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A PATH FOR HORIZING YOUR INNOVATIVE WORK

A GUIDE TO WATER CONSERVATION AND ITS NEED IN PRESENT SCENARIO

MOHD. GULFAM PATHAN[1], VEENA PATHAN[2]

1. Faculty in Asst. Prof, Civil Engineering Dept. J.L. Chaturvedi College of Engineering Nagpur, India
2. Faculty in Asst. Prof, Civil Engineering Dept. Priyadarshini College of Engineering Nagpur, India

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Corresponding Author
Mr. Mohd. Gulfam Pathan

Abstract

With less than one percent of Earth's water available for human use, the Federal Government is leading by example with water efficiency and conservation efforts. Federal laws and regulations require agencies to implement water efficiency efforts and reduce water consumption, making water an integral part of every comprehensive resource management program. Conservation or water conservation helps to recharge ground water by reducing consumption and using alternative source of water. This method includes rainwater harvesting, groundwater recharge, reuse of Greywater and recycling wastewater. This paper guides the way for optimizing utilization of site water resources, minimizing site wastewater outflows. This work explains a treatment system for grey water consisting of natural processes involving equalization, filter bed of sand & aggregates, coal & charcoal, surface wetland and sub-surface wetland. The treatment is economically viable, scientifically feasible and treated water can be used for irrigation, flushing, gardening, washing etc.

INTRODUCTION

India has one of the fastest growing construction sectors in the world. This rapid growth in India's building sector no doubt presents opportunities for improving the living conditions and livelihoods of millions of people. However, in order to be sustainable the environmental pressures of increased demand for resources coupled with a rapidly changing climate must be addressed [15].

Much emphasis has been placed on green buildings over the past two decades. Most of the focus to date has been on green buildings which may feature energy conservation in construction and operation, recycled or native/natural/low tech materials used in construction or even use of high tech concepts to reduce energy and water consumption. The Government is currently developing a code for sustainable buildings. The code is a voluntary initiative to actively promote the transformation of the building industry towards more sustainable practices by requiring buildings that make more efficient use of energy resources, water resources, material resources and practices and materials designed to safeguard occupants' health and wellbeing.

Most Indian cities rely heavily on ground-water for use in buildings. However, ground-water levels in India are projected to have dropped from 1901 m3/ person/yr in 2001 to 1401 m3/person/year by 2030 which is well below the international benchmark for water stress of 1700 m3/person/year. Rainwater harvesting and large scale water recycling are not widely implemented in urban areas despite demand for water often outstripping supply. An added drain on urban water supply is the approximately 30% of water wasted each year due to leaking infra-structure.

Less than one-fifth of one percent of our planet's water is accessible fresh water, and only about 30 percent of that is potable. Over 80 percent of municipally supplied water is used in buildings. There's a reason that water has become a national priority. A recent government survey showed at least 36 states are anticipating local, regional, or statewide water shortages by 2013 (Source:

EPA). By using water more efficiently, we can help preserve water supplies for future generations, save money, protect the environment. Many countries and indeed some states in the United States face shortages in potable water supply. Several opportunities exist to use household water more efficiently without reducing services. Implementing water efficient practices can also lead to substantial savings on the cost of septic tanks, leach fields, and wastewater treatment infrastructure [10]. These measures combined will not only benefit the environment and the community, they can also create economic savings. Increasing water efficiency can reduce water-supply and wastewater-treatment needs and their related costs. Because water suitable for reuse is often a by-product of existing secondary and tertiary wastewater treatment processes, this type of water recycling is a low-energy source of water supply.

The sustainable use of water can fall into two categories

- Conserve water within and around the building; and
- Conserve water on the site [11].

A water management plan includes clear information on how a Federal facility uses water from the point of access or generation to its ultimate disposal or reuse. The water cycle for Federal buildings begins at the water utility and continues beyond the building. Covering the entire water distribution cycle ensures that Federal sites make appropriate water management decisions [12].

Methods of water management can be classified as Conservation, Allocation, retrofit program and Behavioral practices. This paper explains Conservation of water and provides guidance for reuse of greywater. Based on the comparisons made, water reclamation and reuse should be components of any long term water resources management strategy.

Important Methods in Water Management

Conservation

Conservation or water conservation helps to recharge ground water by reducing consumption and using alternative source of water. This method includes rainwater harvesting, groundwater recharge, reuse of Greywater and recycling wastewater.

Rainwater Harvesting System: Rainwater harvesting is the practice of collecting rainwater off roof surfaces and storing that water for later use. While collected water can be filtered and treated for potable uses, such systems are fairly complex. Using collected rainwater for landscape irrigation is more easily accomplished. It is important that homes become increasingly self reliant in collecting their own rainwater for grey water recycling for non-potable domestic use. At the simplest level, rainwater can be collected in a water butt for garden use. More advanced rainwater harvesting systems can provide water supply for all non-potable consumption such as for WCs, washing machines, the garden and car washing. Rainwater harvesting can save around 50% on mains water consumption, depending on roof areas of dwellings and annual rainfall.

Groundwater recharge: Groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater. Recharge occurs both naturally and artificially. In natural groundwater recharge, groundwater is recharged naturally by rain and snow melt and to a smaller extent by surface water such as rivers and lakes. Artificial groundwater recharge is a successful method in order to purify surface water and to improve the water management. Artificial groundwater recharge is the infiltration of surface water into shallow aquifers to increase the quantity of groundwater. The volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged.

Greywater System: Greywater is wastewater from non-toilet plumbing systems such as hand basins, washing machines, showers and baths. Most Greywater is easier to treat and recycle than blackwater, because of lower levels of contaminants. The method and standard of treatment in a Greywater system will vary with the size of the system. Pipes and supply points on the Greywater system must be clearly labeled in order to avoid confusion with the mains drinking water.

Greywater systems can help you save 35% to 40% on your annual water bill.

Recycling wastewater system: Recycling wastewater

is easier to treat and recycle than blackwater. Blackwater contains bacteria that can cause disease. That's why communities build wastewater treatment plants and enforce laws against the release of raw sewage into the environment. Sewage Treatment plant system are used to recycle blackwater. In recent years, there has been growing interest in waste-water reuse as a major component of water demand management.

GREY WATER

Grey water is the 'waste' water that is generated in homes and commercial buildings through the use of water for laundry, dishes, or for bathing.

In recent years not only the threats of improper greywater management have been recognized, there is an increasing international recognition that grey water reuse, if properly done, has a great potential as alternative water source for purposes such as irrigation, toilet flushing and others. The main barrier for wider and faster dissemination of suitable greywater management system on household level is the lack of knowledge and experience in that field, especially in developing countries.

Recycled water is either reclaimed wastewater or untreated grey water, two other possible sources for irrigation water. Reclaimed wastewater is water from a wastewater treatment plant that has been treated and can be used for nonpotable uses such as landscape irrigation, cooling towers, industrial processes, toilet flushing, and fire-protection [13].

As per WichmanK, Otterpohl R. The combination of aerobic biological process with physical filtration and disinfection is considered to be the most economical and feasible solution for grey water recycling.

Weissenbacher, Mullegge showed that the Conventional system was capable to fulfill the physicochemical requirements suggest by different guidelines but could not ensure the hygienic quality for all operating conditions. In comparison to a conventional system the combined system was capable to reduce the fresh water demand by more than 60%.

Greywater generated due to cloth washing can have fecal contamination with the associated pathogens and parasites such as bacteria. Kitchen Grey water is contaminated with food particles, oils, fats and other wastes. It readily promotes and supports the growth of micro-organisms. Kitchen Grey water also contains chemical pollutants such as detergents and cleaning agents which are alkaline in nature and contain various chemicals.

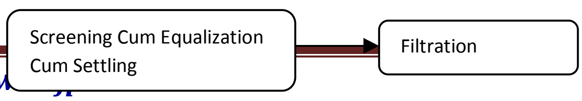
It is important to recognize that greywater is not always pathogen-free. Numerous pathogenic organisms and microbial indicators have been found in grey water. These include coliform bacteria, fecal coliform and virus. Treatment of greywater is important because, there are number of problems related to the reuse of untreated grey wastewater. The risk of spreading of diseases, due to exposure to micro-organisms in the water, will be a crucial point if the water is to be reused for toilet flushing or irrigation. The risk for pollution of soil and receiving water due to the content of different pollutants is another question that has been raised concerning infiltration and irrigation with grey water. Table I gives the different chemical characteristics of typical grey water.

TABLE I. PARAMETERS OF GREY WATER

Parameter	Unit	Range
Ph	--	6.4-8.1
Suspended Solid	Mg/l	40-340
Turbidity	NTU	15-270
Bio-Chemical Oxygen Demand (BOD)	Mg/l	45-330
Nitrite	Mg/l	0.1-2.6
Ammonia	Mg/l	1.0-2.6
Total Phosphorus	Mg/l	0.1-0.8
Sulphate	Mg/l	<0.3-12.9
Conductivity	mS/cm	325-1140
Hardness	Mg/l	15-50
Sodium	Mg/l	60-250

TREATMENT PROCESS OF GREY WATER

Fig. 1 shows the Schematic diagram of treatment process which is recommended for recycling.



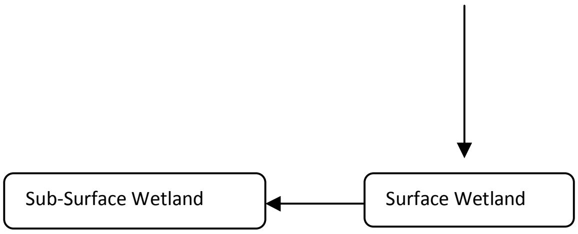


Fig.1 Flow diagram of treatment process

The treatment comprises of following steps:

- **Screening:** is the very first method involved in the treatment of grey water. It helps to remove large debris such as sticks, leaves, rubbish and other large particles which may interfere with subsequent treatment steps.
- **Equalization:** After screening, grey water is equalized by mixing it thoroughly in the tank so that foul smell, odor, etc can be minimized and the water get mixed properly so that the strength of water is same everywhere.
- **Settling:** When grey water gets equalized, it is allowed to settle for 4-6 hours. The solids and heavy particles get settle down at the bottom of tank by gravity and light particles floats on water.
- **Filtration:** In this unit, grey water passes through different media of filter i.e. aggregate, sand, coal and charcoal. Sand and gravel are usually used for filter bed but charcoal and coal have also properties to purify water. Water passes quickly through the sand and small particles are removed. The internal pore characteristics are very important properties of aggregates. Absorption relates to the particles ability to take in liquid and purify. Smelling chlorine and other unpleasant odors is eliminated by the absorption power of the charcoal. Also microorganisms living in the many pores of the charcoal break down unhealthy organic matters. Coal is an adsorbent used to take tiny sediment out of water making it cleaner.
- **Surface Wetland:** Constructed Wetland (CW) Treatment system is a typical natural, engineered treatment system designed and developed to utilize the natural processes involving wetland

vegetation, some filter bed consisting sand or gravel or such material and their associated microbial assemblage in order to treat wastewater. The use of CW can be a cost effective treatment alternative. After filtration, the water is allowed to flow in the tank containing water lily plants. The plants float on water surface and hence it is known as surface wetland. These plants use their roots to purify water as they take up oxygen in their roots and allow micro-organisms to grow which decomposes the organic matter present in water. Mats of floating plants in wetland may serve, to a limited extent, as sediment traps, but their primary role in suspended solid removal is to limit resuspension of settled particulate matter.

- **Sub-Surface Wetland:** After 3 days, water from surface wetland is allowed to flow in the sub-surface wetland in which Typha Latifolia plants are placed with the support of sand and gravel. Typha Latifolia acts as a bioremediater to treat polluted water. Greywater is discharged into the subsurface constructed wetland where the water will be filtered by biological processes. The main compartment consists of gravel and sand, with the vegetation growing on the top portion of mulch or rich soil. The greywater flows through the system beneath the soil surface, which eliminates the risk for standing pools and mosquito breeding. Biological removal is perhaps the most important pathway for contaminant removal in wetland. Contaminants that are also forma of essential plant nutrients, such as nitrate, ammonium, and phosphate, are readily taken up by the wetland plants. However, many wetland plant species are also capable of uptake and even significant accumulation of, certain toxic metals such as cadmium and lead. The rate of contaminant removal by plants varies widely, depending on plant growth rate and concentration of the contaminant in plant tissue. Woody, plants trees and shrubs, provide relatively long-term storage of contaminants, compared with herbaceous plants.

EXPERIMENTAL SETUP

1. Raw grey water is to be collected from different sources of a residential or commercial building.

2. The very first tank, equalization cum settling tank, has screen on the top. The grey water is put in the tank and it gets screened.

3. After that, the water is mixed thoroughly to make it equalized. It is then allowed to settle for 4-6 hours.

4. The heavy matter gets settled at the bottom of the tank and the water is allowed to flow in filtration tank. The water passes through each filter media i.e. sand, aggregate, coal and charcoal. It is a down flow process.

5. After the water is filtered, it flows into surface wetland in which water lily are planted. Water is kept for three days in surface wetland and then it is allowed to flow in the sub-surface wetland.

6. In sub-surface wetland, Typha Latifolia is planted and three samples are collected after every 3 days.

7. The samples of raw grey water, water after equalization, settling, filtration, surface wetland and sub-surface wetland are collected and various tests are carried out in laboratory like Ph, Dissolved Oxygen (DO), Turbidity, Total Solids, BOD, Chemical Oxygen Demand (COD), Hardness etc.

Table II gives the Disposal Standard by Central Pollution Control Board (CPCB) for quality of treated grey water.

TABLE II. EFFLUENT STANDARD TABLE

Parameter	On land for irrigation standards : 3307 (1974)	Into inland surface water IS:2490 (1974)	Into public sewers IS:3306 (1974)	For construction IS:456 (2000)
pH	5.5-9.0	5.5-9.0	5.5-9.0	>=6
BOD	<100 mg/l	<30 mg/l	<350 mg/l	--
COD	--	<250 mg/l	--	--
TSS	<200mg/l	<100 mg/l	<600 mg/l	--
TDS	<2100 mg/l	<2100 mg/l	<2100 mg/l	<3200 mg/l
Hardness	--	--	--	<440 mg/l

Hence, we can reuse grey water after treatment which includes screening, equalization, settling, filtration and wetlands. It is a suitable and effective method of treatment of grey water as compared to the conventional method so it can be implemented at small scale basis at homes, schools, colleges, commercial buildings, etc.

CONCLUSION

- This method of treatment of grey water is economically viable and scientifically feasible and the treated water can be used effectively for irrigation, gardening, flushing, street washing and construction purpose.
- The multimedia filter is effective for the removal of turbidity also, the organic matter is lesser.
- Constructed wetland is very useful for removal of suspended solids.
- DO is increased after filtration process while there is no effect on hardness of water.
- BOD and COD values decrease after treatment.
- Vegetation growth increases rapidly.

Water demand should be reduced as much as possible and water reuse systems, such as rainwater harvesting or grey water recycling, should be installed.

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