hardness.

U.S. Safe Drinking Water Act

U.S. E.P.A. Environmental Protection Agency has set standards for drinking water quality under the U.S. Safe Drinking Water Act for public water systems.

State health agencies look out that the standards to be implemented in the region.

Around 90 contaminants are listed and divided into 6 groups by EPA. These six groups are as follows:

❖ History of Water Treatment Plant of Malakapur

Malkapur town is situated on NH-4 in the area of 'Historical Agashiv Hills' on the boundary of town Karad in District Sarata of Maharashtra state. Malkapur is fast growing town because of the adjoining Karad does not have space to accommodate increasing population. Krishna Hospital, Emerson Industries, Educational Institutes, big hotels, co-op societies etc. are already established in the town, so people prefer to settle at Malkapur. The 2001 census population of Malkapur was 22392 and the growth between 1981-91 & 1991-2001 are 58% and 275% respectively. The present population in 2017 is around 40 thousand. The town Malkapur was a Village Panchayat till year 2007 & converted into Nagar Panchayat from April 2008.

▪ Innovative Schemes implemented by Malkapur Nagarparishad-

24x7 Drinking Water Supply-

Malakapur Nagarparishad successfully implemented 24x7 drinking water supply system for whole town since from 2009. This scheme was awarded by "**National Urban Water Award-2010"** and **"Prime Minister's Award for Excellence in public Administration."** In this scheme drinking potable water supply to citizens through AMR Meter connections on volumetric basis. Citizens can use water any time throughout day as per their requirement, resulting that there is 20% saving in consumption of water. In 24x7 water system, all distribution pipes having 24 hrs water with pressure and no chance to enter dirty water in pipes, resulting citizens get 100% pure and potable water. Monthly consumption of water of each family measures with help of AMR Meters by single person only in few hours through RF technology.

Monthly billing and recovery system improve the collection efficiency, and 100% operation and maintenance cost recovery since last 8 years continuously.

Malkapur is the first town in India who supply 24 hrs continues drinking water to citizens.

❖ Strategy Adopted

The Malkapur water supply distribution was planned, designed, constructed and is being operated with following strategy in mind.

1) The consumer shall get the water whenever he opens the tap - This strategy provides for the service availability whenever consumer desires. The consumer in different trades needs water at different times of the day. The intermittent system provide water at fixed hours or at varying hours (if the scheme is in chaos like Malkapur). This requires citizens to adjust their schedule according to the time at which water is available. It leads to missing economic opportunities or any other opportunity during that period. It was, therefore, thought to make available water at the tap of the consumer 24 x 7. The strategy is also aimed at making redundant the concept of storing of water and throwing it away the next day when fresh water is received and to stop the investment required in storage vessels / tanks.

2) Provide good health to the citizens through good quality potable water - Every piped water supply system endeavor to provide good quality potable water. The intermittent systems, in non supply hours, gets depressurized resulting in outside contaminants entering the pipes from the spots where leakages have occurred. The 24 x 7 pressurized systems do not fall pray to this situation, thus the quality of water delivered is assured all the time.

3) Consumer pay as they use - This principle of consumer paying as per their usage provide the incentive for resource conservation. The metered water supply system provide an opportunity to charge as per the volumes of water consumed, unlike in un-metered flat rates, where quantity consumed is not the criteria. This makes the consumer in metered system try to minimize the usage by closing their taps no sooner their requirement is fulfilled. This helps the pressure in pipes to be maintained and the consumer located at higher elevation do not suffer. This tries to establish equity amongst consumers.

4) Pay at higher rate when using higher per capita water - The telescopic rates adopted requires the higher per capita usage of water to be paid at higher rates. The minimum required water is provided at affordable rates. Thus the poor are taken care, while they also enjoy the benefit of 24 x 7 water availability. This recycles the wealth from the rich to the poor. This strategy is enforceable through the micro mapping of number of persons in each house and the AMR meters provided in the system.

5) The service to work on no loss basis - The water supply service was advised not to be run in loss. The rates were to be determined accordingly. Great care was also needed to keep operational expenditure to its minimum.

❖ Impact of Initiatives

The augmentation to the water supply system was approved on 9th June 1999 for Rs.947.54 Lakhs. However, the work could not be started till 1 7th Dec 2002, due to paucity of funds. The system is designed to provide 55 LPCD water for population of 67196 souls expected in year 2037. The bulk water system consisted of water abstraction from perennial river Koyna, pumping it to water treatment plant at the rate of 3.25 Lakh ltr/hr (8 MLD), through D.l.K-9 pipeline of

400 mm dia. The pumps are of 150 HP The W.T.P having conventional alum dosing, flocculation, coagulation sedimentation filtration and disinfection by chlorine is adopted. The treated water is pumped to the Master Balancing Reservoir located on the hill. The treated and disinfected water from this tank is transferred to the 5 service reservoirs covering six zones of distribution. The treated water pumps are of 75 HP. The system up to ESR was ready by Jan 2005 and the water supply through the existing distribution system was started.

The last of the work but important from the point of view of service delivery was distribution network. The approved project provided distribution system in PVC pipes. This work being directly related to the consumer satisfaction, the latest concepts in distribution network were discussed with the elected representative of the Village Panchayat (now Nagar Panchayat). They were provided information about the 24 x 7 water supply system, the pipe materials, which are useful in helping the system to operate 24 x 7. The house service connection material and methodology, the metered delivery of water and charging the consumer on volumetric basis were also explained. The Sarpanch and the elected representatives were taken to Badlapur near Mumbai, where effort to convert existing intermittent system into 24 x 7 was started by MJP in some wards. They visited and experienced for themselves and got the feedback from the consumers of Badlapur. After having satisfied they were eager to deliberate the matter in their council, and agree for 24 x 7 system with metered water supply and tariff as per actual consumption. The village Panchayat met and resolved accordingly vide their resolution in Gramsabha dated 26th Jan., 2007.

The Panchayat was explained about the HDPE pipes of very good quality to be used for distribution network. They were also made aware that the pipes will come in roll of length 50 m to 1 00 m and there will be reduced number of joints which will help in reducing the number of possible leakage spot in the pipeline. They were also transparently informed that 20 to 25 years back HDPE pipes were used in Maharashtra but failed in large percentage due to quality of pipes and jointing procedure. They were also informed how the new methods and equipments of jointing can make leak proof pipeline. The Village Panchayat was also given idea about how the service connection on the HDPE pipes will be taken by fusion welded tapping tee provided with ferrule and followed by leak proof compression fitting, a single length MDPE blue pipe from ferrule to the meter in the premises of consumer, the AMR meter, its method of taking reading etc. The complete transparency by MJP could make Panchayat fully aware of the quality, workmanship, the equipments and the results that are goint to be achieved.

After having agreed to the system, the distribution network was designed using "Water Gems" software. This software apart from design for steady state flow, also models the system according to the given pattern of usage of water at the different time of the day in the 24 x 7 availability. This gives the design of the system as a whole i.e. ESR and distribution network. The software uses Darwin designer which is a generic algorithm. It provides multi criteria optimization. The criteria being performance and cost. The solutions provided by the software are ranked. This allows the user to choose the best solution which suits to his requirement of pressure and availability of money.

Post design & estimate, a comprehensive tender for distribution network in HDPE pipe, house service connection in MDPE pipe with AMR meter, bulk water meters of AMR type was invited

from the large scale manufacturers of HDPE pipes, having collaboration with the manufacturer of AMR meters. The criterion for performance was also kept in terms of the leakage in distribution network. An incentive/ penalty clause with bench mark leakage level of 5% was kept. On completion of the system it is to be operated by the manufacturer for a period of 2 years and the leakage level have to be reported every month.

The work was awarded to M/S Kimplas Piping System, Nashik through competitive bidding. Kimplas apart from manufacturing quality P.E. pipes also manufactures the P.E. couplers, specials and tapping tee suitable for fusion welded joints. The AMR meters of M/S. ARAD of Israel was agreed to by M/S Kimplas. The work order was given on 7th Dec 2007 and the actual work was started on 8th Mar 2008. The resin to be used for manufacturing the pipes was specified in tender of Borealis Co., which is one of the best resins in the world. The tender condition was incorporated that resin shall be tested by "Bodykote" , the international agency for testing resins and test certificate to be given before using. A visit of elected representatives of the village Panchayat was arranged to factory at Nashik, prior to starting of manufacturing. They were shown all the facilities including quality assurance and quality control methodology, the resin to be used etc. This gave a complete transparency. Before starting the manufacture, the engineers of MJP and of village Panchayat jointly verified the imported resin, its batch number and correlated with the batch number mentioned on the test certificate. While the manufacturing was going on, the representatives and engineers of MJP used to be present in the factory to confirm that the resin imported for Malkapur is only being used for manufacturing the pipes. The third party inspection was also kept essential as per the tender clause and the agency namely "Iteng" inspected the pipes and issued their certificate. These pipes were conforming to IS 4984 for HDPE PE 100 pipes and ISO 4427 for MDPE blue pipes for connections.

The AMR meters were shown by M/S. ARAD to the village Panchayat representatives and the MJP engineers. The working of the meter was explained and how the readings on the meter can be remotely read through the handheld device using Radio Frequency was demonstrated. All the queries of the engineers and elected representatives were answered. These meters were also third party inspected by "Macharot" of Israel for first lot and by "SGS international" for second lot.

Each water connection has been installed with automatic meter readers(AMR), which take meter reading with the help of radio frequency within the radius of 200 m. It is not necessary to go to the meter for taking readings. The data is fed into computer and accordingly water bill is processed. Since there is no any manual interference to take readings, the billing is accurate.

The actual work in the Malkapur town was started in Mar 2008 and the programme for completing each zone in all respect was chalked. Accordingly, the pipelines were laid and zone by zone the system was commissioned as below.

- Zone No.5(part)- Aug 2008
- Zone no.5(complete) and zone no.6 - Dec 2008
- Zone no.2 and Zone no.3 -Mar 2009
- Zone no.1 and Zone No.4- May 2009

Accordingly, the projected demand of Malkapur city for year 2037 for population 67196 was calculated @ 70 LPCD and the scheme was framed, designed and approved by Govt of

Maharashtra. The distribution system network was designed hydraulically by adopting 'Water Gems' Software as per the requirement on proposed distribution nodes. The distribution system was divided in six zones, topographically and accordingly scheme was executed and commissioned in Aug- 2008.

Water Treatment Process in the Plant:

Aeration:

It is the process by which air is circulated through the liquid by means of a fountain.

Addition of TLC and alum:

A coagulant (typically a metallic salt) with the opposite charge is added to the water to overcome the repulsive charge and “destabilize” the suspension to form micro floc.

Settlement Tank:

The tank helps in sedimentation of solids suspended particles.

WATER TREATMENT PLANT
(8.00 MLD)

DOMESTIC WATER
METER

Automatic Panel Board:

The panel board helps in the automatic starting and closing of water flow in the treatment tank. It works on remote sensor.

Pipes and Joints:

Specific design high density polyethylene pipes (HDPE) is a leak proof material were used for the entire network has reduced water looses and increased durability of the network. This technology requires less number of joints, thereby, reducing potential water losses.

Strategy Adopted

The Malkapur water supply distribution was planned, designed, constructed and is being operated with following strategy in mind.

1) The consumer shall get the water whenever he opens the tap –

This strategy provides the service availability whenever consumer desires. It leads to missing economic opportunities or any other opportunity during that period. It was, therefore, thought to make available water at the tap of the consumer 24 x 7. The strategy is also aimed at making redundant the concept of storing of water and throwing it away the next day when fresh water is received and to stop the investment requiredin storage vessels/ tanks.

2) Provide good health to the citizens through good quality potable water –

Every piped water supply system endeavor to provide good quality potable water. The 24 x 7 pressurized systems do not fall pray to this situation, thus the quality of water delivered is assured all the time

3) Consumer pay as they use –

This principle of consumer paying as per their usage provide the incentive for resource conservation. The metered water supply system provide an opportunity to charge as per the volumes of water consumed, unlike in un-metered flat rates, where quantity consumed is not the criteria. This makes the consumer in metered system try to minimize the usage by closing

their taps no sooner their requirement is fulfilled. This helps the pressure in pipes to be maintained and the consumer located at higher elevation do not suffer.

4) Pay at higher rate when using higher per capita water – The telescopic rates adopted requires the higher per capita usage of water to be paid at higher rates. The minimum required water is provided at affordable rates. Thus the poor are taken care, while they also enjoy the benefit of 24 x 7 Water availability. This recycles the wealth from the rich to the poor. This strategy is enforceable through the micro mapping of number of persons in each house and the AMR meters provided in the system.

5) The service to work on no loss basis – The water supply service was advised not to be run in loss. The rates were to be determined accordingly. Great care was also needed to keep operational expenditure to its minimum.

Various difficulties were faced during the implementation difficulties of the project which included following major

- The Gram Panchayat was upgraded to Nagar Panchayat, resulting in dissolution of the elected body. This led to unavailability of people's representative to co-ordinate.
- There was no goal of fixing the water issues till the election was over. Later on the representatives were requested to fix the meters.
- Consequent to commissioning some zones in 24 x 7 water availability, it was not possible to implement metered tariff for these zones, while keeping flat rates in the 'still to be commissioned un-metered areas'. The project was therefore accelerated and all the zones were commissioned by 5/09.
- It was experienced that the number of hours of pumping was getting increased when system was operating 24X7 in commissioned zones but still in the flat rate tariff regime.

Benefits resulting from the project:

The project has not only succeeded in giving benefits to the Malkapur citizens in the below listed aspects but has also provided the state and nation, a success story on 24×7 water supply for whole of the town (unlike the other towns where some wards are 24X7) for the first time in India which can be seen and replicated by other Municipal Councils.

- **Quality of Water**

The quality of water as delivered to the citizens through the tap is now guaranteed as the pipes are pressurized throughout day and night 24 x 7. This does not allow outside dirt to enter in the pipes. People were happy to get assured good quality water as they open the tap.

- **Decrease in water borne illnesses in children**

The survey carried out by Anganwadi Sevika indicated that the water borne diseases in the children have reduced remarkably to near zero level.

- **Reduction in wastage of water**

Wasteful use of water is remarkably reduced and the reduction is to the extent of 30%. The demand management by making the people aware of the system and the telescopic tariff structure made this possible. In the initial period when some zones were working 24 x 7 while

others were intermittent and therefore flat tariff was retained, led to 19-20 hours of pumping in the system. Consequent to demand management exercise by mass awareness and implementation of telescopic tariff reduced the pumping requirement to 13-14 hours when all the zones are now getting 24 x 7 water supply.

- **Simplification of billing procedure**

The AMR type water meters installed, can be re

- **Various difficulties were faced during the implementation of the project which included following major difficulties.**

- The Gram Panchayat was upgraded to Nagar Panchayat, resulting in dissolution of the elected body. This led to unavailability of people's representative to co-ordinate. The Govt. of Maharashtra, through an order, formulated a committee of all party representatives to help the project go ahead.

- During the election of newly formed Nagar Panchayat, 37 consumers denied to fix the meters. There was no go till the election was over. Consequent to election, all these 37 themselves requested to fix the meters.

- The number of consumers in the system before starting the project were 2950 and the project included transferring these connections on the new pipelines using AMR meters, MDPE pipes tapping tee, ferrule etc. However, during the project period 222 No. of additional connections were given by the Panchayat and around 450 new connections were lined up, hence additional money was required for these meters. The same was agreed partly through the project and partly from the MPLAD programme where Hon. Central minister Shri Prithviraj Chavan, allocated these funds.

- Consequent to commissioning some zones in 24 x 7 water availability, it was not possible to implement metered tariff for these zones, while keeping flat rates in the [I]still to be commissioned un-metered areas'. The project was therefore accelerated and all the zones were commissioned by 5/09.

- It was experienced that the number of hours of pumping was getting increased when system was operating 24X7 in commissioned zones but still in the flat rate tariff regime. The people started using excessive water No proper float stop cocks for overhead tanks etc. was leading to overflow of water and also wastage of water. The drive was therefore taken to convince people either to fix the proper stop cocks to the overhead tanks or simply by pass them, as the pressure is adequate to bring the water directly to the tap even at the third floor. The continuous water supply was maintained even though it was overflowing or misused by the people. This was essential to make them assured that "now there will be no outage in water supply". The continuous experience could convince them that fixing proper stop cocks to the overhead tanks is essential. The team of Panchayat employees and MJP engineers visited all the houses and listed such places where these problems occurred. They convinced them not to use the overhead tanks at all, as the quality of water provided through the 24 x 7 system is far superior and it may get contaminated if the overhead tanks are not covered properly OR the children playing on the terrace may put some dust in it OR the birds may try to use the water if they are un-covered. They were also informed about the washing of overhead tank etc. and if it is not carried out timely then

the water get contaminated. This drive of making people aware yielded success and the people chose to fix ball stop cocks or by pass their overhead tanks. This started reducing number of pumping hours.

(Graphical Representation of Reduced Pumping Hours)

Then came the issue of setting of proper water tariff so as to curb excessive utilization of water by the consumer. Telescopic tariff with Rs.7/- per 1000 litres up to first 70 LPCD, Rs.10/- per 1000 litres for consumption between 70 to 100 LPCD and Rs 14/- per 1000 litres for consumption beyond 100 LPCD was proposed by MJP; to the elected representatives of Nagar Panchayat. There was informal discussion in which there was a school of thought to keep less number of steps than three and decrease the rate. It was explained by the MJP that, having gone through the phase, when the flat rate tariff was there, and the water was 24 x 7; there was continuous increase in hours of pumping. Unless the higher consumption is curbed by keeping higher rate; the water supply system capacity may stand insufficient to the excessive demand by the citizen and in that case there will be no 25th hour in a day.

1) Improvement in delivery time and services

Pre-Project, the town Malkapur used to depend on bore wells, tankers and meager water supply through earlier piped water supply system which was only for old Gaothan. The timings of the services were unpredictable and the people had to rush for water at any time when it was made available, which included late night hours as well. This used to disturb the time management of the citizens. Now the water is available to the taps any time it is opened 24 x 7. This has totally removed the constraints of attending to irregular water services and thus the citizens have been freed of any special time to be allocated for water supply.

The beneficiary feedback is video captured and all the citizens of Malkapur are very happy and feel proud of their system which is the only one in India where the whole town is provided with 24 x 7 water supply. The feedback also specifies the time saved by them and the wastage of water stopped due to throwing away the water filled earlier day. The ladies are especially very much happy that they do not have to fetch the water from long distance and they can get water whenever they want by just opening the tap.

2) Quality of Water

The quality of water as delivered to the citizens through the tap is now guaranteed as the pipes are pressurized throughout day and night 24 x 7. This does not allow outside dirt to enter in the

pipes. People are happy to get assured good quality water as they open the tap. The 'Krishna Medical College, Karad' carried out a study on the quality of water after commissioning of the 24 x 7 system and they have reported that 100% of the samples are potable and free from contamination.

3) Decrease in waterborne illnesses in children

The survey carried out by Anganwadi Sevika indicated that the water borne diseases in the children have reduced remarkably to near zero level.

Shifting control of the distribution system from Valve man to the Consumer When the supply was meager, and many valves were to be operated for giving waterto the people at different time of day and night, "Valve man" used to be key person dictating the water supply. Now no valves are required to be operated in the distribution network and the consumer is the "King" and can open tap and get the water at any time of the day or night. Thus 22 Valve man and their misconduct is now a part of history.

4) Simplification of billing procedure

The AMR type water meters installed, can be read remotely by driving through the streets using hand held device & radio frequency and hence the meter reading procedure is simplified. There is no problem even if the door is locked, and of average reading. The data is free from the errors of manual handling. The readings can be downloaded from the handheld i-paq (A hand held device) to the computer and bills can be generated immediately. Thus the earlier annual billing procedure is now monthly billing and thus the cash flow of the Municipal Council is improved. So also for consumer paying a large sum at the end of year used to find it difficult than small sum every month now.

5) Saving in Electricity & helping clean development initiatives

Prior to the project, households and people living in 2/ 3 storey buildings used to pump the water from ground floor to the tanks on terrace, some of them also used to operate power pumps on bore wells, the M.C. also used to operate 1 1 Nos. of power pumps on bore wells for supplying water to the respective areas. All this is now stopped, as the water is available 24 x 7 with a pressure that can fill the terrace tank on the 3rd floor without pumping. This has saved electricity to the tune of 330336 KWH / yean This is as per the actual electricity billing data pre and post project. This exercise was carried out for submitting the proposal for 'Energy Conservation Award' to MEDA. The energy saved is equivalent to reduction in 450 tons of carbon dioxide in the atmosphere.

6) Increased prestige & pride for Citizens leading to increase in revenue recovery

The ideal service made available has increased the prestige of people and they are now experiencing pride that their town is owner of such a good system. At the same time the revenue recovery in the water is improved from 60% earlier to 80% and is improving day by day.

7) Reduction in operation cost

The simple system automation like operating the raw water pumps from water treatment plant using GSM technology has reduced the cost of operation as the raw water pumping station is now operated un-manned. This has eliminated the requirement of 2 pump operators there.

8) A successful pilot

It has achieved its aim as a pilot project. Many Municipal Councils, MLAs and others aspiring to implement 24 x 7 water supply system are visiting the town and understanding the methodology. The Vice President of the Municipal Council along with the Chief Engineer of MJP and field engineers of MJP are delivering lectures jointly to the aspiring municipalities / technocrats and giving them an insight how and where to implement 24 x 7 system and the role of technocrats, beneficiary people and people's representative as a homogeneous team in achieving the success.

❖ Replicability

The initiative is replicable where the availability of water is sufficient for all the 365 days of the year. It is replicable with the system capacity sufficient to cater for the increased demand by the people in the transition phase of complete town getting switched over to 24 x 7 and effective demand management is done through mass awareness and telescopic rate implementation. The smaller system capacities cannot satisfy this increased transition stage requirement and the initiative gets nipped in bud. The peri-urban areas where the distribution network is to be laid totally a fresh are the best areas where the system can be replicated successfully.

❖ Awards

This initiative got "Prime Ministers Award for Excellence in Public Administration" for the year 2009-10 on account of successful planning, designing & executing 24x7 Malkapur water supply scheme. This has also earned National Urban Award for year 2010.

National Urban Award for year 2010

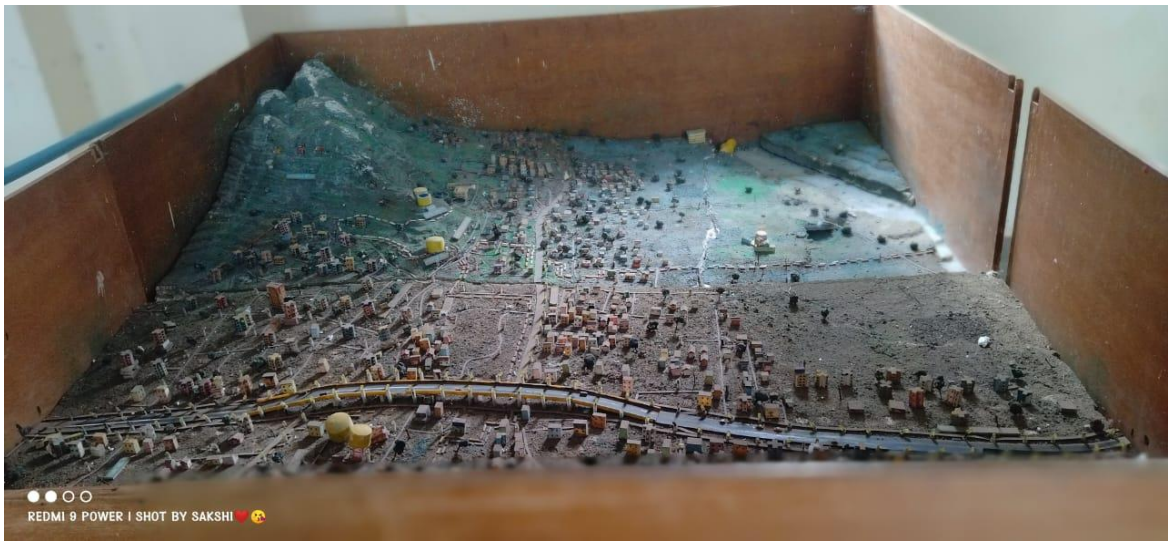
Prime Ministers Excellence Award year 2009-2010

Use of recent modern technology is being incorporated successfully to run 24x7 Malkapur Water Supply Scheme and the scheme has tested to its 100% efficiency and satisfaction of the people. In future it is planned to pay water bills by adopting SMS systems on consumer mobile.

The proper & effective combination of high political will power, successful Government Machinery & public contribution, has yielded excellent and successful 24x7 Water Supply Scheme, such as Malkapur & Malkapur only, which is a path finder & mile stone for all water supply schemes which are proposed to be executed in future.

❖ **Pictures of Our Visit To Malkapur Water Treatment Plant**


FLASH MIXER
OPPO F21 Pro
2023.09.15 16:39


REDMI 9 POWER I SHOT BY SAKSHI


मलकापूर नगरपरिषद
२४x७ नळपाणीपुरवठा योजना
मलकापूर नगरपरिषद
२४x७ नळपाणीपुरवठा योजना
आपले सहर्ष स्वागत करीत आहे


OPPO F21 Pro
2023.09.15 16:45


REDMI 9 POWER | SHOT BY SAKSHI

8. Skill developed / Learning outcomes of Microproject:

By doing this particular microproject we achieved following learning outcomes:

1) Discuss the scope of Environment.
2) Describe various types of environments.
3) Describe the importance of environment studies.
4) Discuss about the need of public awareness about environment.
5) Describe various environmental issues.
6) State the effects of water pollution on environment and lives.

9. Application of the microproject

This microproject created detailed report on water treatment contains various scattered information about water treatment, in single document. It has all data that will be helpful to understand about water treatment.

10. References:

1. https://washdomain.wordpress.com/wash/sanitation/success-story-of-malkapur-24x7-water-supply-scheme-maharashtra/