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Grey Water Recycling Treatment using Vermiculture Biotechnology

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Abstract -The organic matter helps in various bioprocesses. Management of organic waste is challenging because of the improper disposal causing hazards to the environment. The sludge from the sewage treatment plant is dumped as landfill and used as fertilizer in agricultural operation. This action may solve the disposal of quantity of sewage sludge but the environment is highly affected by the pathogens. Nowadays vermicomposting is used for the removal of pathogens in organic matter. It includes accelerated treatment of nutrients in which waste end products are put to useful end products. When this method of vermicomposting is used in domestic wastewater management considerable reduction in pathogens was found in the organic waste so that the end product can be safely applied safely to land. This work gives a view of the management of domestic waste water utilizing vermiculture. The process can be used for household waste treatment and rural or urban waste management in a small scale.

Key Words: vermiculture, bioprocess, waste water, domestic, organic, treatment, reuse , recycle.

1. INTRODUCTION

The waste water is generated from all sources in large quantitiesand reasonable part of this waste water is collected and recycled.The untreated wastewater discharged from the households andindustries is being a harmful agent to nature and humans indeveloping areas and causes eutrophication and transmission ofdiseases spreading through water. The scenario is worsening withthe rapid urbanization without proper sanitation.More number of new technologies are being used towards thehandling of disposal of organic wastes. Hence the dumping oforganic wastes affect the habitat lifeline and environment. Vermiculture technology is a branch of biotechnology usingearthworms as a bio filter. The earthworms use the soil food chainprinciple for stabilizing the soil nature which can be used forprocessing of organic wastes. This technology helps to giveeconomic value for organic waste and makes cleaner environmentby using the bio-energy of organic waste.The wastewater from domestic area is made to apply onvermiculture soil. The impurities in the water are absorbed in thesoil and the excess water percolates and drained. Vermi culturesoil have the property of large specific surface for bacterialactivities and also good drainage conditions.The objectives of this project are to assess the suitability ofvermification process for wastewater of hostel mess, to evaluatethe treated efficiency by using the two plants (Canna and Ginger)with the combination of vermin culture soil and to study the effectof variation in terms of removal of BOD as well as COD bydiffering the organic loading.Taylor & Francis (2001) studied the effectiveness of the Cannaplant in the treatment of waste water for the removal of Nitrogen,Carbon and Phosphorous under subtropical conditions.SGajalakshmi and S Abbasi (2003) studied the effect ofvermicast on the growth of the plant and found that thiscomposting supports in significant reduction of the percentage ofpathogens in organic matter. Cheng, Zhao B et al (2004) made aresearch on the cleaning of organics and toxins in the waste waterby using Ginger plant. Nitin Prakaskpandit, Nabeel Ahmad (2012) found that the treatedeffluent results in reduction of pathogens when recycled throughvermicast soil. Amouei A.I., Yousefi Z., Khosravi T. (2017)studied the comparison of products formed by using earthwormsfor the treatment of waste water and domestic solid waste.

2. MATERIALS AND METHOD

2.1 Sample collection and Testing

The main concept of this project is to recycle the water from thedomestic need and hence the type of waste water that has beenselected is the waste water that has been constantly collected fromthe daily activities such as washing of utensils, clothes, shower orbath water and other water except excreta. This water is known assullage water. In this project college mess is chosen as a sourcepoint for sullage water. The water collected here is of washingutensils which contains food waste and soap content. Thefollowing tests has been done in the pH, Temperature,Biochemical Oxygen Demand, Chemical Oxygen Demand,Turbidity, Total solids and Odour.

2.2. Formation of Filter Beds

The experimental setup consists of two tubs used for growing canna and ginger plants. Drain holes are provided at the bottomfor the collection of water. 25 mm size coarse gravel is laid for7.5cm at the bottom. A 4.5cm thick layer of 12mm gravel is laidabove the coarse gravel over which a 3.5cm thick layer of silt freesand is laid. These layer do not have any vital role in the processof vermification. But they support for upper vermification andprovide drainage above the sand layer of 20cm thick.

2.3. Vermicomposting

Vermicompost is the composting process using various species ofworms by which a mixture of decomposing vermicast is created.Approximately about 30 to 40 earthworms has been added on eachof the experimental set. Necessary manure is added to the soilalong with earthworms. The soil is completely in wet condition isprovided for the comfortable environment for the earthworms.

2.4. Plantation of Canna and Ginger

Canna and Ginger plants have been planted in each of the tubs separately and is daily watered and made sure that there is acomfortable environment for the plant growth. Red soil is foundsuitable for the plant growth and is made sure that the plant has ahealthy growth for the water purification.

2.5. Treatment of waste water:

The sullage water is collected and poured into the treatment plant regularly. The volume of sullage water that is poured is beennoted. The sullage water that is poured should be made sure that isfree from solids since it may lead to death of plants andearthworms. The filter bed is completely saturated initially andthen the sullage water is poured or else there will not be anyproper results.

2.6. Test on treated water

The water that is obtained after the purification from the filter iscollected and amount of water collected has been noted down for calculation of the efficiency of the treatment plant.

2.7. Comparison of treated and collected sample:

The samples obtained from the treatment plant using differentplants is collected and is tested. The test results for the varioustests are tabulated. Comparison is made between the quality ofbetter purification characteristics of the Canna plant and theGinger plant.

3. Vermiculture technology

i) Composting using Earthworms:
Earthworms are more than 80 percent of soil invertebrate biomass. They produce vermicastings which contains high percent ofmicroorganisms, organic matter and inorganic minerals in theform that can be used by plants.
ii) Space for earthworm culture and size of pit:
Earthworms grow 7.5 cm to 10.3 cm in a week and can be used inindoor and outdoor vermicomposting. One worm can reproduce asmany as 99 offerings in 11 weeks hence it must be ensured thatthe pit does not get over crowded with earthworms since it leadsto insufficient spacing for earthworms and causes death ofearthworms.
iii)Raw materials:
The pre-digested material can be converted into quality vermicompost within 30 days. The composite organic wastes aredecomposed using diluted fresh cow dung slurry, which is to besprinkled. The heap has to be kept moist by regular watering, andit will have to be turned two to three times at an interval of tendays.

4. Canna as a plant filter

Canna lilies which work as a filter have thick masses of roots.Cannas remove nitrogen, phosphorous and toxic heavy metals.

Fig 1: Canna plant

5. Ginger as a plant filter

Ginger (Zingiberofficinale) is an ancient plant species that hasbeen harvested for millennia for not only medicinal uses but inmany Asian cuisines as well. Raw ginger is composed of 79%water, 18% carbohydrates, 2% protein, and 1% fat. Extract ofginger is found to be a green inhibitor for the corrosion of steel insulfide polluted NaCl solution. The wastewater is a combinationof kitchen waste water, washing and rinsing, bathing water whichcontains very highconcentration of organic substances such asproteins, carbohydrates and lipids. Zingiberaceae have thickmasses of roots that work as a filter. Ginger to be grown on reedbeds, which help to remove toxicity in the water. Ginger removetoxic heavy metals, nitrogen, phosphorous and radioactivenuclides, among other pollutants. It reduces the inorganic nitrogenand COD from wastewater, it is one of the most importantobjectives in any water treatment process and is usually used toevaluate the performance of the treatment system.

Fig.2: Ginger plant

6. Experimental setup and procedure

The domestic wastewater obtained after washing the utensils isused as experimental liquid. The experimental setup consists oftwo plastic tubs having cross sectional dimensional of 600mmdiameter and height of about 600mm. the boxes have the holes atthe bottom for water recovery. A layer of coarse gravel 25mm sizeis laid at the bottom. A 30mm thick layer of 12mm gravel supports20mmthick layer silt free sand passing through 1.70mm.I.S sieveover that. This is the drainage Thick layer of vermification withearthworm are placed. Canna tree is planted in one box and gingeris planted in another box. The vermifier are watered is sprinkledfor ten days for acclimatization of the system.In order to access the performance of vermifier, unit samples werecollected from the mess drainage line. This sample was tested for45 *International Journal of Engineering & Technology*SS, COD, BOD before feeding to tank. The samples of wastewater is then applied over the vermifier at the constant rate of flowso that the rate of infiltration of vermifier was equal to the rate ofapplication of sewage and no ponding occurred. The output fromthe each vermifier is collected in another tank. Earthworms areversatile waste eaters and decompose-rs. It promotes the growth ofbeneficial decompose r bacteria' in wastewater and acts as anaerator, grinder, crusher, chemical degrade r, and a biological simulator. The waste water is passed through the experimentalsetup which contains bottom layer of coarse aggregates havingsize of 7.5cm and it is filled up-to to a depth of 25cm. The secondlayer contained about 3.5cm to 4cm of gravels it is filled up-to adepth of 25cm with a layer of garden soil on top. This formed thevermifilter bed.

The topmost layer of about 10cm consists of pure soil in which theearthworms were released. The earthworms were given aroundone week settling time in the soil bed to acclimatize in the newenvironment. It is important to note that the soil and sand particlesand gravel also contribute filtration and cleaning of wastewaterby adsorption of the impurities on their surface. The root zone ofcanna and ginger plant acts as a biofilter. It reduces the toxicelements and heavy metals from the waste water. After thisprocess the recycled form of wastewater is get collected in anothertank. The recycled wastewater contains less BOD and COD thanthe raw wastewater. By this process the BOD, COD and TS fromwastewater gets reduced. The collected water canbe used for carwashing, gardening, and flushing, etc. The sewage and theeffluents from vermifier 1 and vermifier 2 were tested for BOD,COD and suspended solids at regular intervals; the results aretabulated in the subsequent tables.

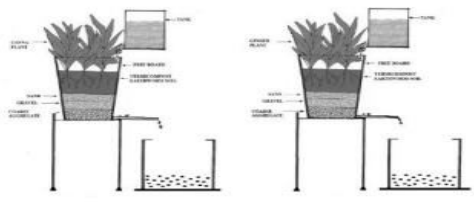

Fig.3: Experimental set up

Date	Hydraulic Loading
23/8/20	1 liters. Per day(water)
27/8/20	2 Liters Per day(water)
30/8/20	3 Liters Per day (water)
4/9/20	3.5 Liters Per day (water)
8/9/20	4 liters per day (water)

Table 1: Rate of hydraulic loading

DATE	HYDRAULIC LOADING
15/10/20	3 Liters. per day (sullage water)
20/10/20	3 Liters. per day (sullage water)
25/10/20	3 Liters. per day (sullage water)
1/11/20	3 Liters. per day (sullage water)
5/11/20	3 Liters. per day (sullage water)

Table2: Rate of hydraulic loading of sullage water

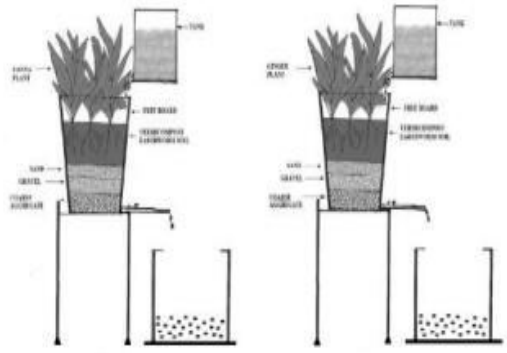

Fig 4: Water Before Treatment and After Treatment

7. Laboratory Analysis

All the samples of the waste water which being collected were analyzed into laboratory for important parameter like biochemical oxygen demand, chemical Oxygen Demand and Suspended solid of the waste watersamples.

8. Results of Laboratory Analysis

The results of the laboratory analysis carried out during the study project are present in tabular format as well as through curves. The overall quantity of waste water from hostel is revealed , which is prepared on the basic of analysis of different samples

SL. NO	Parameter	Concentration
1	Colour	Pale yellow
2	pH	7.32
3.	Temperature	28 ˚C
4	Suspended Solids (mg/lit)	25
5	BOD5 (mg/lit)	9
6	COD5 (mg/lit)	190
7	Turbidity	70 NTU

Table 4: The characteristics of treated water using Canna plant

SL. NO	Parameter	Concentration
1	Colour	Yellow
2	pH	6.8
3.	Temperature	28 ˚C
4	Suspended Solids (mg/lit)	26
5	BOD5 (mg/lit)	21
6	COD5 (mg/lit)	212
7	Turbidity	90 NTU

Table 5: The characteristics of treated water using Ginger plant

For each of the organic loading rate applied to the vermifier tablesare prepared to depict the pattern of bio- degradation of waste interms of reduction in the concentration of various parameters like46 International Journal of Engineering & TechnologyCOD, BOD and Total Solids. The pattern of bio-degradation of thedomestic wastewater through the process of vermification in termsof percentage removal of different parameters is presented.

9. Results

The variation in concentration of COD, Total solids and BOD with respect to time and with respect to different loading rate is analyzed. And from the above table can be seen that thepercentage reduction in COD for vermifier 1 ranges from a valueof 65.00% to 86.00% corresponding to different initial organic loading's. The corresponding reduction in Vermifier 2 ranges from61.00% to 76.00% thus the overall efficiency of removal of CODis higher in case of Canna Vermifier. The reduction inconcentration of BOD in Vermifier1 ranges from 90.00% to97.00% corresponding respectively different organic loading. Thecorresponding reduction in Vermifier 2 ranges from 75.00% to93.00% thus the overall efficiency of removal of BOD is higher incase of Canna Vermifier than Ginger Vermifier.The percentagereduction in concentration suspended solids in VF1 correspondingto different loading varies from 91.00% to 95.00% respectively.The corresponding removal in VF2 ranges from 91.00% to94.00%. From the above results it is seen that the water quality interms of BOD, COD and S.S have been reduced considerably asthe wastewater passes through the filter. Due the presence of earthworm the soil is broken into smaller units in the form vermicomposed due to which large percentage reduction in S.S isobserved.During the course of experimentation it was found that there wereno sign of any development of anaerobic condition in the model asthere was no odour or noflies inspite of daily application ofsewage. The effluent from both the vermifilter was totally odourfree. It shows pale yellow color due to leaching of some dissolvedsalts. The intensity of this color decreased as the system stabilized with acclimatized over the span of one months. The growth ofplants in Vermifier 1 (Canna vermifier) was found to be more ascompared to that of plants in Vermifier 2 (Ginger Vermifier)
.Canna plants gave birth to new shoots old plants were cut, so thatthe new plants could grow efficiently. The younger plant consumed the metabolites i.e. nutrients more efficiently and theeffluent of better quality was obtained. Also the Canna plant andGinger plant provided shade for the vermifier.

10. CONCLUSIONS

Vermiculture and vermicomposting technology is an easy practice, ecologically safe, economically sound. Recycling is oneof the best techniques. Vermifilteration of domestic wastewater isadvantageous over the conventional treatment system and they areeco-friendly and economical. This system offers an easy handlingand utilization oriented method of bioconversion of wastewater.From experimental setup we can conclude that CANNA is moreeffective than GINGER in water purification process.

REFERENCES

1. GuptaP.K..,2003Why vermicomposting?Vermicomposting for sustainable agriculture, Agrobios (India), Agro House, Jodhpur, pp.14-25
2.Ismail S.H, Joshi P and Grace A. 2003“The waste in your dustbin isscarring theenvironment” – The technology of composting, Advanced Biotech (II) 5: 30-34
3. Shewta, Singh Y.P and Kumar U.P. 2004“Vermicomposting a profitable alternativefor developing country”, Agrobios (II) 3: 1516
4. Singh D.P. 2004“Vermiculture biotechnology and biocomposting InEnvironmentalmicrobiology and biotechnology” , NewAgeInternational (P) Limited Publishers, New Delhi, pp. 97-112.
5. Sujatha K, Mahalakshmi A and Shenbagarathai R. 2003 “Effect of indigenous earthworms on solid waste in Biotechnology in Agriculture Industry and Environment” (Eds. Deshmukh A.M) Microbiology society, Karad, pp. 348-353
6. Tripathi Y.C, Hazaria P, Kaushik P.K and Kumar A. 2005“Vermitechnology and waste management In: Verms and vermitechnology, New Delhi, pp. 9-21