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**WASTE WATER MANAGEMENT FOR HOSTEL OF AN EDUCATIONAL  
INSTITUTE - A CASE STUDY**

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**ABSTRACT**

Water is life, is the well known phrase. In coming years, due to various reasons like rise in population, deforestation for infrastructure development, etc. the whole world is going to face the water scarcity problem. Like money saved is money earned, the proper management of waste water can reduce the demand for fresh water. The treated water can be used for the purpose like construction work, washing of vehicles, cleaning of floors and many more where the fresh water is not required. In this work we have studied and calculated the amount of water that can be treated and reused. The educational institute is having hostel with occupancy of 200 students. We found out that if sewage treatment plant is installed, near about 22,381 lit. of treated water per day i.e. approximately 4,700,010 lit. of treated water in an academic year can be obtained from only hostel buildings. In addition to this the less polluted water will be disposed to environment.

**Keywords:** *sewage, waste water management, treated water*

**1. INTRODUCTION**

There is no other alternative for Water. It is the main requirement for every living thing. In 21<sup>st</sup> century scarcity of water is one of the most concerned issues. According to International Water Management Institute's prediction by year 2025 out of every 3 Indian, 1 person will be suffering from scarcity of water. Considering this aspect we need to look for alternate water resources such as reuse of grey water and sewage water, rain water harvesting etc. [N-1]. If proper steps are not taken by human being in time to resolve this problem, there might be war between countries for water [N-2].

Central Water Commission (CWC) which monitors the live storage of water reservoirs in India issues advisory to states if the storage of reservoirs in that state falls below eighty percent of normal value of that state, so that the respective states should utilize its resources properly and efficiently to avoid any shortage of water during the remaining period of year. According to Annual Report of Central Water Commission 2019-20, such advisory was issued to thirteen states in which state of Maharashtra was also included [N-3].

The importance and severity of proper management of available resources of water can be understood by the campaign Jal Jeevan Mission launched by Honorable Prime Minister. In his address of 73<sup>rd</sup> Independence Day, Honorable Prime Minister said that this Jal Jeevan Mission campaign on water conservation should not just remain limited as a government initiative but people should also join and contribute in the movement [N-4].

As the demand of fresh water is increasing day by day and the resources of fresh water are limited, for satisfying the demand we have to look for alternatives available. We know a proverb that money saved is money earned, likewise as sources of water are limited, we can say the water reused, conserved or saved is water earned. Recycling of waste water which may be black or grey water is possibly a good alternative to reduce and control the demand of fresh water.

This paper has proposed the installation of Sewage Treatment Plant (STP) to recycle the waste water from a hostel building of an educational institute to minimize the requirement of fresh water and contribute in Water Sustainability.

## **2. NEED OF WASTE WATER MANAGEMENT**

As waste-water contains nutrients, toxic compounds, various micro-organisms which are dangerous for environment if directly sent to environment. So it is advisable to treat waste water and then disposed to the environment [N-5]. So to minimize pollution the wastewater should be well treated and then released into the environment.

For increasing resources of water, reclamation of waste water and its reuse is the good option to reduce scarcity of water [N-6].

Recycling of Wastewater is another reliable resource to reduce the demand and also in reduction of waste to be treated. Importance of waste water management is increasing in the developing countries. It is also important for reducing cost of water [N-7].

For protection of environment, reducing health problems related drinking water quality, waste water management plays a crucial role. Also this treated water can be used for the purpose of home gardens and in agriculture [N-5].

## **3. WASTE WATER, LIQUID WASTE OR SEWAGE**

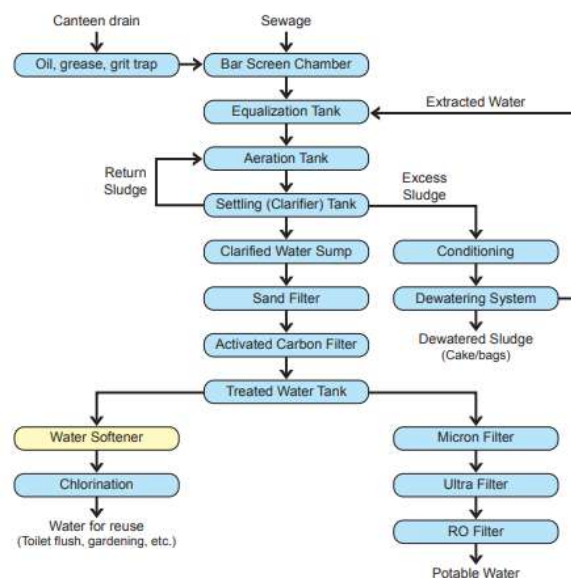
Liquid waste is generated from industries, storm or kitchens, bathrooms, toilets in houses. Grey water and black water are the types of waste water. Here we are concerned about the waste water generated from residential area.

Grey water is the water generated by washing vegetables and utensils in kitchen, bath and washing cloth. While black water is generated from toilets. The organic loading differentiates the grey water and black water. Grey water has lower organic loading than the black water [N-6]. So for easy understanding we can say that grey water is generated from bathrooms and kitchens whereas black water generates from toilets.

50-60% of total grey water is generated by washing and bathing, 25-35% of total grey water is generated by cloth washing and 10% of the total grey water generated from kitchen [N-8].

## **4. SEWAGE TREATMENT PLANT:**

Using Sewage treatment plant (STP) contaminants are removed from waste water so as to make the water reusable. In STP physical treatment, chemical treatment and biological treatment is given to waste water. Sewage treatment plant destroys the pathogenic micro-organisms and removes biodegradable organic materials which are dissolved in waste water. In STP water and sludge or soil is produced. The produced water can be used for gardening, car washing, construction work, floor cleaning and gardening, while the sludge or soil formed can be disposed in to the environment safely [N-2]. The treatment is done in three steps Primary treatment in which settling is done and also floating waste is removed, secondary treatment in which additional settling along-with biological treatment is done and finally advanced treatment is done. The typical flowchart of STP is shown below [N-9].



**Fig. 1:** Typical flowchart of STP

### 5. TYPES OF STP

- a. Sequencing Batch Reactor or SBR is the STP in which using activated sludge liquid waste is treated in this organic matters are reduced by bubbled oxygen through liquid waste and sludge.
- b. Moving Bed Biofilm Reactor or MBBR is the STP in which a biofilm process is used.
- c. Membrane Bio Reactor or MBR is the STP in which membrane process and biological waste-water treatment are combined. This process is very popular and widely used due to less space requirement and less involvement of operator.

### 6. ESTIMATION OF SEWAGE GENERATION AND WATER TREATED

Sewage is generated from the fresh water taken for domestic and flushing purpose. The total sewage generated is the sum of 85% of Domestic part and 100% of Flushing part. Out of which depending upon the efficiency of Sewage treatment plant (STP) 80% to 90% of treated water can be obtained.

According to Central Ground Water Authority, Estimation of water requirement for drinking and domestic use the daily requirement of with full flushing system per head per day is 135 lpcd [N-10]. Also Water Requirements for Buildings such as Hostels it is as below:

**Table -1:** Water Requirements for Buildings

Sr.	Type of Building	Domestic Lit. per head/ day	Flushing Lit. per head/ day	Total Consumption Lit. per capita/ day
1	Hostels	90	45	135
2	Without boarding facilities	25	20	45

### 7. CASE STUDY: WASTEWATER RECYCLE & REUSE CALCULATIONS

- A] Capacity of hostel = 200 students  
Warden + 1 with boarding facilities = 2 (Per 100 students)  
So total Capacity of Hostel (with boarding facilities) = 204 numbers
- B] Security Guards (without boarding facilities) = 2 numbers
- A1] Considering the Total Consumption of water in Lit. per capita/ day (lpcd) is 135 lpcd for person with boarding facilities  
Total water Consumption @ 135 lpcd = 204 X 135

$$= 27540 \text{ lit. per day}$$

The bifurcation of [A] is:

A1.1] Domestic part for person with boarding facilities @ 90 lpcd =  $204 \times 90$   
 $= 18360 \text{ lit. per day}$

A1.2] Flushing part for person with boarding facilities @ 45 lpcd =  $204 \times 45$   
 $= 9180 \text{ lit. per day}$

B1] Considering the Total Consumption of water in Lit. per capita/ day (lpcd) is 45 lpcd for person without boarding facilities

$$\text{Total water Consumption @ 45 lpcd} = 2 \times 45 = 90 \text{ lit. per day}$$

The bifurcation of [B] is:

B1.1] Domestic part for person with boarding facilities @ 25 lpcd =  $2 \times 25$   
 $= 50 \text{ lit. per day}$

B1.2] Flushing part for person with boarding facilities @ 20 lpcd =  $2 \times 20$   
 $= 40 \text{ lit. per day}$

So, total quantity of sewage generated and going to STP

$$\begin{aligned} &= 85\% \text{ of Domestic part} + 100\% \text{ of Flushing part} \\ &= 85\% \text{ of } (a1.1 + b1.1) + 100\% \text{ of } (a1.2 + b1.2) \\ &= [85/100 \times (18360+50)] + (9180+40) \\ &= (85/100 \times 18410) + (9220) \\ &= (15648) + (9000) \\ &= 24868 \text{ lit. per day} \end{aligned}$$

Considering 90% of treated water will be obtained from STP

$$\begin{aligned} \text{Treated water which can be obtained} &= 90/100 \times 24868 \text{ lit. per day} \\ &= 22,381 \text{ lit. per day} \end{aligned}$$

For 1000 lit. Capacity STP, an area of 1sq. meter or 10sq.ft. will be required.

Taking capacity of STP as 23000 lit. per day,

The space required for it will be 23 sq. meter.

In an academic year students stay in hostel for 7 to 8 months i.e. approximately 210 to 230 days.

For calculation purpose considering on minimum side i.e. 210 days.

So, calculating the treated water that can be obtained as follows:

$$\begin{aligned} \text{In an academic year treated water that can be obtained} &= 22,381 \text{ lit.} \times 210 \text{ days} \\ &= 4,700,010 \text{ lit.} \end{aligned}$$

The cost of Municipal water tanker is say approximately 30 Rs. /1000 lit.

$$\begin{aligned} \text{So, the value of treated water from hostel per day will be} &= 22,381 \text{ lit.} \times 30/1000 \\ &= 671 \text{ Rs. /day} \end{aligned}$$

$$\begin{aligned} \text{Means, for an academic year i.e. for 210 days the amount will be} &= 210 \text{ days} \times \text{Rs. } 671 \\ &= \text{Rs. } 140,910/- \end{aligned}$$

## CONCLUSION

If the sewage treatment plant is installed, it will reduce the requirement of fresh water. It also reduces the contamination of natural water resources and related health issues of people if disposed in environment after treatment. Instead of fresh water, the treated water can be used for gardening, floor cleaning, construction work and flushing purpose.

Near about 22,381 lit. of water per day and 4,700,010 lit. of treated water (approximate cost Rs. 140,910/-) in an academic year can be reused. In case some day this treated water is not used, then this water can be released into the environment which will minimize the chances of pollution. It will create awareness about water conservation among students as well as in society.

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