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Grey Water Treatment and Management

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Abstract

Water is becoming a rare resource in the world. In India alone the International Water Management Institute (IWMI) predicts that by 2025, one person in three will live in conditions of absolute water scarcity (IWMI, 2003)(1). It is therefore essential to reduce surface and ground water use in all sectors of consumption, to substitute fresh water with alternative water resources and to optimize water use efficiency through reuse options. This alternative. Resources include rainwater and grey water .Grey water is all wastewater that is discharged from a house, excluding backwater (toilet water). This includes water from showers, bathtubs, sinks, kitchen, dishwashers, laundry tubs, and washing machines. It commonly contains soap, shampoo, and toothpaste, food scraps, cooking oils, detergents and hair. Typically, 50-80% of the household wastewater is grey water. If a composting toilet is also used, then 100% of the household wastewater is grey water. Reusing grey water serves two purposes: it reduces the amount of freshwater needed to supply and reduces the amount of waste water entering sewer or septic systems.

Introduction

Water is becoming a rare resource in the world. In India alone the International Water Management Institute (IWMI) predicts that by 2025, one person in three will live in conditions of absolute water scarcity (IWMI, 2003). It is therefore essential to reduce surface and ground water use in all sectors of consumption, to substitute fresh water with alternative water resources and to optimize water use efficiency through reuse options. These alternative Resources include rainwater and grey water. Grey water is water that has been used for washing dishes, laundering clothes, or bathing. Essentially, any water, other than toilet wastes, draining from a household is grey water. Although this used water may contain grease, food particles, hair, and any number of other impurities, it may still be suitable for reuse. Not all grey water is equally "grey". Kitchen sink water laden with food

solids and laundry water that has been used to wash diapers is more heavily contaminated than grey water from showers and bathroom sinks. Therefore, different grey water flows may require different treatment methods that would render the water suitable for reuse.[1]

Grey water composition and characteristics:

Grey water is a reflection of the household activities and its characteristics are strongly dependent on living standards, social and cultural habits, number of household members and the use of household chemicals. Grey water from bathtubs, showers and hand washbasins is considered as the least polluted grey water source.

The average grey water contribution to the total organic load (BOD_5) amounts to about 40 – 50%. Grey water also contributes to one fourth of the total suspended solids and up to two thirds of the total phosphorous load. Dishwashing and laundry detergents are the main sources of phosphorous in grey water. In countries where phosphorous-free detergents are used, these loads are minimal. Kitchen grey water is the main source of nitrogen in domestic grey water, while the lowest levels are generally observed in bathroom and laundry grey water.[2]

Table 1. Water-quality characteristics of selected domestic wastewater.

Water Source	Characteristics
Automatic Clothes Washer	Bleach, Foam, High pH, Hot water, Nitrate, Oil and Grease, Oxygen demand, Phosphate, Salinity, Soaps, Sodium, Suspended solids, and Turbidity
Automatic Dish Washer	Bacteria, Foam, Food particles, High pH, Hot water, Odor, Oil and grease, Organic matter, Oxygen demand, Salinity, Soaps, Suspended solids, and Turbidity
Bath tub and shower	Bacteria, Hair, Hot water, Odor, Oil and grease, Oxygen demand, Soaps, Suspended solids, and Turbidity
Evaporative Cooler	Salinity
Sinks, including kitchen	Bacteria, Food particles, Hot water, Odor, Oil and grease, Organic matter, Oxygen demand, Soaps, Suspended solids, and Turbidity
Swimming Pool	Chlorine,

Treating Greywater :

Grey water treatment includes settling tanks, disinfectants and filters.

Grey water Treatment Scheme
Raw grey water
Primary treatment
Screening
Equalization tank
□□
Secondary treatment-I
Gravel filter
Sand filter
□□
Secondary treatment-II
Broken brick
Charcoal
Chlorination
□□□
Treated grey water

Tanks

In a settling tank, solids and large particles will settle to the bottom, while grease, oils, and small particles will float. The remaining liquid will be reused. A settling tank also allows hot water to cool before reuse. The tank should be large enough to hold twice the expected daily flow plus 40 percent, to allow for sludge accumulation and surge loading. One type of settling tank well-suited for grey water treatment is a septic tank. A septic tank is specifically designed to allow settling, but do not confuse the use of a septic tank to treat grey water with the conventional use of a septic tank. Grey water intended for reuse should never be mixed with toilet wastes.

Grey water coming out of a septic tank contains little or no oxygen. Grey water from an aerobic tank will contain more oxygen, which is better for irrigation purposes. An electrical pump or aerator added to a septic tank can create an aerobic environment. Aerobic conditions allow some decomposition of wastes in the tank, and may help minimize sludge build-up and blockages in the system. Both aerobic and septic tanks will need to be pumped out every three to five years.

Several types of tanks may be suitable for settling or storage of grey water. In addition to metal, polyethylene, fibreglass or wooden tanks that are commonly used.

Filters :

The type of filter required for a grey water system depends largely upon the amount of grey water to be filtered and the type of contaminants present[3].

Many types of commercial water filters are available. Most use an activated charcoal, cellulose, or ceramic cartridge that must be cleaned or replaced regularly. Slow sand or multi-media filters are usually built by the homeowner. These gravity filters may be constructed in a 55-gallon drum or similar container that is of suitable size. Features that should be part of a filter include a perforated plate or some other device to distribute water evenly over the top, a concrete funnel in the bottom to help water drain to the perforated drain pipe, and a cover and vent to prevent odours. Fill the bottom of the filter with stones that are too large to enter the drain pipe.

Slow sand filters are shallow layers

of stone, medium gravel, and pea gravel beneath a deep layer of sand. Filtration was followed due to their advantages mentioned below:

Easy operation and maintenance
Economical
Provides extensive physical treatment
Treated grey water is of better quality
Use of locally available filter media
No requirement of external energy source
Anaerobic process require a methogenic state to complete the destruction of Vegetable fatty acids and removal of ammonia

Efficiency of slow sand filters :

The normal rate of flow in slow sand filters may be between 100 to 200 litters per hour per square meter of the filter area. They are highly effective in the removal of bacterial load from water. They are expected to remove 98 to 99% of bacteria in water, under normal conditions. However operated at slower rates or with some preliminary treatment and chlorine, the overall bacterial efficiency may reach 99.5 to 99.9%, and the removal of coliforms is equally high. The slow sand filter is not effective in removing colloidal turbidity. The slow sand filters will not successfully remove turbidity over 50 rpm. For water having higher turbidity, preliminary treatment for turbidity reduction is essential.

Disinfection :

Two chemicals used to disinfect water are chlorine and iodine, with chlorine being more common. Not only is it readily available (as household liquid bleach or at swimming pool supply houses) and relatively inexpensive, but it is stable in storage and will, in time, vaporize from the water after disinfection. Organic material in grey water may combine with chlorine, and reduce the amount available for disinfection. For this reason, a filter or settling tank before the disinfection point may be advisable.

Iodine is less affected by organic material, persists longer, and may be more effective at the high pH of grey water. Iodine is also fast-acting, requiring no more than two minutes to kill most pathogens.

Ultraviolet (UV) light :

Typical UV disinfection systems involve the flow of water through a vessel containing a UV lamp. As the water passes through the vessel, microorganisms are exposed to intense ultraviolet light energy which causes damage to genetic molecules (*i.e.* nucleic acids: DNA 21 or RNA) needed for reproductive functions. This damage prevents the microorganism from multiplying or replicating in a human or animal host. Because the microorganism cannot multiply, no infection can occur. Disinfection of water is achieved when UV light causes microbial inactivation.

Uses of Grey water :

Grey water recycling is ideally suited to hotels, Old aged homes, leisure centres, large office and residential blocks as it recycles water used in baths and showers to flush toilets and irrigate gardens. Grey water is suitable for irrigating lawns, trees, ornamentals, and food crops. Though irrigation methods in greenhouses may differ greatly from outdoor irrigation, several guidelines for use of Grey water apply to both situations.[4]

- Apply Grey water directly to the soil, not through a sprinkler or any method that would allow contact with the above-ground portion of the plants.
- Root crops which are eaten uncooked should not be irrigated with grey water.
- Plants that thrive only in acid soil should not be watered with grey water, which is alkaline.
- Use Grey water only on well-established plants, not seedlings or young plants.
- Disperse Grey water over a large area, and rotate with fresh water to avoid build-up of sodium salts.

Toilet flushing can use considerable amounts of grey water, as it normally accounts for up to 50% of indoor water use. Poor quality grey water is not a problem if it is used to flush toilets, because the water goes into the sewer or septic system where it would have gone had it not been reused.

Untreated grey water should not be kept for longer than one day, but adding two tablespoons of chlorine bleach per gallon of water will extend storage time somewhat. Try to use grey water the day it is collected or the high bacteria count will cause objectionable odors.

Precautions when using untreated grey water:

- Grey water containing sodium, bleach or borax can damage plants. For this reason, water from automatic dishwashers should not be used for irrigation.
- Water used to wash cooking utensils in the sink may contain grease, fats and oils, and is not acceptable for grey water use.
- If you plan to use water from your washing machine, avoid liquid fabric softeners and detergents with softeners. Use a dryer fabric softener sheet instead.

Benefits of grey water recycling :

- Grey water recycling saves water and reduces the amounts of fresh, high-quality drinking water by substituting the water demand not intended for drinking.
- On-site grey water treatment reduces the volume of wastewater that must be diverted to more costly sewage and septic treatments
- Grey water is a valuable resource for landscaping and plant growth especially in arid climates.
- Grey water contains one-tenth the nitrogen content of black water of which half of it is organic and more easily filtered and removed by biological uptake in plants.
- Grey water is rich in phosphorous, potassium, and nitrogen, making it a good nutrient or fertilizer source for irrigation.
- Localized grey water systems decrease freshwater use for transportation and treatment of wastewater.
- The use of grey water for irrigation reincorporates nutrients from the waste stream into the land-based food chain, rather than contributing to surface and ground water pollution via sewers and septic systems
- Grey water diversion is particularly well-suited for small-scale or decentralized wastewater systems and can be implemented in either a rural or urban setting.

Conclusion

Grey water recycling has the potential to save a third of the domestic mains water usage. If the property is metered, this will

reduce the water bill. The resulting financial savings will depend both on the price of water in the area and the amounts of water reused. This in turn will reduce the pressure on the fresh water resources and reduce the quantity of discharged wastewaters.

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