STUDY OF ENVIRONMENTAL IMPACT OF CHEMICAL BASED PRODUCTS ON GREY WATER

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Abstract

Declining natural resources and increasing environmental contamination due to human activities trigger people to consider a sustainable way to solve two problems in a solute practice. In India, numerous households discharge greywater straight into surface water, polluting the water and surrounding ecosystem. Water scarcity has become a big issue. Today in the growing world the demand of water is increasing and also water pollution is also increasing. As the population grows, so does the demand for water. On the other hand, the amount of potential water resources is declining nationwide, resulting in high pollution levels and requiring the high cost of water treatment to purify the water. To reduce the pollution load as well as to provide alternative water for indoor and outdoor use, it is necessary to find the most effective treatment. Grey water coming from household was collected and treated in laboratory scale experimental model. The model is based on the concept of STABILIZATION and Up flow-down flow. The small-scale device was built for grey water cleanup, and laboratory reports of several parameters are compared. According to report, there has been a drop in pH, BOD, COD, Total Solid, Conductivity, Chloride, levels, total removal of oil and grease, and a reduction in total dissolved solids, Nitrogen, & micro biological like MPN, E-COLI. among other things.

Keywords: Bio-Chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Stabilization Tank

1. Introduction

1.1 Importance of water

Water is our lifeline, allowing us to bathe and eat. Water is believed to be the very source of life in ancient cultures. With their aqueducts, the Romans were the first to pipe water into their expanding towns. They also realized that sewage water could harm their people and that it needed to be removed from heavily populated regions. Water has had a part in religion, mythology, and art, as well as in the history of countries. In many religions, holy water is used to purify the soul. As it rained from the heavens, water has always been seen as a gift from the god. The water crisis is a global issue that does not affect just one country. Water contamination has been an unavoidable result of humanity's strong desire to improve living conditions through increased efforts and activities manifested as heavy industrialization and persistent urbanization, which has resulted in progressive aquatic system pollution. Humans are completely reliant on renewable fresh water for drinking, crop irrigation, and industrial use such as production, transportation, recreation, and waste disposal. The volume and quality of water available to suit human requirements is already limited in many parts of the world. Climate change, increased water usage, and population growth will expand the gap between freshwater availability and demand in the future century.

Out of all the total water on earth, salt water in oceans, seas and saline groundwater makes up about 97% of it. Only 2.5–2.75% is fresh water, including 1.75–2% frozen in glaciers, ice and snow, 0.7– 0.8% as fresh groundwater and soil moisture, and less than 0.01% of it as surface water in lakes, swamps and rivers. Freshwater lakes contain about 87% of this fresh surface water.

As the year draws to a close, the world's population, pollution, industrialization, and, ultimately, water consumption will rise. In 1989, the amount of available fresh water per person per year was around 9,000 m3. By the year 2000, this figure had fallen to roughly 7800 m3 per person. The amount of water per person is anticipated to drop to 5,100 m3 by 2025, as the global population rises from 6 billion to over 8 billion people. More than a billion people on the planet do not have access to safe drinking water. If current trends continue, the demand for fresh water is predicted to exceed the amount already available by 2025.

1.2 Grey water

Grey water gets its name from its hazy appearance and it falls between fresh, drinkable water (also known as “white water”) and sewage water (also known as "black TA water”) Showers, bathtubs, washbasins, washing machines, and kitchen sinks all produce grey water. If untreated, kitchen wastewater is not advised for use as grey water. Grey water does not include toilet, urinal, or bidet effluent. This is known as black water (water containing human excrement). Grey water can be collected from any or all of these sources and treated before being utilized for non- drinking water uses around the house, such as toilet flushing or garden watering.

1.2.1 Sources of grey water

The grey water is outcome of the household activities, and its characteristics strongly depend on the living standards, social and cultural habits, household members and the use of household chemicals.

1.2.1.1 Grey water from bathroom

Water used in hand washing and bathing generates around 45-50% of total grey water. Bathroom greywater is thought to be the least contaminated source of greywater in a home. Soaps, shampoos, toothpaste, and other personal care items are available. Shaving waste, skin, hair, body lipids, lint, even residues of faeces and urine are also found in bathroom greywater. As a result, pathogenic germs may be present in greywater from showers and baths.

1.1 Aim

To carry out feasibility study of grey water using up flow – down flow "Study of

Environmental impact of chemical based products". This overview will focus on the use of grey water for domestic purposes without compromising public health and how to maintain and enhance the quality of the environment by setting minimum standards for the design and installation of grey water reuse systems. This study is also useful for architects to implement this model in their design.

1.2 Objectives

1. To study the need of low-cost technologies.
2. To develop a lab scale model with up-down vertical motion of grey water for grey water treatment.
3. Treated grey water do not harm the environment, or cause a nuisance, and are appropriately sited and maintained according to a regulatory standard.
4. To check structural modifications and to compare cost aspects for implementing the project.
5. Implementation of model in building design.
6. To reduce load on STPs (Sewage Treatment Plants) & ETPs (Effluent Treatment Plants), reduction in collection and conveyance cost of waste.
7. To create stabilization models for settling solids & flow clear water for multipurpose.

2. Literature Review:

1. Title: “A Review on Grey Water Treatment and Reuse” Authors: Karnapa Ajit

Review:

Increasing water demand due to the exponential growth in population has led to the idea of using waste water as a source of water. Immense technological advancements have been made in the field of waste water engineering which helps in separating various types of solids from waste water. Identification of the reuse potential of different types of waste water thus facilitates in treating them at source and using them for various beneficial purposes. Grey water, a mixture of waste water from kitchen, laundry and bathroom is such a source which due to its less organic and coliform content compared to mixed sewage may be treated and reused for purposes like landscape irrigation, agriculture, toilet flushing and ground water recharge. The current paper looks at the reuse possibilities of grey water by studying the characteristics and available treatment options of grey water.

2. Title: “A review of grey water characteristics and treatment processes” Authors: Yash Boyjoo, Vishnu Pareek, Ha Ming Ang

Year: April 2013

Review:

This paper presents a comprehensive literature review of different characteristics of greywater (GW) and current treatment methods. GW is domestic wastewater excluding toilet waste and can be classified as either low-load GW (excluding kitchen and laundry GW) or high-load GW (including kitchen and/or laundry). This review provides information on the quantity of GW produced, its constituents (macro and micro), existing guidelines for wastewater reuse, current treatment methods (from storage to disinfection) as well as related costs and environmental impacts. Moreover, some successful examples from various countries around the world are examined. The current preferred treatments for GW use physical and biological/natural systems. Recently, chemical systems like coagulation, adsorption and advanced oxidation processes (AOPs) have been considered and have been successful for low to moderate strength GW. The presence of xenobiotic organic compounds (XOC), which are hazardous micropollutants in GW, is emphasised. Since conventional treatments are not efficient at removing XOC, it is recommended that future studies look at chemical treatment, especially AOPs that have been found to be successful at mineralising recalcitrant organic compounds in wastewater.

3. Title: “Characteristics and treatment of greywater—A review” Authors: Dilip Ghaitidak, Kunwar Yadav

Review:

Safe and sufficient quantity of water is necessary for a healthy growth of human beings. The gap between water demand and available water supply is increasing day by day. Proper sanitation, especially decentralized approach, can solve the problem of water supply and wastewater management and that can be done by reuse of greywater. Typically, from a household, greywater (GW) flow is around 65 % of the total wastewater flow. Further light greywater is around 50 % of the total GW. Hence, GW has a high potential for recycle and reuse. The aim of this article is to reveal the present state of art in GW treatment and to identify the further scope for research. Present article contains a review on per capita GW generation, GW characteristics, and its treatment. Around 22 treatment systems comprising different treatment processes are discussed in detail for removal efficiency of pollutants, effluent concentrations and their compliance with wastewater reuse guidelines and standards. Constructed wetland and filtration were found efficient in the removal of most of the reuse parameters compared to other technologies. Anaerobic followed by aerobic system with post- disinfection unit may be a sustainable option for GW treatment for reuse. There is a need to develop the technologies for GW treatment at household level to increase the reuse practises at grass root level. Further, there is need of development of flow diagram with different technologies by targeting the type of reuse (flushing, gardening, agriculture, etc.).

4. Title: “Review of nature-based solutions for grey water treatment”

Authors: Fulvio Boano, Alice Caruso, Elisa Costamagna, Luca Ridolfi, Silvia Fiore, Francesca Demichelis, Ana Galvao, Joana Pisoeiro, Fabio Masi

Year: August 2019

Review:

In this literature review Nature based Solution for grey water treatment is discussed. One of the most critical limits to the application of Nature Based Solutions in densely built urban areas is the lack of available space. Grey water may represent up to 75% of total domestic WW. Treatment of grey water using Constructed wetlands, green roof and green wall is explained in detail. In particular, the reviewed data about green walls and green roofs showed that a high removal efficiency in terms of organic matter can be obtained in systems with hydraulic loading rates up to 800 L/sq. m/day. The mentioned data provide a broad indication that values of HLR up to 500 L/sq. m/day can be employed in green walls and green roofs irrigated with greywater without reducing the removal efficiency for the parameters considered in this analysis. But finally concluding that most of the research is available in Constructed wetland.

5. Title: "Review of the greywater and proposed greywater recycling scheme for agriculture irrigation reuses"

Authors: Abeer Albalawneh, Tsun-Kuo Chang

Review:

In this study, we reviewed grey water characteristics and various treatment technologies with the aim of coming up with the schematic of grey water recycling system designed specifically for restricted agricultural irrigation reuse. Characteristics of grey water are highly variable; grey water amount varies from 50% to 80% of the wastewater volume produced by households. All types of grey water show good biodegradability in terms of COD: BOD5 ratios. The ratio of BOD5/COD in grey water ranged from 0.31 to 0.71. Most countries apply the same standards to reclaimed municipal wastewater as they do to grey water. However, some countries have established specialized standards for grey water reuse. Technologies used for grey water treatment are classified into physical, chemical, biological, and natural systems, or a combination of these. Using physical grey water treatment processes solely as the main treatment method is insufficient for grey water treatment, chemical grey water treatment processes are attractive for single household low-strength grey water treatment systems, as the variability in the strength and flow of the grey water did not affect their treatment performance. Constructed wetland can be regarded as the most environmentally friendly and cost-effective technology for grey water treatment and reuses. Finally, the study suggests the possible grey water recycling scheme for agricultural irrigation reuse purposes.

6. Title: "A New Technology Gets Ready to Bloom" Authors: J. Bishop

Year: May-June 1997

Review:

Phytoremediation is the process of extracting or promoting the breakdown of harmful chemicals in soils, groundwater, surface water, wastewater, and sediments using specially selected agricultural plants or trees. In some situations, it may be able to harvest pollutants such as heavy metals that have been absorbed by plants and recycle them. Plants can also boost the establishment of naturally occurring microbial communities, which then decompose organic pollutants in soils like petroleum hydrocarbons. The cost of adopting phytoremediation techniques at appropriate sites might be half to less than 20% of the expense of using physical, chemical, or thermal treatments.

7. Title: “Technology Evaluation Report: Phytoremediation”

Authors: Schnoor, J. L. Ground-Water Remediation Technologies Analysis Center Year: October 1997

Review:

Phytoremediation is most effective when organic, nutritional, or metal contaminants are present in small amounts. Phytoremediation is well-suited for use at large field sites where other remediation methods are not cost-effective or practical; at sites with low concentrations of contaminants where only "polishing treatment" over long periods of time is required; and in combination with other technologies where vegetation is used as a final cap and closure of the site. The technology has limits that must be carefully considered before it is used for site rehabilitation. Limited regulatory approval, long periods of time required to clean up to below action levels, potential contamination of the vegetation and food chain, and difficulties establishing and sustaining vegetation at some toxic waste sites are some of these issues. This comprehensive research examines the present state of phytoremediation for soil and groundwater treatment. Participants, substances handled, site characteristics, results, and contacts are all listed in several field demonstration summaries.

8. Title: “Technology Overview Report”

Authors: Miller, R. Groundwater Remediation Technologies Analysis. Center, Pittsburgh Year: 1996

Review:

Phytoremediation makes use of plants' inherent capacities to absorb, collect, and/or degrade elements of their soil and water habitats in order to clean up contaminated soil and ground water. According to research, it may be used to detect a wide range of contaminants, including metals, radionuclides, and organic chemicals (including chlorinated solvents, BTEX, PCBs, PAHS, pesticides/insecticides, explosives, nutrients, and surfactants). Based on the data gathered. Huge regions of low to moderate surface soil pollution (0 to 3 feet) or large volumes of water with low-level contamination subject to low (stringent) treatment regulations are common site circumstances that lend themselves to phytoremediation. The likelihood of generating fewer secondary wastes, minimum related environmental disturbance, and the ability to keep soils in situ and useable condition following treatment are the four major advantages indicated for phytoremediation as compared to standard remediation procedures. Long periods of time (typically many growing seasons) are required, as are depth restrictions (3 feet for soil and 10 feet for ground water), and the risk of contaminant entry into the food chain through animal eating of plant material.

9. Title: “Phytoremediation Field Demonstrations in the U.S.” Authors: EPA SITE

Program Rock, S. and Beckman Year: 1998

Review:

The SITE programme of the United States Environmental Protection Agency's National Risk Management Research Laboratory is assessing phytoremediation's efficacy and cost at field scale demonstrations in Oregon, Utah, Texas, and Ohio. The Superfund Innovative Technology Evaluation (SITE) Program is part of the Environmental Protection Agency's (EPA) research of alternative hazardous waste remediation technologies. To carry out these demonstrations, the EPA collaborated with the USAF, USGS, Ohio EPA, N Chevron USA, Phytotech, Inc., and Phyto kinetics, Inc. A perennial ryegrass is being used to treat shallow soil contaminated with PCP and PAHs at a wood treater in Portland, Oregon. A mixture of poplar trees, juniper trees, alfalfa, and fescue has been planted near Ogden, Utah, to repair a petroleum leak that poisoned the soil and ground water. Cottonwood trees are being used to catch a portion of a massive TCE ground water plume on an Air Force base near Fort Worth, Texas. A demonstration of phytoextraction of lead, cadmium, and hexavalent chromium using Indian mustard is taking place in the shallow soil of a former metal plating business in Ohio. Each demonstration involves soil, groundwater, and plant material monitoring. Planting began in 1996, and the areas will be monitored until at least 1999.

10. Title: “Purification of Grey water using the natural water method”
Authors: Snehal joshi, Priti Planane, Dr. Suniti Gire, MS. Anuja oke, Gopika Manjunanth, Dr. Chitra Naidu, Dr. Minal Jloshi.

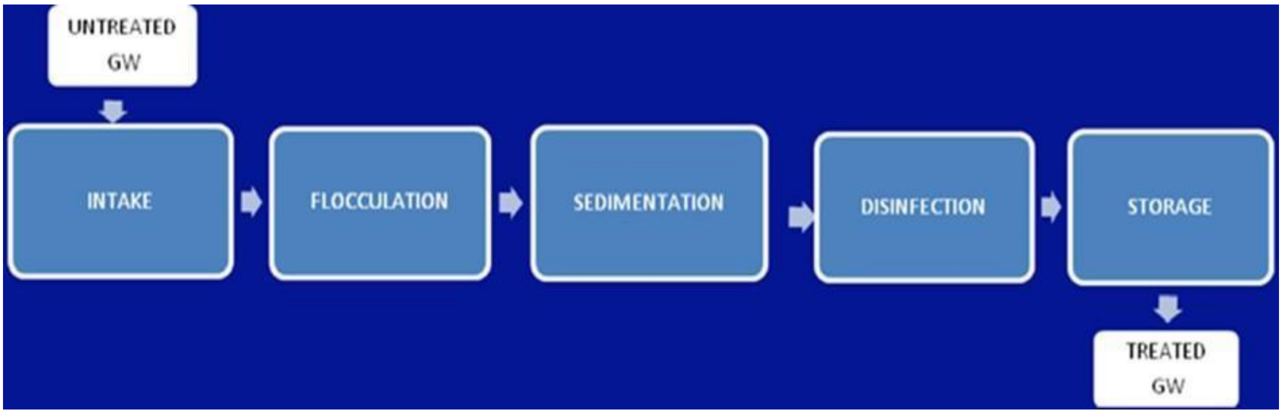
Year: 1995

Review:

The water crisis is a major problem now a day, to solve this problem there are various method of water conservation such as rain water harvesting or water reuse grey water treatment is also option for water conservation. Grey water is the untreated household wastewater that has not come into contact with sewage (WHO-ROEM2006). In this study. We have used various flocculating agents like alum, PAC lime, Chitosam alum + alum fuller earth, ferric chloride ferric sulphate, PAM micro plus + soya been, alum+ soya been etc. & one of that gave most significant result were used for further study, among the flocculating agent used alum + soyabeen powder gave promising result. This flocculating agent & coagulating aid were used for further experiment. We using biochar groundnut husks which is a waste material & activated using zink chloride. We prepared a unit which consist of a column packed with sand, gravel activated biochar & vetier roots. We passed supernatant obtained after flocculation this through unit a flow rate 5 lit/hrs. The effluent water disinfected using medichlor. In this unit turbidity increased to 0.08NTU, PH 6.3, nil, TDS reduce up to 75%, MPN test was found negative.

3. Methodology

Fig-01: Research Methodology



4. Design of Grey Water Treatment System (Model)

Experimental setup & operation condition

The project work consists of a rectangular tank with vertical baffles, continuous flow in horizontal & vertical direction in zig zag manner with dimensions as following

Model size:

1) Length = 90 cm.
2) Width = 60 cm.
3) Height = 30 cm.
4) Compartment = 05
5) Alternate height of compartment = 21cm 27 cm.
6) Distance between two compartment = 18 cm.
7) Alternate height of partition wall = 21cm & 22cm.
8) Lower space for water flow from one compartment to another compartment = 8cm

Actual model

The stabilization tank was divided into five compartments with the help of baffle walls. The entered water is allowed to pass through the gap made in the wall at the upside and downside opposite to each other. After certain duration the impurity of water will get settled down. At the bottom surface and water will be passed out through the outlet pipe. The result of stabilization tank process is found to be very effective as compared to the conventional methods. The stabilization tank is also economical than other treatment available.

Removal of leakages we used Mseal. Then allow to dry tanks for 1 day, after drying the test is carried out to detect leakage by using raw water. Now the model is ready for work.

In this study the tank was placed on the table to maintain atmospheric conditions. Once in a day 35 liters domestic grey water was poured in the detention tank. Tap was used to adjust the flow of grey water from the detention tank in to the stabilization tank. Detention period is 100 ml per 2.30 minutes rate.

Fig. 02: Experimental setup & operation condition

5. Results and Discussions

The project work was carried out to study the feasibility of model for grey water management in multi-storied building. The grey water sample was collected and analyzed. The result obtained from system were effective change in physical, chemical and biological properties of inlet and outlet water grey water sample was observed and there was a notable change in all properties.

Change in properties of grey water

Colour of inlet grey water sample was different than the outlet grey water sample. odour of inlet grey water sample was intense compared to outlet grey water sample.

Table 01: Change in physical & chemical properties of grey water

Sr.No.	Parameters	Results				
		13/02/2023	17/02/2023	20/02/2023	24/02/2023	27/02/2023
1.	Ph	7. 40	7. 50	7. 20	7. 10	7. 20
2.	Colour	Grey	Grey	Grey	Grey	Grey
3.	Odour	Rotten egg.	Rotten egg.	Rotten egg.	Rotten egg.	Rotten egg.
4.	Temperature	28^0 C	27.5^0 C	26.5^0 C	28.2^0 C	28.6^0 C
5.	Turbidity	8. 8 NTU	9. 2 NTU	16. 5 NTU	18. 6 NTU	20. 2 NTU
6.	Conductivity	1. 74 Ms	1. 92 mS	2. 12 mS	4. 26 mS	6. 80 mS
7.	Total solids	1460.00 Mg/lit	1480.00 Mg/lit	1496.00 Mg/lit	1600.00 Mg/lit	1620.00 Mg/lit
8.	Total dissolved solids	270.00 Mg/lit	282.00 Mg/lit	290.00 Mg/lit	320.00 Mg/lit	340.00 Mg/lit
9.	Total suspended solids	1190 Mg/lit	1198 Mg/lit	1206 Mg/lit	1280 Mg/lit	1280 Mg/lit
10.	Dissolved Oxygen	nil	nil	nil	nil	nil
11.	Biochemical oxygen demand	230 Mg/lit	244 Mg/lit	268 Mg/lit	252 Mg/lit	250 Mg/lit

12.	**Chemical Oxygen demand**	400.0 Mg/lit	480 Mg/lit	544 Mg/lit	524 Mg/lit	580 Mg/lit
13.	**Chloride**	86.00 Mg/lit	88.0 Mg/lit	90.0 Mg/lit	90.00 Mg/lit	90.00 Mg/lit
14.	**Oil & Grease**	0.32 Mg/lit	1.96Mg/lit	1.68 Mg/lit	1.74 Mg/lit	1.44 Mg/lit
15.	**Total Nitrogen**	1.12 Mg/lit	1.99 Mg/lit	1.68 Mg/lit	1.72 Mg/lit	1. 20 Mg/lit
16.	**Phosphate**	1.65 Ml/li	1.8 Ml/li	2.10 Ml/li	2.10 Ml/li	2.560 Ml/li
17	**MPN**	≥ 2400	≥ 2400	≥ 2400	≥ 2400	≥ 2400

- The above all characteristic results are shown grey water taken from same building, same pipeline but sample readings are not same because the samples were taken on an interval of five days for five times. The grey water poured into detention tank will come out from the outlet of stabilization tank after five days.
- Dissolved oxygen is all time nil generally dissolved oxygen will be zero of grey water
- BOD, COD, turbidity, oil and grease, total nitrogen and phosphate slightly increases at every time the sample is taken out.
- The grey water gives an odour like that of rotten eggs.
- TS, TDS and TSS are increased every time.

6. Conclusion

As the laboratory test reports show promising results in the reduction of the contaminants.

BOD, COD, and Solids are reduced at observed.

1. The reduction in BOD of grey water is obtained up to 75 - 85 %.
2. The reduction in COD of grey water is obtained up to 80- 88 %.
3. The reduction in chloride of grey water is obtained up to 25- 30 %.

4. The reduction in TS of grey water is obtained up to 40-50%.

5. The reduction in TDS of grey water is obtained up to 45-55%.

6. The reduction in TSS of grey water is obtained up to 20-30%.

7. The reduction in Temperature of grey water is obtained 2-8%
8. The reduction in Turbidity of grey water is obtained 75-85%

9. The increment in pH of grey water is obtained up to 2-7%.

10. The reduction in Conductivity of grey water is obtained up to 65-75%.

11. The reduction in Oil & Grease of grey water is obtained up to 60-70%.

12. The reduction in Nitrogen of grey water is obtained 25-30%

13. The reduction in Phosphate of grey water is obtained 65-70%

14. The reduction in Odour of grey water is obtained 100%

15. The reduction in Colour of grey water is obtained 100%

16. The reduction in Phosphate, Oil & grease of grey water 30-40%

17. The reuse of grey water in countries of the region will solve many problems related to water scarcity, and will lead to the saving of financial resources which in turn helps to support the economy.

22. This study reviewed greywater characteristics, treatment systems, reuse strategies and perception of greywater reuse among users.

23. All the treatment systems reviewed were applicable on a large scale and cannot be applied at the household level.

24. This project report encourages local level participation in grey water reuse schemes.

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