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Low-Cost Technology for The Greywater Treatment

[1]Shrikant Baburao Lokhande, [2]Nibe R. L, [3]Misal S. A

[1]Research Scholar, [2]Professor, [3]Head of Chemical Engineering Department
[1]Department of Chemical Engineering,
[1]Pravara Rural Engineering College, Loni, India.
shrikantlokhande.49@gmail.com

Abstract: The precipitation occurs all over the Maharashtra and in India is not uniform. So, there is deficiency of the water on the earth surface. Due to industrialization and globalizations demand of water is increasing on a large scale. In 21st century life style of humankind is changing. Change of life style having direct and indirect impact on water usages, sanitation, wastewater generation, and wastewater treatment process. Greywater (GW) is residential wastewater originating from showers, bathroom, kitchen and hand wash bowls and clothing and comprises 50-80% of indoor domestic water use. The major involvement to greywater comprises cloth washing and from bathing. Bath room shower comprises 31 % grey water, basin water includes 4% greywater, dish washing, kitchen sink involves 17 % greywater, and cloth washing, laundry includes 10 % grey water. It means the domestic wastewater contain around 62% greywater. Greywater treatment strategies differ dependent on location conditions and greywater qualities. Daily water consumption is depending upon the various factors such as availability of water source, climatic condition, temperature, humidity, life style or habit of people, living standard, community, etc. The amount of greywater generation depends up on the daily total water consumption. Generally, 55-72 % greywater is produced from the domestic wastewater.

Greywater has potential to recycle and reprocessed. Sub surface flow construction wetland can be applicable to treat the greywater. Recycling of greywater after the treatment can minimize the odour and curtail the sanitation problem. Parameter minimized such as pH, BOD, COD, and TDS respectively 7.77, 28.70 mg/l, 80.18 mg/l, 98.51mg/l.

***Index Terms* – Grey water, Sub surface flow construction wetland, Biological Oxygen Demand (BOD5).**

I. INTRODUCTION

The precipitation occurs all over the Maharashtra and in India is not uniform. So, there is deficiency of the water on the earth surface. Due to the geographical features, topography, climatic variation in some area more precipitation occurs and, in some area, less precipitation is occurred. Day by day precipitation percentages are reducing on a large scale due to the climatic variation, global warming effect. Also due to industrialization and globalizations demand of water is increasing on a large scale. Sea water or ocean water, glacier water is not useful for the domestic purpose or industrial purpose directly, it needs proper treatment before its application. In 21st century life style of humankind is changing. Change of life style having direct and indirect impact on water usages, sanitation, wastewater generation, and wastewater treatment process. Greywater is characterized as wastewater that incorporates water from showers, showers, hand bowls, clothes washers, dishwashers, and kitchen sinks, yet bars streams from latrines. A few creators prohibit kitchen wastewater from the other greywater streams. Wastewater from the washroom, including showers and tubs, is named light greywater. Greywater that incorporates more debased waste and from clothing offices, dishwashers and, in certain occasions, kitchen sinks is called greywater. International Water Management Institute (IWMI) has been predicted that by 2025 India will face water scarcity problem. IWMI also predicted that ground water resource going to be decreasing and drastic change will be occurred in India by 2050. Many states of India will face the water scarcity problem in around 2040-2050. States including Maharashtra (M. S), Madhya Pradesh (M. P), Uttar Pradesh (U. P), Gujarat, Bihar, Jharkhand, Haryana, Rajasthan, Karnataka, Andhra Pradesh (A. P), Telangana, Odisha will face big issues related to water scarcity. Over 300 districts in 13 states of India are facing shortage of drinking water. In Madhya Pradesh (M. P), and Uttar Pradesh (U. P) almost 46 and 56 districts are affected due to crisis of water. 30 towns from Andhra Pradesh (A. P), and Telangana facing water crisis as the demand of drinking water rises. By 2030, minimum 21 cities in India will move towards zero ground water level. Many big cities like Chennai, Hyderabad, Coimbatore, Vijayawada, Simla and Kochi are moving towards severe water shortage. There is acute water crisis in cities like Delhi and Bengaluru. As per British Broadcasting Corporation (BBC) news on 11th February, 2018, Bengaluru is likely to run out of drinking water. Alarm bells are ringing in front of us to wake up for the rise in fresh water demand. We are now in the middle of cross road where further unsustainable and impractical uses of fresh water are not acceptable. General normal and guidelines for disposal of grey water is elaborated in table 1.

Table 1. Norms for Disposal of Greywater

Standards	pH	BOD mg/L	Turbidity (NTU)	TSS mg/L	Reference
CPCB India	On land for irrigation Into inland surface water Into Public sewers	5.5-9 5.5-9 5.5-9	100 30 350	200 100 600	CPCB (2008)
USEPA	Unrestricted use Restricted use	6-9 6-9	10 30	- 30	USEPA (2012)

Greywater has potential to recycle and reprocessed. Sub surface flow construction wetland can be applicable to treat the greywater. recycling of greywater after the treatment can minimize the odour and curtail the sanitation problem. Treated greywater may be applied for artificial plant and gardening purpose. Greywater treated by sub surface construction wetland technology can be applicable to recharge the ground water. The contribution of public wastewater to organic trash in indigenous rivers is estimated to be roughly 7%. A substantial portion of this wastewater comes from greywater that flows into the river through water channels without going through an appropriate water treatment process, thus impacting the river's environment and water quality. The volume of greywater produced by residences could be as high as 95 L per person per day, or roughly 70–75 percent of total utilized water. Location, lifestyle, climate, infrastructure, culture, and other factors all influence the total amount of greywater produced by the public. The majority of public greywater waste comes from the kitchen and the toilet, with leftover food and drinks dominating organic waste in the kitchen and trash from cleaning agents such as soap and detergent and urine waste in the toilet. Toilet waste has significant levels of surfactant, such as ammonia, nitrite, and phosphorus, and the main source is laundry waste, which contains the surfactant element. If a chemical contamination identified in greywater is consumed by the public, it might have serious consequences, hence extra effort is required to remove the waste and protect the people's health. The population of India's cities is estimated to be around **1,398,457,617**, or around 55.8% of the country's overall population. From the literature survey it is found that grey water is generated on a large scale and need to be treat properly for safe disposal of grey water on the terrestrial ground or in aquatic or in pond, river, ocean, etc.

Numerous treatments are available to treat the grey water such as physicochemical, chemical, and biological methods. Out of these method biological methods is found to be more effective and economical to treat the grey water.

II. MATERIAL AND METHODOLOGY

One of the low-cost options of wastewater treatment technology based on natural processes of purification is SSFCW and VF. Micro-organisms that naturally live in saturated media and on the roots of wetland plants consume organic matter and nutrient. The operation and processes in these physical and biological systems is complex and requires better theoretical description. A sound knowledge on pollutant dynamics of SSFCW is required for proper design, achieving good removal efficiency for organic matter and nutrient. The oxygen transfer in support media by root of vegetation and presence of aerobic/anaerobic zones needs to be understood properly. Further, vermi-action for removal of organics (carbonaceous and nitrogenous) needs to be described. This chapter describes theoretical concepts, components, and mechanism of wastewater purification for SSFCW and VF.

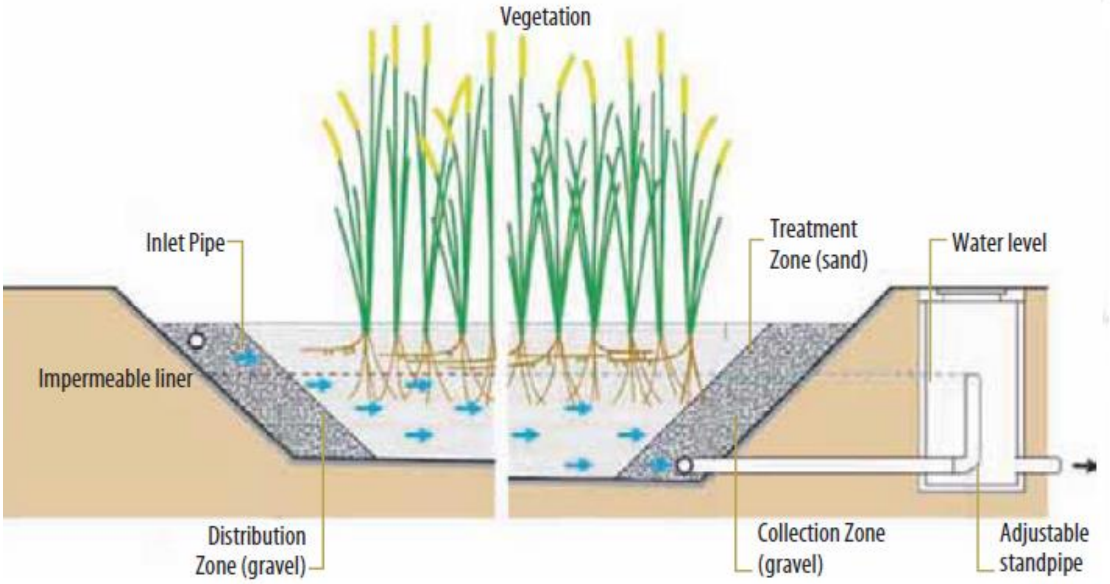

Fig. 1. Horizontal Flow Type Constructed Wetland

Substrate Arrangement in Horizontal Flow and Vertical Flow Construction Wetland

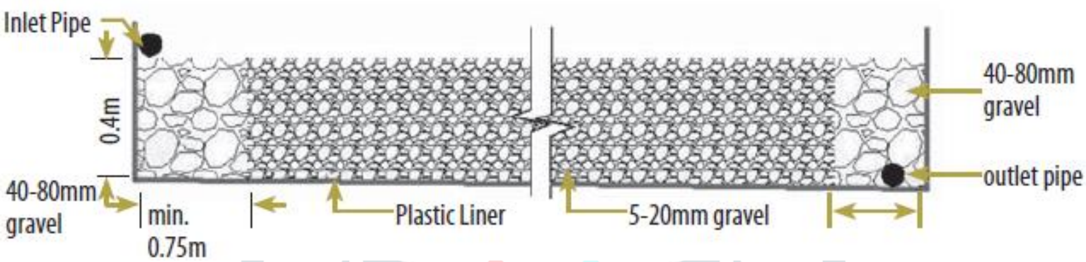

Fig. 2. Substrate Arrangement in Horizontal Flow Construction Wetland

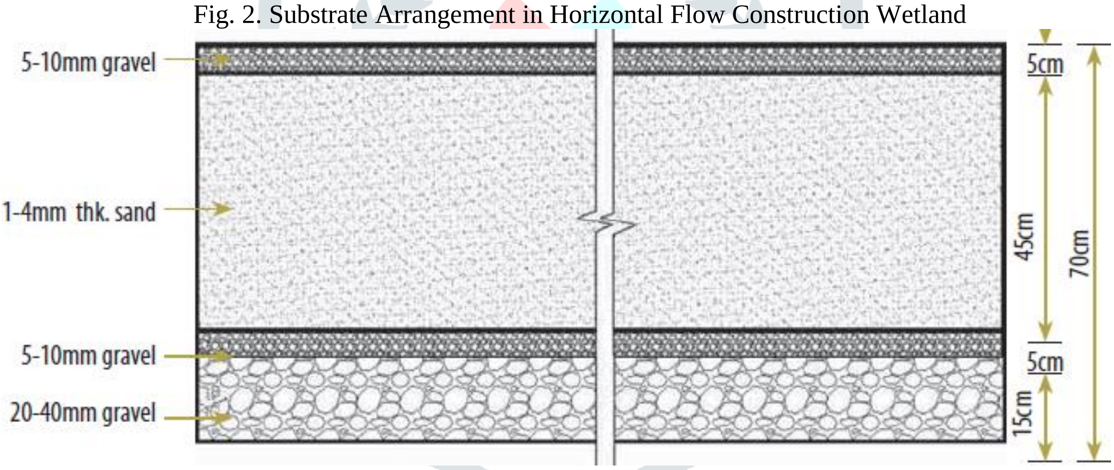

Fig. 3. Substrate Arrangement in Vertical Flow Construction Wetland

Fig. 2, and Fig 3. represents the substrate arrangement in horizontal flow and vertical flow construction wetland. In case of HF wetland diameter varies 0.2 mm to 30 mm. To avoid the clogging, it is essential to maintain the spacing of top and bottom in between 40 mm to 80 mm.

Collection of Grey wastewater for Treatment

A row sample of wastewater was collected in a container and kept in the refrigerator (Fig. 4). Analysis of grey wastewater was carried out to find out the characteristics of grey wastewater (Table 2). Surrounding is extremely contaminated if domestic waste is discharged without treatment, then river, pond, and ground water may get contaminated. The Maharashtra government treat 22% greywater collected. There maining78 % row wastewater predisposed into waterways which creates chances of water-borne diseases [10]. In India, the government and scientists are facing the problem due to habit of human being to handle the sewage water [11]. One of the low-cost options of wastewater treatment technology based on natural processes of purification is Sub-surface flow constructed wetland (SSFCW) and vertical subsurface (VF). Micro-organisms that naturally live in saturated media and on the roots of wetland

Fig. 4. Row wastewater collection

Table 3.2. Chemical Characteristics of collected Wastewater

Sr No.	Test Parameters of untreated sample	Laboratory Result
1	pH value	7.12
2	Electrical Conductivity, ds/m	0.631
3	Turbidity, NTU	9.0
4	TDS, ppm	321.4
5	COD, mg/lit	323
6	BOD (at 3 day), mg/lit	192
7	DO, mg/lit	1.42
8	Total Hardness as $CaCO_3, mg/lit$	294
9	Total alkalinity as $CaCO_3, mg/lit$	148

RESULT AND DISCUSSIONS

The efficiency of parameter removal is depended upon the temperature. At higher temperature rate of degradation is more than the lower temperature. Hydraulic loading, detention time also play a significant role to curtail the parameters of greywater. Adequate (carbon to Nitrogen) C/N ratio, (food to microorganism) F/M ratio can enhance the efficiency of parameter removal. The constructed wetland treatment can be used for secondary and tertiary treatment for various wastewater. Appropriate selection of aquatic plant is the key factor. Cyperus Rotundus, Canna Indica aquatic plants are commonly used in India for CW. Fig 4.2. to Fig. 4.4. shows the variation of pH, COD, and TDS of grey water after the treatment

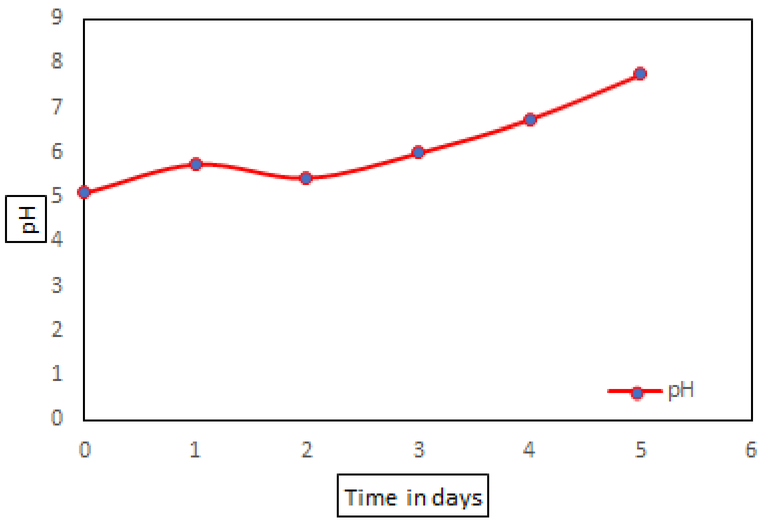

Fig. 4.2. pH variation in grey water after the treatment

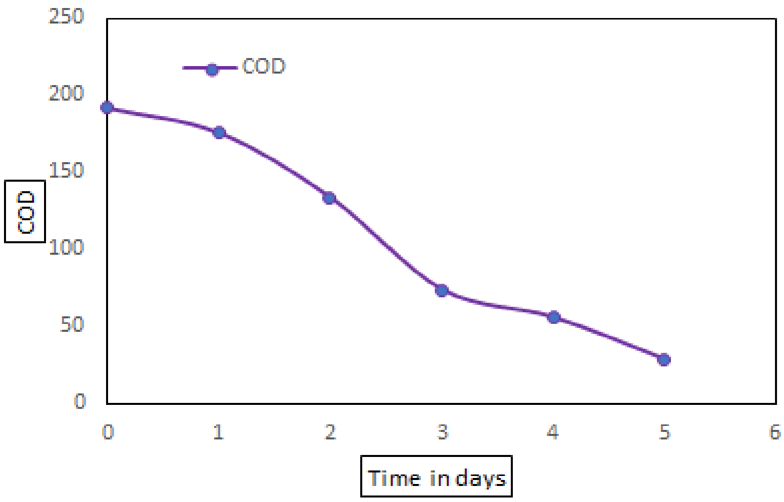

Fig. 4.3. COD variation in grey water after the treatment

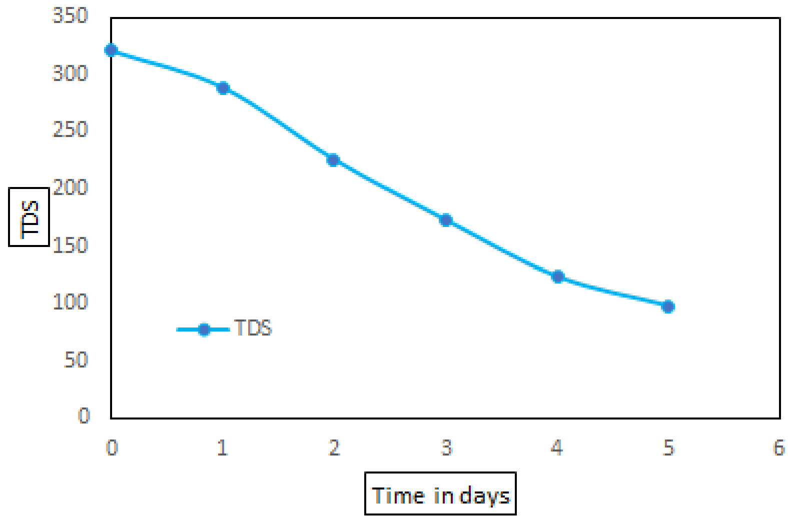

Fig. 4.3. TDS variation in grey water after the treatment

In the sub-surface flow construction wetland, process of various mechanics takes place such as sedimentation process, filtration process, adsorption, ion-exchange, advance oxidation process. Adsorption process are essential which binds the minerals for plants. Aerobic and anerobic process takes place due to which the parameters of grey water are reduced on a large scale. As the sedimentation, filtration, adsorption process takes places numerous types of pathogens present in the grey water are going to deactivate or reduced at a substantial level. As nutrients are get trapped in the sub-surface flow type constructed wetland. Pathogens are reduced rapidly by natural die or one pathogen attack on the other pathogen as food to microorganism's ratio increased rapidly. It also known as declined growth. Fig 5. illustrate the basic information bout the Nitrogen transformation process in sub-surface flow constructed wetland.

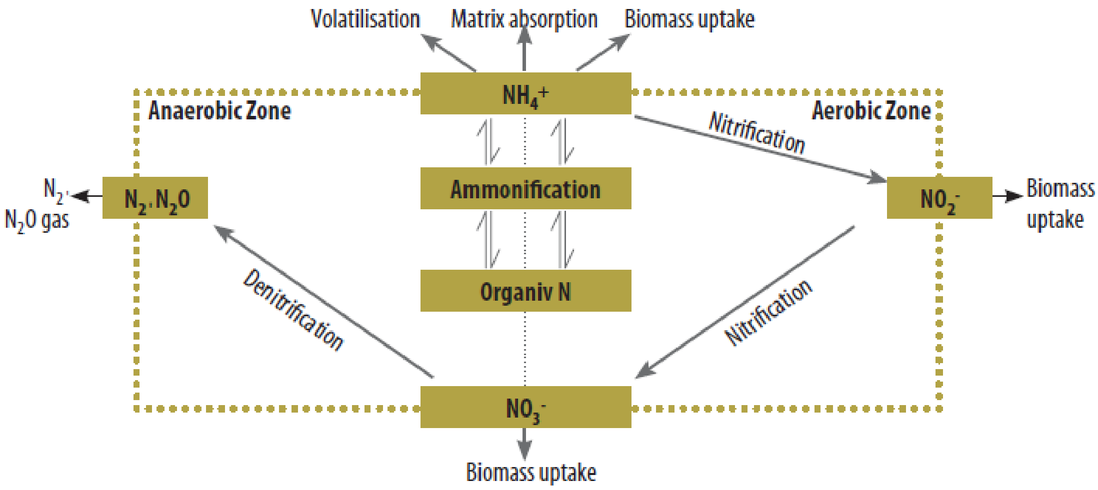

Fig. 5. Nitrogen transformation process in sub-surface flow constructed wetland

Day by day water will be scarce. To fulfil the water demand it needs to recycle the greywater. Around 70 % of the water has been consumed for irrigation needs. Greywater treated by CW can fulfil the shortage of water demand. The treated greywater if incorporated for irrigation purposes it will be more beneficial for crops. These treated water-content nutrients nourish plant growth in a good manner. Input required for CW is very less. Also, the construction, operation, and maintenance costs of CW are less as compared to other conventional processes. CW treatment technology is eco-friendly and treated water can be used for irrigation purposes. The operation and processes in physical and biological systems are complex and require a better theoretical description. Sound knowledge on pollutant dynamics of SSFCW is required for proper design, achieving good removal efficiency for organic matter and nutrients. The oxygen transfer in support media by the root of vegetation and the presence of aerobic/anaerobic zones needs to be understood properly. Sub-surface flow type constructed wetland found to be economical and having potential to treat the parameters of grey wastewater. Initial parameters of grey water are to much as and cannot be disposed of as per the guidelines provide for disposal of grey water. So, it needs treatment to degrade the parameter. SSFCW minimize the parameters such as Chemical oxygen demand (COD), biochemical oxygen demand (BOD), total dissolved solids (TDS). Chemical oxygen demand (COD) reduced around 75.64%, biochemical oxygen demand (BOD) reduced 85.05 %, total dissolved solids (TDS) curtailed 69.31%.

CONCLUSIONS

The operation and processes in physical and biological systems are complex and require a better theoretical description. Sound knowledge on pollutant dynamics of SSFCW is required for proper design, achieving good removal efficiency for organic matter and nutrients. The oxygen transfer in support media by the root of vegetation and the presence of aerobic/anaerobic zones needs to be understood properly. Sub-surface flow type constructed wetland found to be economical and having potential to treat the parameters of grey wastewater. Initial parameters of grey water are to much as and cannot be disposed of as per the guidelines provide for disposal of grey water. So, it needs treatment to degrade the parameter. SSFCW minimize the parameters such as Chemical oxygen demand (COD), biochemical oxygen demand (BOD), total dissolved solids (TDS). Chemical oxygen demand (COD) reduced around 75.64%, biochemical oxygen demand (BOD) reduced 85.05 %, total dissolved solids (TDS) curtailed 69.31%.

Future Scope

Constructed Wetland can be used for degradation of parameters of municipal waste. Fig. 6 illustrate the application of constructed wetland to treat the municipal waste. This unit consists of coarse screen, bar screen, anaerobic reactor, sludge drying bed, Horizontal flow constructed wetland, Vertical flow constructed wetland.

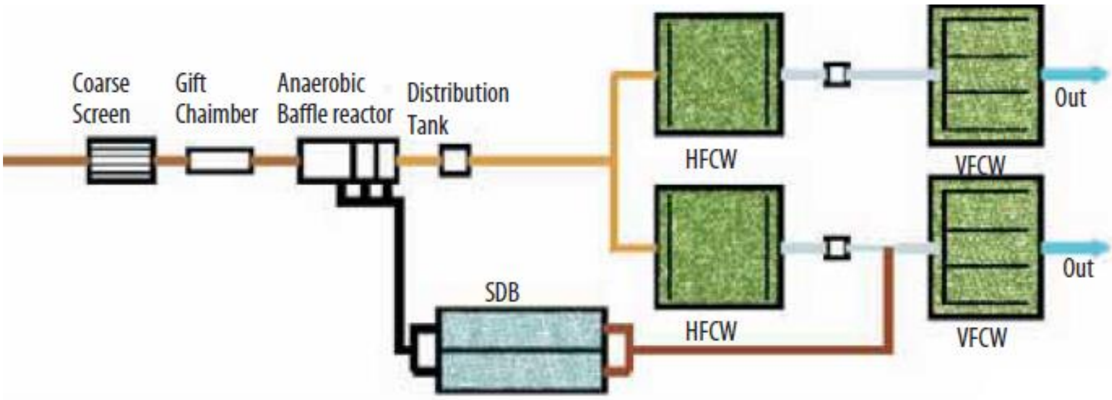

Fig. 6. Constructed Wetland application for Municipal Waste Management

Constructed wetland can be applicable to manage the domestic waste. Fig. 7. shows the application of constructed wetland for domestic waste.

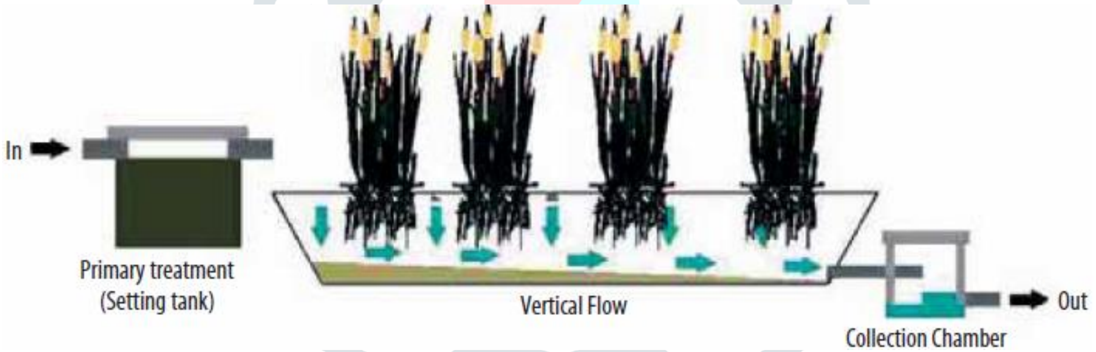

Fig. 7. Constructed Wetland application for Domestic Waste Management

II. ACKNOWLEDGMENT

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