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CHEMISTRY OF GRAY WATER-QUALITY ASSESSMENT AND STRATEGIES FOR REUSE

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Research Guide

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Abstract

Graywater is the wastewater generated in the bathroom, laundry and kitchen. Graywater is therefore the component of domestic wastewater, which has not originated from the toilet or urinal. In general terms, gray water has lower concentration of organic matter, nutrients and microorganisms. The concentration of phosphorus, heavy metals and xenobiotic organic pollutants are around the same levels. The pollutants of gray water are reduced by a natural treatment system (laboratory scale) was the aim of this study. This thesis are to asses the

potential reuse of grey water by which to reduce the load of fresh water in the rural region. This is a socio-economical treatment method gives the wide significant in the rural development.

Introduction

With increasing global population, the gap between the supply and demand for water is widening and is reaching such alarming levels that in some parts of the world it is posing a threat to human existence. Alternative sources of water can potentially save significant amounts of precise fresh water. One alternative source of water is gray water. Scientists around the globe are working on new way of conserving water. It is an opportune time, to refocus on one of the technique to recycle water through the reuse of gray water by economical way. Gray water is non-industrial waste water generated from domestic processes such as washing dishes, laundry and bathing. Gray water is distinct from black water in the amount and composition of its chemical and biological contaminates (from feces or toxic chemicals). Dish, shower, sink, and laundry water comprise 50-80% of residential wastewater. Gray water treatment is an environmental friendly process as a control of water pollution. Many people have investigated the various waste water treatment methods extensively on the international and national levels and many researchers tried to reduce the cost for recycling of the water. The household gray water can be reused for other purposes, especially landscape irrigation, floor washing, car washing and toilet flushing. Grey water has some pollutants that are considered as fertilizer for the plants. Phosphorous, nitrogen, and potassium are excellent sources of nutrients when reusing gray water for irrigation of landscaping and gardens. Benefits of grey water include using less fresh water, sending less waste water to septic tanks or treatment plants, less chemical use, groundwater recharge, plant growth, and raises awareness of natural cycles. Throughout the world, supply of water to the rural population has been a challenging risk. In India, the 'water shortage' is one of the major issues coming from the

rural area. Due to this, the government of Andhra Pradesh has designed and constructed a number of slow sand filtration for rural water supply schemes in the state. Our designed gray water treatment process is like a low technology systems, also called extensive or natural systems, are based on the imitation or adaptation of processes that occur naturally in soils and water bodies. The various conventional intensive technologies are in competition with natural systems to treat the gray water of medium and small size communities. In big cities, the sophisticated technologies are used by authorities and plants operated by highly skilled personnel to abide by discharge regulations and prevent the failure that could damage the environment. Large town can afford high treatment expenses, which is not the case for rural communities. Experiences of treating gray water by natural treatment systems have not been widely reported. In general terms, gray water has lower concentration of organic matter, nutrients and microorganisms. The concentration of phosphorus, heavy metals and xenobiotic organic pollutants are around the same levels. The pollutants of gray water are reduced by a natural treatment system (laboratory scale) was the aim of this study. This is a socio-economical treatment method gives the wide significant in the rural development.

Materials and Methods

Laboratory scale gray water treatment plant was designed for 180 lit/hr capacity restricted four stage physical operations such as primary settling with cascade flow of water has 20 liters capacity, aeration has 15 liters tank capacity, agitation has also 15 liters and filtration unit of 20 liters. The sources of the gray water was collected from bathrooms, basins and laundries in residential rural area in a tank and sent to the primary settling unit by the 0.5 HP pump. The flow rate of feed raw water was controlled by the manual control valve. The gravitational force was used for the flow of water from primary settling tank with 04 steps of cascade system to the aeration, agitation and filtration unit to the storage tank. The 0.18 m diameter agitator and 0.125 HP motor was used in the agitation operation. The easily available and natural materials were used as filter beds in the filtration unit such as fine particles (equal size) sand bed, course size bricks bed, charcoal bed, wooden saw dust bed and bed of coconut shell covers. The bed height of each material was determined and finalized by the experimentation. The

samples were collected from raw water and from each stage for the analysis. These samples were analyzed by standard method for water and waste water analysis at environmental laboratory. The parameters such as pH, total dissolved solids (TDS), total suspended solids (TSS), chemical oxygen demand (COD), total hardness and oil and grease contained in gray water were determined for each samples. Additionally, parameters like ammonia nitrogen (NH4-N), fluorine (F), Chlorine (Cl), nitrites (NO2), nitrates (NO3), phosphates (PO4), sulphates (SO4), sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca) were determined of raw and treated water sample for the performance study of the plant. The natural materials such as sand, bricks, charcoal, saw dust and coconut shell covers were used as an adsorbent in the filtration unit. The sample of water was taken before and after filtration with varying bed height of each filter bed and found the positive effect on the pH level at 2 lit / min (LPM) of water flow rate. The filter bed of coconut shell cover and charcoal were given the maximum effect on the pH level from 8.23 to 7.88 and the minimum effect found for the bed of bricks. The bed of sand and saw dust material were found the fair change in the pH level 8.23 to 8.16. The deviation in pH by each filter bed was found because each filter bed having the different capacity of adsorption of ions. For the further experiment the depth of each bed were selected as 0.15 m, 0.1 m, 0.2 m, 0.15 m and 0.2 m for sand, bricks, charcoal, saw dust and coconut shell covers respectively set from bottom to top in the filtration unit based on the pH level effect. The maximum pH effect found by the coconut shell covers bed was kept at top in the filtration unit. The samples of raw gray water i.e. before cascade stage and final filtered water i.e. after filtration stage were taken with varying flow rate of water. The characteristics parameters of gray water such as TDS, TSS, COD, total hardness, oil and grease were determined and all these are pretentious by the flow rate of water after the flow rate of 2.5 lit/min. The gray water average organic load removal was found 84 % at the water flow rate of 2.6 lit/min. The removal capacity of organic load of gray water was decreased by raising flow rate of gray water. The results show the 100% removal of oil and grease from the gray water only up to the 2.5 lit/min. water flow rate. The input and output flow rates of water were nearly found the equal rates because there were no accumulations of gray water. The time required for 2.5 lit/min flow rate was 105 sec from input to output of the plant which was the departed time of plant operation. The gray water was collected from the bathrooms, basins of the residential area of college hostel located at Sinnar rural area in Nashik city, India. Total 08 samples of gray water were taken at first day of morning and evening of every week and the performances of system were investigated. The average organic load in gray water found 327 mg COD/lit. The solids in gray water were found to have about 76% dissolved and 24% suspended particles. The average 83 % of organic load was removed and the 46 % anions and 49 % cations were found to be adsorbed by the natural adsorbents used in filtration. The traces of potassium, magnesium and calcium were found and removed fully from gray water.

Result and Discussion

Based on finding of this study, this treatment technology can be considered as a viable alternative to conventional treatment plants in rural region since they are characterized by high potential for COD, TDS, TSS, total hardness, oil and grease, anions and cations removal. The benefits found are low energy demand, less operating and maintenance cost, lower load on fresh water, less strain on septic tank, highly effective purification, and ground water recharge. Hence, this is an environmental friendly, without chemical operation, cost effective and resourceful plant for rural development. The gray water contains harmful chemicals. Sodium, potassium and calcium are alkaline chemicals. Because of the presence of these chemicals in laundry detergent, gray water use tends to raise alkalinity of the soil. Slightly alkaline soils will support many garden plants. Even most acid-soil loving plants will be happy with slightly alkaline soils that are generously amended with organic matter. The pH of an acid soil is 6.9 or lower while that of an alkaline soil is 7.1 or higher. If a simple pH test indicates that the pH

reading is over 8.0, the pH should be reduced. A sandy, well-drained soil will be less affected by the application of gray water than a poorly drained clay soil. To correct these problems and keep soil healthy, the treatment before irrigation of gray water is necessary. To study the effect of treated water on plant growth, we have applied the treated water to the garden plants continuously for one month. It is observed that:

. Plants grow normally by applying treated water.

. There is no effect of treated water on plant

. The concentration of salts, detergents and minerals are reduced, so there no potential for adverse impacts on the soil and plants.

. There is sufficient level of phosphorous present in treated water which is good for plant growth.

. pH of the treated water reduces up to 7.3 to 7.5, so alkali loving plant are not affected.

The cost effective Graywater treatment plant is a very important in the rural region. The capital cost, energy cost, operating cost and maintenance cost of the pant are considered in economy of the plant. The main objective of the Graywater reuse system is to satisfy the water related needs to the community at the lowest cost to the society whilst minimizing the environmental and social impacts. Thus the financial aspect focuses on two types of the costs mentioned below:

. Capital costs of Graywater reuse system

. Operation and maintenance cost of the Graywater reuse system

The Cost Benefit Analysis (CBA) considers the capital cost, maintenance and operating costs of Graywater reuse systems against the savings in particularly potable water uses for such purpose.

Cost savings for the Cost Benefit Analysis (CBA) were benchmarked against the calculated potable water cost savings of reusing Graywater for the college campus applications such as toilet flushing, garden watering and floor washing. From this the payback period was found nearly 2.2 years.

Conclusion

The present study demonstrate the reuse and treatment of residential bathrooms, basins waste water called as gray water for the purpose of landscaping, gardening, irrigations, plant growths and toilet flushing. Based on finding of this study, this treatment technology can be considered as a viable alternative to conventional treatment plants in rural region since they are characterized by high potential for COD, TDS, TSS, total hardness, oil and grease, anions and cations removal. The benefits found are low energy demand, less operating and maintenance cost, lower load on fresh water, less strain on septic tank, highly effective purification, and ground water recharge. Hence, this is an environmental friendly, without chemical operation, cost effective and resourceful plant for rural development.

References