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Greywater Treatment & Reuse: Present Status and Future Aspect

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Abstract: *This study 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 constructed wetlands, coagulation, adsorption and advanced oxidation processes (AOPs) have been considered and have been successful for low to moderate strength GW. Treatment of greywater can be a solution for increasing freshwater demand.*

Keywords: *Greywater, treatment, Advanced Oxidation Process, Constructed Wetland*

I. Introduction

According to WHO (1), shortage of water is adversely affecting more than 40% of the world population. Apart from this, more than 25 % of the world population suffers from health and hygiene problems which are mainly related to water borne diseases. UNO in recent time has taken various proactive actions for providing safe potable water to masses but more than 1000 million people still have no access to improved water supply and sanitation, especially in high population density continents like Asia, Latin America and Africa (2).

Domestic waste water is one of the major workings of public, private and familyutilities in major cities and larger towns. It produces large amount of waste water. It is outcome of massive activities produces polluted water from residences, commercial and industrial facilities (3).The water usage in these sectors is affected by climate, community size and density of development. The waste obtained from this source is largely organic and get oxidized by bacterial decomposition to nitrate, phosphate, methane, carbon monoxide and water. Around 70 % of the population in the world is living in buildings, which are no access to sewage treatment plants, and most of which have been inadequate to cope up with the existing scenario. Release of sewage in to water intensifies the already existing pollution problem.

. It is in fact very simple to understand that, in developing country like India waste water treatment will be handled by three aspects,

1st:The development of treatment of waste water generated from domestic use. Since this will provide a solution for scarcity of fresh water.

2nd: The development of appropriate method oftreatment of contaminated water used for drinking.

3rd: The development of appropriate methods for waste water containing hazardous and non biodegradable chemical compounds.

In this work more emphasis is given in the first part, especially in treatment of grey water(domestic waste water). In this work waste water generated from domestic use is subjected to the treatment. Grey water is defined as waste water generated in home except latrine water. It consist of water generated by cloth washing, dish washing, bathing etc.

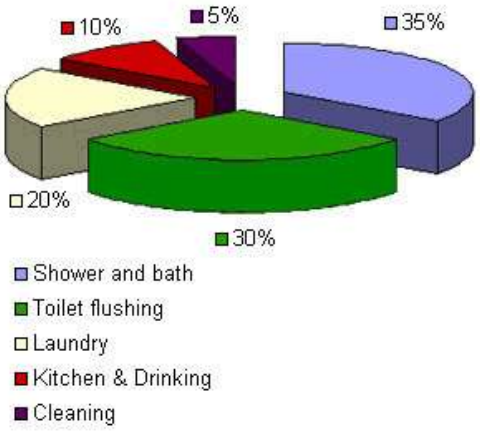

Figure1: Grey water source (Source WHO/CSIRO Report 2000)

Domestic waste water and sewage contains high level of organic waste, detergents, decomposed organic matter and pathogenic bacteria. Then these are released in nearby water body and it becomes a major source of pollution. Huge quantity of industrial waste is released by factories, industries, power plants, tanneries, chemical plants, food processing units etc. Since these wastes have complex chemical composition, these are not breakable by natural system. Naturally available resource faces increasing pressure due to growing industrial developments and better quality of living in growing population. Hence to achieve water quality objectives, we apply engineering systems to treat water required for public water supplies and to treat water before it is released to the environment.

A great work is going on in development of new methods of treatment as well as reuses the treated waste water. This is due to limited freshwater resources, new life style and exponential demand of fresh water due to increasing population. India is located in south Asia content and season is on an average dry though out year, especially in Nagpur, a developing metro city of Maharashtra (State). Fresh water is always short its availability is continuously decreasing. Thus, the potential of reusing waste water to earn environmental and economical benefits is an attractive way for the management of water source (Eriksson et al .,2002; Lazarova et al .,2003) (4) (5).

Some available methods apply a method of "Mix – first – and Separate- later". In some studies it is found that quality of the effluent from industrial plants is much closer to that of grey water (Gunther., 2000) (6). Gunther suggested that grey water if separated, its reuse is possible, which may help as potential method in the recycling and reuse of waste water. (For example Christova –Boal et al.,1996; Jefferson et al .,2000; Jeffery and Jefferson; 2001; Eriksson et al.,2002, Lazavora et al., 2003) (7-9).

Eriksson et al .,2003 (10)**"defined grey water as waste water without any input from toilet or heavily polluted industrial process water"**. Its quality as well as quantity varies significantly due to various activities involved in it generation that also depend on life style of persons, number of person in a family , different process of cloth washing, dish washing and so on. This result in wide range of parameter in literature such as chemical oxygen demand (COD=13 – 8500 ppm) ,Biochemical oxygen demand (BOD = 5-1460 ppm) , pH (5-10), turbidity (15-240 NTU), suspended solids (17-330 ppm) as per Erikssson et al.,2002. (4).

Grey water treatment has been treated with variety of technologies varying from simple storage to sophisticated systems which are usually based on biological, physical separation and chemical/advance oxidation process. Advance oxidation processes (AOP's) have been widely used in the treatment of drinking water and domestic or industrial waste waters, its application in greywater treatment has been limited to photo catalysis.

Hence, the aim of this laboratory based study was to examine the applicability of UV based AOP process for grey water treatment such as UVC/H_2O_2, UVC/TiO_2, UVC/O_3 and Photo Fenton process. Coagulation is used for settlement of impurities in few cases and supernatant was subjected to AOP treatment. The parameters were discussed such as after coagulation before coagulation, pH, COD of sample, dosage of reagents (alum, ferrous sulphate and H_2O_2) and reaction / retention time.

Scale of treatment project decides complexity of suitable grey water diversion, treatment or reuse system. Even simple treatment can be opted for grey water by giving screening, filtration and chemical disinfection if any, treatment before reuse. Whereas large scale projects generally involved more advanced technologies such as filtration (sand and/or membrane, microfiltration, ultra-filtration, nano-filtration or reverse

osmosis), coagulation, advanced oxidation process , bioreactors, sterilization unit and tertiary treatment (Jefferson et al.,2000; Jeffrey and Jefferson, 2001: Pidou et al.,2007). (7) (8) (11)
Grey water treatment technologies can be categories in to basic following types,

1. Biological treatment
2. Physical separation techniques
3. Chemical or advanced oxidation process.

In many cases combine process gives better results in terms of efficiency of process, removal of contaminants, reduction of size of equipments and consumption of chemicals.
Combine process of grey water treatment was opted i.e grey water treatment by Recycled Vertical Flow Constructed wetland (RVFCW) and subsequently RVFCW treated water was subjected to AOP process. Pidou et al (2007) (11) gave a chronological development of grey water treatment which reflect shift of treatment from coarse filtration or membrane filtration coupled with disinfection in 1970s to biological treatment in the 1980s and 1990s, followed by membrane bioreactors and low cost options like reed beds and wetlands in late 1990s. He also pointed out that only three basic methods had been followed for grey water treatment as per librature review i.e.

1. Coagulation,
2. Electro coagulation
3. Photo-catalysis.

It can also be concluded that number of treatment procedures have been prescribed for water and wastewater treatment, but no single process alone can serve the purpose of controlling effluent toxicity within permissible limits and hence a combination of these physical – chemical and biological processes has to be used for optimum treatment of wastewater.

II. Conclusion

Grey water reuse is important to mankind. Its non potable use is gaining global interest due to its minimum contamination. Microbial count is very low in grey water after its treatment. Similarly, quantity of chemicals comes down to minimal. Grey water is available in mass quantity. It is generated daily. And its cost effective treatment is possible. Minimum treatment of grey water makes it suitable to reuse as compared to other wastewater. In the coming years, greywater treatment and its reuse will be important aspect for reclamation of freshwater.

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