LITERATURE STUDY OF GREY WATER MANAGEMENT AND TECHNIQUES

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Abstract - *An Grey water is all* wastewater *generated in households or office buildings from streams without fetal contamination, i.e. all streams except for the wastewater from toilets. Sources of grey water include, e.g.* sinks, showers, baths, *clothes* washing machines *or dish washers. As grey water contains fewer* pathogens *than domestic wastewater, it is generally safer to handle and easier to treat and reuse onsite for* toilet flushing, *landscape or crop* irrigation, *and other non-potable uses. When grey water is mixed with toilet wastewater, it is called sewage or* black water *and should be treated in sewage treatment plants or onsite sewage facility, which often is a septic system. When it is kept separate, it may open up interesting decentralized treatment and reuse options. The separate treatment of grey water falls under the concept of source separation which is one principle commonly applied in* ecological sanitation *approaches. The main advantage of keeping grey water separate from toilet wastewater is that the pathogen load is much reduced and the grey water is therefore easier to treat and reuse.*

Key Words: Grey Water, Treatment, Recycling, Reuse, Quality, Quantity

1. INTRODUCTION

Grey water is all wastewater generated in households or office buildings from streams without fetal contamination, i.e. all streams except for the wastewater from toilets. Sources of grey water include, e.g. sinks, showers, baths, clothes washing machines or dish washers. As grey water contains fewer pathogens than domestic wastewater, it is generally safer to handle and easier to treat and reuse onsite for toilet flushing, landscape or crop irrigation, and other non-potable uses. When grey water is mixed with toilet wastewater, it is called sewage or black water and should be treated in sewage treatment plants or onsite sewage facility, which often is a septic system. When it is kept separate, it may open up interesting decentralized treatment and reuse options. The separate treatment of grey water falls under the concept of source separation which is one principle commonly applied in ecological sanitation approaches. The main advantage of keeping grey water separate from toilet wastewater is that the pathogen load is much reduced and the grey water is therefore easier to treat and reuse.

Water shortage in India will be a key issue for its sustainable development in the future. India is facing a water crisis and by 2025 it is estimated that India's population will be suffering from severe water scarcity. International Water Management Institute (IWMI) predicts that by 2025, one in three Indians will live in conditions of absolute water scarcity. Conventional groundwater and surface water sources are becoming increasingly vulnerable to industrial and natural pollution.

Grey water reuse methods can range from low cost methods such as the manual bucketing of grey water from the outlet of bathroom, to primary treatment methods that coarsely screen oils, greases and solids from the grey water before irrigation via small trench systems, to more expensive secondary treatment systems that treat and disinfect the grey water to a high standard before using for irrigation. The choice of system will depend on a number of factors including whether a new system is being installed or a disused wastewater system is being converted because the household has been connected to sewer. The main purpose of grey water recycling is to substitute the precious drinking water in applications which do not require drinking water quality. Non-potable reuse applications include industrial, irrigation, toilet flushing and laundry washing dependent on the technologies utilised in the treatment process. With grey water recycling, it is possible to reduce the amounts of fresh water consumption as well as wastewater production, in addition to reducing the water bills. If grey water is regarded as an additional water source, an increased supply for irrigation water can be ensured which will in turn lead to an increase in agricultural productivity. Unlike rainwater harvesting, grey water recycling is not dependent on season or variability of rainfall and as such is a continuous and a reliable water resource. This results in smaller storage facilities than those needed for rainwater harvesting. Grey water has a relatively low nutrient and pathogenic content and therefore, it can be easily treated to a high quality water using simple technologies such as sand/gravel filters and constructed wetlands (planted soil filters). Moreover, if space is not available, other systems such as sequencing batch (SBR) or membrane reactors (MBR) can be installed in the cellar.

2. LITERATURE SURVEY

Shaikh et al (2015) Demonstrated he reuse and treatment of residential bathrooms, basins waste water called as grey 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 BOD, 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.

Hegokar, (2015) presented the design of laboratory scale grey water treatment system which is restricted to 5 stages of physical operation such as raw grey water. 1st Filtration unit of sand and gravel, 2nd dual filtration and scoring unit for treated grey water. The research pa[er is related to physic-chemical characterization of grey water sample by using low cost technological option.

Ayoub et al (2012) Water Installation of decentralized grey water treatment systems in small rural communities contributes to a more sustainable supply. In order to gauge community attitudes about collection and use of grey water, a door-to-door survey in the farming community of DeirAlla, Jordan was conducted by Royal Scientific Society interviewers. The survey results showed that the socio-economic characteristics of the study area are generally very difficult. The families are poor and with low education levels. The main source of income for the local people is derived from agricultural activities. However, in spite of all these considerations, people are still willing to accept the reuse of grey water and to adapt its treatment in order to secure their water needs for irrigation due to severe shortage of water resources in the study area.

Friedler et al (2005) With pilot plant treating light grey water for seven flats. The pilot plant combines biological treatment (RBC) with physicochemical treatment (sand filtration and disinfection). The pilot plant produced effluent of excellent quality, meeting the urban reuse quality regulations, and was very efficient in TSS turbidity and BOD removal: 82%, 98% and 96%, respectively. The overall performance of the pilot plant was excellent, producing very high quality effluent which meets the highest requirements of the Israeli Ministry of Health urban reuse regulations. Overall removal efficiency ranged from 64% (COD) to 98% (turbidity), producing very low effluent BOD (2.3 mg/l) and turbidity (0.6 NTU). The RBC SB successfully retained bio solids produced in the process, discharging effluent with less than 20 mg/l TSS. The pilot plant successfully removed 58%, 87%, 96% and 72% of the TP, TKN, ammonia and organic nitrogen, respectively. This produced effluent with low nutrient content which together with low BOD reduces the regrowth and fouling potential in the reuse system.

Friedler et al (2005) Analysed the economic feasibility of on-site grey water reuse in the urban sector. RBC- and MBR-based systems were selected as model systems for the economic analysis. The analysis showed that the investment costs of an RBC-based system consist of less than 0.5% of the price of a flat for buildings of more than 20 flats (five storeys). This paper analysed the economic feasibility of on-site grey water reuse systems in new buildings in the urban sector, since a prerequisite for this practice to become widespread is its economic feasibility to the individual consumer. The analysis demonstrated that on-site grey water reuse is a feasible solution for decreasing overall urban water demand, not only from an environmental standpoint, but also from economic profitability under typical conditions.

Mama1 et al (2013) studied the performance and economic viability of a simple inexpensive grey water treatment system consisting of a filtration unit and an adsorption unit was evaluated. At steady state, the overall performance of the combined system was 85.68% BOD removal, 57.09% COD removal and 70.74% TSS removal. An economic analysis showed that 77.5% savings in water expenditure can be achieved if a simple grey water treatment is installed for toilet flushing. The overall performance of the pilot scale was commendable producing an appreciably improved quality of grey water. The final effluent at a steady state had a BOD of 13.7 mg/L which is close to values obtainable with some standardized water treatment technologies.

Thakur et al, (2013) Emphasized that water is one resource that has no substitute. Even though water covers three quarters of the planet, 97% of the Earth's water is saline water, and thus useless for drinking and other purposes. Less than 3% of water is fresh water. In the recent years, many events have occurred which point towards the decreasing fresh water resources of the world. As the needs for water increase in agriculture, industry and households with the increase in cities and populations the problem is getting worse globally. This situation necessitates that the need of conservation of water be understood and put into practice. Therefore it is essential to reduce surface and ground water use in all sectors of uses and to substitute fresh water with alternative and to use water efficiently through reuse options. Since the intended use of water is for irrigation and toilet flushing the required treatment standards are therefore less stringent as compared to that for drinking purposes therefore the greywater is acceptable for reuse. From the above study it can be concluded that that grey water recycling can be the viable option in the present situation of water scarcity.

Kanawade et al, (2015) Presented a comparison of chemical versus biological package grey water treatment systems was undertaken using a new laboratory based protocol that included a synthetic grey water formulation that mimics average bathroom and laundry grey water in Australia. The results for chemical, nutrient and metals removal showed that the treatment systems behaved very differently under the test conditions. The chemical system was able to remove most of the components of grey water that could be detrimental to the environment and produced high quality product water. The biological system was only able to remove some of the components of the grey water, and did not produce the same quality of product water. Grey water compositions change with the use of more biodegradable, low environmental impact personal care and cleaning products, biological treatment. The synthetic grey water formulation that was developed as part of this research was proven to meet the parameter range criteria and mimic an average grey water in composition as well as providing a suitable medium for the transport of micro-organisms for testing. The testing protocol was found to work successfully to allow each technology to be evaluated rigorously. Systems may be better suited to treating grey water in the future.

Christova-Boala, (1995) Surveyed and selected four "typical" Melbourne homes were and plumber to utilize grey water for toilet flushing and garden irrigation. Social surveys were conducted by mail and phone to homeowners to determine perceived attitudes towards grey water reuse. Grey water from baths, showers, laundry troughs and washing machines is being examined for physical, chemical and microbiological parameters to determine the potential health and environmental risks associated with reuse. Soil tests were also undertaken on gardens to determine any long-term detrimental effects that might occur as a result of using grey water. Fangyue Li et.al, Hamburg Grey water reused guideline proposed in this paper was used as a standard to evaluate the treatment efficiencies of reported grey water treatment. The MBR appear to be very attractive solution for medium and high strength grey water recycling, particularly in collective urban residential building serving more than 500 inhabitants.

CC chen, (2006) Water is a resource of increasing scarcity due to quantinual expansion of production there are at present no particular method for reuse of reclaimed water. Hence, piping and ducting system for grey water and black water in households. They develop and implementation plan involving governmental policy, communities construction of treatment plant, house hold commitment to recycling, control and checking.

Kordana, (2015) Suggested that the grey water recycling and economical use of rainwater can be a valuable alternative source of water, especially for non-potable uses. This analysis showed that the use of these systems in the tested building is financially viable, despite the fact that their implementation is associated with incurring higher investment cost than in the base case (Variant 0). The study was expanded by a sensitivity analysis on the basis of which it was possible to conclude that the project involving the use of alternative sources of pending water and energy in this building is only slightly susceptible to changes in calculation parameters. Conclusions the search for alternative sources of water and energy is essential due to the rapid development of urban areas and the related increase in demand for these valuable resources and the progressive depletion of natural resources. The research results described in this paper have and can provide guidance to potential investors of such facilities. Considering that in many countries the charges incurred for water supply and sewage disposal as well as for the purchase of electricity are much higher than in Poland, the profitability of the application of the analysed installation variants in these countries would be even higher.

Morel And Diener, (2006) Found that the issue of grey water management including wastewater from bath, laundry and kitchen but excluding toilet wastewater is steadily gaining importance, especially in low and middle-income countries (LMIC) where inadequate wastewater management has a detrimental impact on public health and the environment. Appropriate reuse of grey water not only reduces agricultural use of drinking water and water costs, but also increases food security and improves public health. The report is not a plea for stand-alone grey water management systems for all situations and at all costs but aims at providing a comprehensive description of the main components for successful grey water management. In urban and per urban areas of low and middle-income countries, grey water discharged untreated onto streets, into drainage channels, rivers or ponds leads to surface water contamination, deterioration of living conditions and increased health hazards. However, grey water is perceived as a valuable resource in rural areas and arid regions where it is often used untreated in irrigation. Without precautionary measures, this practice may lead to contamination of food, salinization and clogging of soils and potentially also to groundwater pollution.

3. CONCLUSION

Fangyue Li et.al, Hamburg Grey water reused guideline proposed in this paper was used as a standard to evaluate the treatment efficiencies of reported grey water treatment. The MBR appear to be very attractive solution for medium and high strength grey water recycling, particularly in collective urban residential building serving more than 500 inhabitants. CC chen,(2006) Water is a resource of increasing scarcity due to quantinual expansion of production there are at present no particular method for reuse of reclaimed water. Hence, piping and ducting system for grey water and black water in households. They develop and implementation plan involving governmental policy, communities construction of treatment plant, house hold commitment to recycling, control and checking.

References

[1] Shaikh, SkSameer, SkYounus,(2015)," grey water reuse: a sustainable solution of water crisis in pusad city in Maharashtra", civil engineering department B.N.C.O.E.pusadsantgadge baba amravatiunivercity, india.

[2] Vijay V. Shegokar 1*, DilipS. Ramteke 2 AndPravinU.Meshram,(2015), "design and treatability studies of low cost grey water treatment with respect to recycle and reuse in rural areas", Department of Envirmnmental science, Several MahilaMahavidyalaya, Nagpur-440009, India.

[3] Ayoup M. GhrairAndSharon B. Megdal, (2012)," Grey water reuse for Agricultural Purposes in the Jordan Valley: Household Survey results,"Water Resources Research Centre, University of Arizona, Tucson, AZ 85721, USA.

[4] E.Friedler, R KovalioAndN.I. Galil, Israil, (2005)," On-site greywater treatment and reuse in multistoreybuildings,"Faculty of Civil and Environmental Engineering, Technion, Haifa 32000, Israeal.

[5] E. Friedler, M. Hadari, Isreal(2005)," Economic Feasibility of On-site greywater reuse in multistorey buildings," Division of Environmental, Water and Agriculture Engineering, Faculty of Civil and Environmental Engineering, Technion, Haifa, Israeal.

[6] Cordelia N Mamal, ArinzeEkwuemeAnd TerlumunUtsev,(2013)," Feasibility of a Filtration-Absorption Grey Water Treatment System for Developing Countries" Department of civil engineering, university of Nigeria, Nsukka, Nigeria.

[7] Sandeep Thakur, M.S.Chauhan, (2013)," GREY WATER RECYCLING" Reserch scholar, Department of Civil Engineering, Maulana Azad National Institute of Technology Bhopal,India.

[8] SachinMadhavraoKanawade, (2015)," Grey Water Treatment Systems Under Controlled Laboratory Conditions." Dr. VasantraodadaPatilShikshanMandal'sPadmabhooshanVasantraodadaPatil Institute of Technology, Maharashtra.

[9] Diana Christova-Boala, Robert E. Eden, Scott Mcfarlane, (1995), "An investigation into greywater reuse for urban properties", Victoria University of Technology,Balart Road, Footstore 3011, Australia.

[10] Fangyue Knut WichmanA, Ralf Otterpohl, (2008), "Review of technological approches for grey water treatment and reuses", Hamburg University of Technology, Institute of Water Resources and Water Supply, Schwarzenbergstr. 95 E, D-21073 Hamburg, Germany.

[11] C.C.Chen, (2006), "A framework for greywater recycling of household wastewater", Instituted of Environment management, nan hua university, 32 chungkenglia, dalin, chiayl 622,Taiwan.

[12] AgnieszkaStec, Sabina Kordana, (2015)," Analysis of profitability of rainwater harvesting, grey water recycling and drain water heat recovery systems",Department of Mechanical Engineering, Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland.