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Sullage Water Treatment Technique

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Abstract: *Domestic waste is one of the major source of water pollution. Discharge of domestic wastes and sewage into the water bodies is one of the preliminary source of pollution. Natural wastewater treatment systems are simple, low cost methods that utilize the physical, chemical and biological processes that occur in the natural environment between water, soil, plants, microorganisms and the atmosphere. Recycled water is most commonly used for non-potable (not for drinking) purposes, such as agriculture, landscape, public parks, and golf course irrigation. Other non-potable applications include cooling water for power plants and oil refineries, industrial process water for such facilities as paper mills and carpet dyers, toilet flushing, dust control, construction activities, concrete mixing, and artificial lakes. Present day wastewater treatment technologies have grown increasingly complex with the requirement of relatively sophisticated and expensive plants. In addition to capital cost, considerable outlay is required for operation and maintenance expenses. Natural treatment systems are a viable alternative that can produce effluents of high quality at a fraction of the cost and without requiring skilled operation. Their main limitation for application in industry is the fact that they take up lots of space. Newly developed processes and media developed by root zone allow the treatment of municipal and domestic wastes to tertiary treatment standards and significantly reduce the area requirement and hence cost of new facilities for water treatment. However, they can also serve to enhance the environment and make the facilities suitable for recreation. With the objective to evolve a low cost treatment technology, this paper has been undertaken to study the efficiency of treatment of sullage water, to assess the economic return.*

Keywords: *Wastewater, Sullage, Root Zone technique, Sullage treatment model, Typha plant.*

1. INTRODUCTION

Today word is facing environmental pollution problem which has tremendous ill effects on leaving as well as non-leaving things. Out of this pollution water pollution is one of the major. One of the major source for water pollution is domestic waste. Present day waste water treatment technology have grown increasingly complex with the requirement of relatively sophisticated and expensive plants. In addition **capital cost**, considerable **skilled** is required for operation and maintenance. In spite of giving such costly treatment the results are not up to mark due to negligence in operation and maintenance process. Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use. Below fig. shows types of treatment processes and suggested uses at each level of treatment. In uses where there is a greater chance of human exposure to the water, more treatment is required. As for any water source that is not properly treated, health problems could arise from drinking or being exposed to recycled water if it contains disease-causing organisms or other contaminants.

1.1 The Need for Water in Arid Areas

After World War II there was a dramatic revival of interest in the wastewater recycling/reuse strategy. The primary driving force behind this new thrust resulted mainly from the need for additional water resources in water short areas of the developed countries and the arid zone developing countries. Major new agricultural development projects to supply food to the rapidly growing population coupled with the rapid growth of urban areas with no solution for their wastewater disposal problems fueled this drive. There is nothing as powerful as economic and social necessity to modify prejudiced ideas and preconceived notions. In present days, all different technologies for types of artificial wetlands have been used for water treatment.

1. Constructed Wetlands 2. Reed bed Filters

3. Subsurface Wetlands.

1.2 Water Recycling Options

Although water recycling for agricultural irrigation is by far the most widespread form of wastewater reuse, a complete listing of the reuse options would include :

a - Agricultural irrigation

b - Aquaculture

c - Ground water recharge

d- Aquifer recharge for the prevention of seawater intrusion

e - Industrial uses : cooling and process water

f - Recreational lakes for non-body contact use

g- Recreational use for body contact sports e.g. swimming

h- Urban non-potable uses - parks, gardens, green-belts, golf courses, football fields and highway landscaping

i - Urban potable/domestic use.

2. ROOT ZONE METHOD

Root zone technology has widespread applications wherever a Low tech low maintenance approach is desirable to pollution problems. This system involves running contaminated water underground through the root zones of specially designed bed with wetland plant.

- The plants which are essentially wetland plants, have the capacity to absorb oxygen from the surrounding air through their stomata openings.
- The oxygen is pushed through the porous stem of the plants into the hollow roots, where it enters the root zone and creates conditions suitable for the growth of numerous bacteria and fungi.
- These micro-organisms oxidize impurities in the waste waters. Finally the water which comes out is clean water.
- In present practice Root Zone Method is used to treat industrial waste and wetland pieces which is used reed plant from Australia.
- This process was developed by Thermax.
- Many studies have done on the domestic waste but actual implantation is not in practice.

2.1 Advantages

- This method combines mechanical filtration, chemical precipitation and biological degradation in one step for the treatment of wastewater.
- This method is low operating cost, less energy requirement and ease of maintenance.
- Root zone is an attractive alternative for wastewater management.
- Highly skilled persons are not required to operate the Site/work.
- The recycled wastewater is used for the surrounding lawn, gardens, fruit trees, irrigation etc.
- This water can also be used to recharge the groundwater table where there is scarcity of water.
- This process also eliminates most of the incoming organic matter as well as chemicals.
- This treatment plant is free from any smell and mosquitoes.

2.2 ABOUT FILTER METHODS

There are two types of filters,

1. Vertical 2. Horizontal

- Horizontal filters are used in low solids situations and vertical filtered in high solids (sludge) situations. In some applications a combination may be used.
- The design of systems depends on the specific waste water or sludge characteristics and the required level of treatment.
- In particular wastewater from households, industries and other sources in remote areas can be treated at low cost in this way.
- The treatment plant is incorporated right next the house and blends fully into the garden landscape. Being one of the first pilot plants, several improvements were introduced over the years, especially in the composition of the filter material.
- The initial filter material, consisting of limestone blocks, pebbles and a fine sand layer was subsequently changed to a full pebble filter bed. This removed the problems of clogging observed at the inlet with the limestone layer and the slow filtration rate of the sand layer during increased water use from the washing machine.
- The major requirement from the household members was for an odour free operating **planted filter**, which, despite initial drawbacks, has been achieved during the entire five-year operating period. The presence of fish, frogs and dragonflies in the polishing pond is beneficial for the whole aquatic eco-system and keeps a firm control on the

mosquitoes. The presence of duckweed, water hyacinths, lotus plants and water lilies replicates a natural functioning system and is also aesthetically pleasing.

- Planted horizontal gravel filters are also referred to as sub surface Flow Wetlands, Constructed Wetlands or Root Zone Treatment Plants.
- The horizontal planted filter is simple by principle and requires almost no maintenance.
- Planted filters are suitable for pre-treated domestic or industrial wastewater of a COD content not higher than 500 mg/l. wastewater must be pre-treated especially in respect to suspended solids, given the fact that the biggest problem in ground filters is **clogging** of the filter media.

3. PRINCIPLE OF THE HORIZONTAL PLANTED FILTERS

1. Continuous oxygen supply to the upper layers only.

2. Anaerobic conditions in the lower parts of the filter.

3. Roots of plants provide favorable environment for bacteria

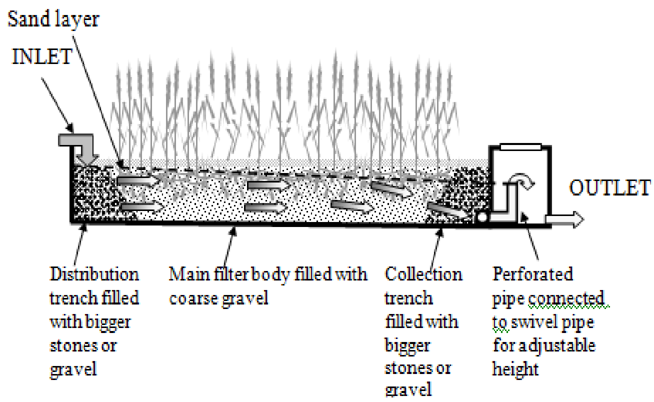

Figure 1: *Schematic of Root zone technique model*

3.1 Model Which We Have Developed Treats the Domestic Sullage Particularly from the Sink.

This model consist of two main parts,

1. Filter bed base 2. Wetland plant

In this first taken one horizontal rectangular container or tank with the size for 4-5 persons in a house, approximate Wide-0.30m, Length-0.60m and Height-0.60m.

The tank were installed on a flat surface, with the flow between tank controlled by variation in inlet and outlet heights.

- Outlet is provided 1 inch above bottom of the container surface, so that water may be present for the roots of the plant.
- Each inlet and outlet pipes used in PVC material and also PVC pipe joints used for fixing.
- The inlet was positioned higher than the outlet on tank.
- Each outlet and inlet pipe was perforated with 20 to 40mm diameter holes.
- In the tank first bottom layer provided gravel size 40mm.
- Top most layer of the tank provided very fine sand. The layer sand to eliminated the smell completely.
- In this process natural **Aeration** takes place.

Photo 1: *Plantation of Typha plant in Model*

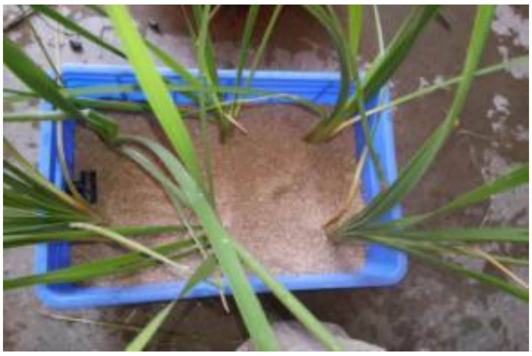

Photo 2: *Filling of graded soil layers*

Photo 3: *Model Fitted with pipes to supply of Sullage*

3.2 Mechanism Of Filtration

- Mechanism straining
- Electrolytic action
- Biological metabolism or zoo gel
- Attachment

3.2.1 Mechanical straining

Voids are present in the filter media. These voids act as a strainer when water is supplied to the filter media. Suspended impurities are usually larger than the voids of the filter media in the above layer & which retains them and allows the water to pass through. Major impurities are retained on the upper part of the filter media.

3.2.2 Electrolytic action

The clarified water after sedimentation contains some residual alum flock. The flock forms a thin coating on the surface of the grain which are positively charged. Whereas the colloidal particles which are negatively charged gets neutralized & gets deposited in the voids of the sand. Here, each void functions as sedimentation tank.

3.2.3 Biological metabolism

The surface of the sand layer gets coated with Zoo-gel film, these film contains colonies of organisms which feed on complex organic impurities & convert them into compound by biological reaction.

3.2.4 Attachment

When water containing colloidal particles passes through sand it follows a curved path. A centrifugal force act on the particles following a curved path & these particles are draw on the surface of sand grain due to the centrifugal action and get attached to the sand grain. Due to these actions the impurities are removed.

4. SECOND PART WETLAND PLANT

- Cattail pollen is a fine substitute for flours; it is a bright yellow or green color, and turns pancakes, cookies or biscuits a pretty yellow color.
- This flour would probably contain about 80 % carbohydrates and around 6% to 8% protein.
- We use Indian locally available wetland spices like Typha.
- It is a wetland plant which takes oxygen from the atmosphere and transfers it to the roots with the help of hollow steam.
- The oxygen releasing capacity of Typha is 70 to 80% as compared to other plants.

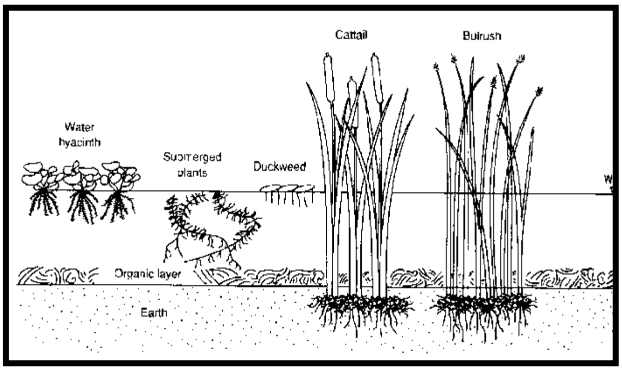

Figure 2: *Various Wetland plants*

This model developed natural systems as well as horizontal filter, the combinations both are given

1. Sedimentation
2. Filtration
3. Gas transfer
4. Chemical precipitation
5. Chemical oxidation
6. Reduction & Biological conversion
7. Degradation.

Root zone Filters have been constructed all over the world for such diverse purposes as wastewater from:

1. Hospitals
2. Hotels & motels
3. Boarding schools
4. Private houses.

5. COLLECTION OF SAMPLE

The main purpose of sampling is to collect a portion of sullage (kitchen wastewater) from sink outlet small enough in volume to be conveniently transported to and handled upto test model while still accurately representing the sullage being sample. For general physical and chemical examination, the sample should be collected in a chemically clean bottle made of good quality glass fitted with a good stopper, or in chemically inert plastic container.

6. OBSERVATIONS

Here many tests given for this water through the test model (photo 3). Check the difference in between the before and after treatment of following:

1. pH
2. BOD

3. COD
4. Total Alkalinity
5. Total Hardness
6. Total Dissolved Solids (TDS)
7. Dissolved Oxygen(DO)
8. Total Suspended Solids (TSS)

Table 1: *Observation Table (Before And After Treatment)*

Sr.no	Para-Meter	Week 1		Week 2		Week 3		Desirable limit BIS 10500
		Before	After	Before	After	Before	After	
1	pH	7.89	7.44	7.95	7.5	9.97	7.47	6.5-8.5
2	TSS	56.39	20.10	60.5	18.20	58.2	17	-
3	COD	1760	360	1800	340	1780	330	500 mg/l
4	BOD	590	120	610	110	585	100	300 mg/l
5	DO	30	10	40	13	35	17	Not mentioned
6	TDS	500	100	450	120	520	105	500-2000 mg/l
7	Total Hardness	230	220	250	200	240	205	300-600 mg/l
8	Total Alkalinity	80.3	25.2	78.5	21	79	26.3	200-600 mg/l

7. RESULT AND DISCUSSION

pH range of 6.5 to 8.5 is normally accepted as suggested by BIS. In this study pH values were found in the range of 7.44 to 9.97 in the water samples which is reducing after treatment. High TDS levels generally indicate hard water, which can cause scale build up in pipes, valves and taps. In the present study, as the water contains only the solids from vegetables after washing or utensils washing. The value of TDS found in the range 100 to 520 mg/l. After treatment maximum TDS is removed by the model itself. Alkalinity found in the range of 26.8 to 80.3 mg/l. The Alkalinity exceeds the desirable limit at all points after monsoon, can cause taste become unpleasant. The total hardness found is out of the range of BIS standard at near about all stations. The values of hardness are found to be 200 to 380 mg/l.

Chemical oxygen demand (COD) value found in the range of 330 mg/l to 1800 mg/l. COD test which measure the oxygen required for the oxidation of all the substance present in water, included those are not biologically decomposable. COD is a reliable parameter for judging the extent of pollution in water. The COD of water increases with increasing concentration of organic matter. In this test it is observed that the removal of COD is more which is within the BIS range. Biochemical oxygen demand (BOD) found in the range of 100 mg/l to 610 mg/l, is the measurement of the amount of biologically oxidisable organic matter present in the sullage. After the treatment the BOD is within the range.

Dissolved oxygen found in the range of 10 to 40 mg/l. This can be attributed to addition of effluents containing oxidisable organic matter and consequent biodegradation and decay of vegetation at higher temperature leading to consumption of oxygen from water. Concentration below 5 mg/l may adversely affect the functioning and survival of biological communities.

8. CONCLUSION

It is concluded from the present study that the pH value exceeds the desirable range as per BIS in one week, means it make water alkaline. Alkalinity at all three weeks are within the desirable limit. There is no more effect of this method on Total hardness. Total dissolved solids (TDS) found to be more effectively reduced after treatment. Dissolved oxygen found is reduced but not very less. Biochemical oxygen demand (BOD) are found higher, but that is controlled after treatment. As DO decreases BOD increases. COD values are out of range before treatment, but reduced to within the desirable level by treatment. All other parameters tested are within the desirable limits of BIS. After the treatment there is overall good result of this root zone method model. This model we can install at the kitchen sink outlet in the home. And by this we can reduce the load of wastewater from Wastewater Treatment Plant. Overall this model is very cost effective.

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