

# Review Studies on Grey Water Treatment

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**ABSTRACT:** Water crisis is increasing day by day due to adverse effects of climatic changes worldwide. Scenario of water crisis shows that it is very difficult to cope up with today's natural resources as there is increasing crunch in availability of water and in improper implementation of water shed management techniques. Hence it is a need of hour to develop new methods for water management and storing the natural available water. The contribution of household grey water to the total organic load calculated as Biological Oxygen Demand content for 5 days; is about 35 to 60 percent in average. It is found out that grey water also contributes to TDS and total phosphorus content, nitrogen content, oil and grease content in water. If recycled properly, grey water can be effectively reused for irrigation, laundry and toilet flushing purposes and some non potable use. It is observed that grey water can effectively contribute to sustainable water management. Present review study highlights different techniques for grey water treatment.

## INTRODUCTION:

Waste water if recycled properly can become a significant source of useful water, and potential sources for urban reuse are sewage, rainwater and grey water (1,2,3). Grey water is domestic waste water discharged from household activities. Sources of grey water includes water runoff from kitchen sinks, dishwashers, washing machines, floor cleaning waste water, bathtubs, shower bath waste. It commonly contains soap, shampoo, toothpaste, food scraps, cooking oil, detergents and hairs etc. Grey water is different from black water as black water includes sewage water which is rich in different types of faecal and some typical chemical compounds from urine pathogens. Thus water effluents from domestic equipments other than toilets is called greywater. Kitchen sink water as it contains food solids, and also laundry water are more heavily contaminated than those coming out from showers and bathroom sinks. Typically 50-80% of household wastewater consists of grey water. Characteristics of grey water strongly depend on standard of living, social and cultural habits, use of chemicals for domestic use, number of members using domestic water. Hence depending upon the sources, different treatment methods may require that would render water suitable for reuse. Grey water treatment is utilized as a treatment process for non-potable reuse of water. Grey water can be available as an additional and continuous water source and can be effectively implemented as reliable resource of water as it does not depend upon total rainfall but depends only upon the consumption of fresh water. Hence, as a solution on the problem of water crisis, it becomes mandatory to develop water treatment techniques like grey water treatment.

## OBJECTIVE OF STUDY:

- To study techniques available for reuse of water.
- To study techniques for reducing amounts of fresh water consumption.
- To study different techniques available for Grey Water Treatment

## 1. COMPOSITION , COLLECTION AND REUSE OF GREY WATER :

To study composition of grey water, Total Suspended solids, Biological Oxygen Demand, Chemical Oxygen Demand, Total Phosphorous content, Total Nitrogen Content, Total Coliforms and E. Coli should be determined. In terms of microbial contamination, contamination with faecal coliforms is generally low as such, the risk to contract diseases when greywater is used for several purposes without any prior treatment is very minimum. Organic load in greywater is very less about 30%, and 9 to 20% nutrients.(5)

Greywaters from baths, showers, wash basins, and washing machines has to be collected separately from blackwater, it is to be treated, disinfected and should be reused for non potable purposes. Depending upon the source, grey water reuse may be cheaper as just bucketing, or may be costly as installing automatic grey water diversion, treatment, distribution and irrigation systems are required. Most commonly applied is garden irrigation, car washings where immediate after bucketing, grey water can directly reused(6). In advanced systems, collection is followed by filtration, and then followed by treatment and application.

Treatment technologies which includes treatment and recycling of grey water have been reported in earlier studies(7..10). These technologies were mainly based on mainly physical and disinfection treatments in which grey water samples were allowed for coarse filtration and then followed by disinfection. To control the quality of treated effluent for reuse, no international regulations have been published and standards are developed on the basis of countries needs. By considering purity of recycled water as the main risk factor, these techniques included testing of microbial content. Due to these considerations, the standards includes the treatment of organics and solids. Hence it become necessary to determine Biochemical Oxygen Demand(BOD), Total Dissolved Solids (TDS), Suspended Solids (SS), and Turbidity.

## COLLECTION OF GREY WATER:

Greywater collection can be achieved by applying either of the two systems,

a) Centralised system, b) Decentralised system. In the Centralised system, greywater is collected from several houses or several buildings or housing complexes and are allowed to enter to a treatment plant outside the building or in the nearby vicinity. In the Decentralised system, greywater collected from either a single house or multiple houses is treated inside the house by applying distribution pipes for collection. Hence it exhibits more investment and higher maintainance costs while centralized systems requires a larger space. However, regardless of the system, separate greywater plumbing is mandatory for both types of systems. The choice of the system depends upon several factors such as, Planned Site, Available Space, Need of the citizens etc. According to Nolde 2005, Grey water treatment involves mainly following steps : i) A Primary Treatment Tank , ii) A Secondary Biological Treatment Tank or Aeration Stage, iii) Ultra Violet Disinfection Stage, iv) Storage Tank and,v) Water Pumping System. A scheme for greywater system can be mentioned as Water from different sources like irrigation, house cleaning, bath shower, hand wash basins, washing machines, kitchen sinks are collected through separately plumbed pipes and are stored in the storage tank. Then after filtration, and sedimentation it is allowed to pass for oxidation through bioreactors (4) like biological aerated filters, or membrane bioreactors or rotating biological contractors for aeration. It is then disinfected through UV disinfection or Chlorination, which is then stored in storage tank. In this storage tank where treated grey water is stored, extra or wasted drinking water is also stored. Finally, treated and disinfected grey water can be used for different non-potable purposes.

## GREY WATER TREATMENT TECHNIQUES:

Once collected, grey water is allowed for further treatment depending upon its composition and required treatment. These techniques mainly includes, Simple Treatment Systems, Chemical Treatment Systems, and Physical Treatment Systems and Biological Treatment Systems.

### 1. SIMPLE TREATMENT SYSTEM

Simple Treatment Systems involves two stage treatments viz; Sedimentation with Coarse Filtration; followed by Disinfection. Simple Treatment System involves treatment for organics and solids. Average removal of 70% of COD, and near about 50 % removal of suspended solids can be done through Simple treatment systems. Due to such limitations, Chemical treatments and physical treatments are more preferably used even though simple systems possess low operational costs. It was still observed that effect on removal of microorganisms is quite useful with very less number of total residual coliforms in treated effluents. Simple Treatment System however are applicable only for small number of household systems.

### 2. CHEMICAL TREATMENT SYSTEM

Chemical Treatment involves mainly coagulation with chemicals like aluminium salts, Ferric salts, activated carbon etc. Main principle behind chemical treatment is flocculation or coagulation which removes total solids including Total Organic Carbon. To remove Total Organic Content, advanced oxidation treatment is also applied in which, UV radiations and titanium dioxide is used. By applying Chemical Oxidation Treatment, 90% of Turbidity, and 80% of Total Organic Content can be removed. 82% reduction in TOC is observed within few minutes after combined treatment with  $\text{TiO}_2$ / UV. The rate of oxidation reaction has been observed to be independent of TOC content and  $\text{TiO}_2$  concentration (10). The different applications reported were for toilet flushing, irrigation or garden watering, outdoor use and cleaning, laundry etc.

### 3. PHYSICAL TREATMENT SYSTEM

Physical Treatment System involves mainly filtration techniques. Filtration can be carried out by two ways, a. Sand filtration b. Membrane filtration or filtration using activated charcoal (11, 12, 13.). Sand filtration provides coarse filtration of the grey water eventhough it achieves limited treatment of different fractions present in the grey water. Itayama studied treatment of grey water by coarse filtration on kitchen sink water with high contents of organic matter, has reported 67% for removal of Biochemical Oxygen Demand and 78% removal of suspended solids with residual concentrations of 166 and 23 ppm of both respectively (14). Many researchers have reported upto 100% removal of turbidity and suspended solids with residual concentrations below 2NTU and below 10 mg/L of turbidity and SS respectively (8, 15, 16). It was reported by (Nolde 10); that a rotating biological contractor preceded by a sedimentation tank and followed by UV disinfection can be effectively applied for treatment of grey water. Similarly, Friedler (17) reported the use of a 1mm screen and disinfection with hypochlorite respectively before and after applying a membrane bioreactor. Grey Water treatments can be grouped into five categories as Simple (includes coarse filtration and disinfection); Physical (includes sand filter, adsorption and membrane); Biological (includes biological aerated filters, rotating biological contractor and membrane bioreactor), extensive (constructed wetlands) and Chemical (includes photocatalysis, electro-coagulation and coagulation). These technologies are mostly work in the sequence as Screening or Sedimentation stage prior and then a Disinfection stage with using either UV or Chlorine followed by it later.

**CONCLUSION :**

Water crisis is becoming a severe and a threatening problem worldwide with increasing population, industrialization and manmade pollution increasing activities. Water storage and water shed management is the only solution to overcome this alarming situation. Water Crisis has reached to a stage for considering an important reason for wars between several countries. Grey water recycling has proved tremendously advantageous as it has the potential to save one third amount of the domestic mains water usage. Similar to the techniques like, Rain Water Harvesting, Roof Top Water Harvesting; Grey Water recycling is also a need of an hour and can be effectively implemented as a solution on the severe problem of water crisis. It becomes more advantageous as it does not depend upon the total or annual rainfall. Other than this, Grey water treatment and its recycling has a large number of benefits such as it reduces the need of amounts of fresh, high quality drinking water by substituting water demand not intended for drinking. It reduces a large amount of waste water run off to sewages which is the main and important reason for ground water runoff and ground water wastage. Grey water treatment techniques, and grey water treatment plants are cost effective and thus are economically viable for easy use by public. Treated grey water helps in agricultural and plantation development as grey water is rich in nutrients like nitrogen, phosphorous and potassium. Accordingly, it can be used as a rich source of organic fertilizer. Thus, it contributes directly to Green Technology and effectively implemented for sustainable development.

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