Treatment of Domestic Waste Water by Filtration Operation Using Low-Cost Natural Adsorbents

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Abstract – In India, the most common method of disposal of waste water is by land spreading this treatment method has numerous problems namely high labor requirements and the potential for eutrophication of surface and groundwater. The reuse of domestic waste water for non-potable water application is a potential solution for water deprived region worldwide since water is such a vital resource for survival of both plants and animals it is our responsibility to manage this resource not only as a social Industrial and commercial good but also for the sustainable benefits of all present and future living matter increasing pressure to meet more stringent discharge standards or not being allowed to discharge treated effluent has led to implementation of a variety of advanced biological treatment process. This paper reviews the application of filtration process using low cost natural adsorbent for domestic waste water treatment. Treatment of wastewater using a simple, decentralized, environment friendly method using minimum energy which is applicable to rural as well as urban areas at a low cost is need of the present. The main advantage of filtration process is that they maintain high concentration of microorganism resulting in high removal rate.

Filtration technology is a low-cost treatment technology based on physical process to treat wastewater contaminants likecolour, odour, hardness, BOD, COD and suspended solid etc. for a wide range of application in domestic as well as industrial application research on alternate filtration media has expanded the options available for improving excellent quality. The low cost filter is a household point-of-use water treatment system, and has been identified as a sustainable and suitable water treatment technology in rural remote areas in developing countries. It is a modified intermittently operated sand filter capable of filtering pathogens, suspended solids and decreasing turbidity levels through physical, physio-chemical and biological processes. This paper intense to provide an overall vision of multimedia filter technology an alternative method for treating waste water.Treated water use for Irrigation, toilet flushing, car washing, gardening, fire fighting, etc.

Index Terms – Domestic wastewater; Multimedia filter; Packing materials.

1. INTRODUCTION

Wastewater is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid wastes charged by domestic residences commercial properties industries and agriculture and can import range of potential contaminants and concentration. In the most common uses it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of waste water from different sources waste water also known as sewage originates from residential commercial and industrial area. Wastewater also contains nutrients which can stimulate the growth of aquatic plant and may contain toxic compounds are compounds that potentially may be mutagenic and carcinogenic. Beside that the purpose of wastewater treatment is to remove pollutants that can harm the aquatic environment if they are discharged intoit.Conventional treatment techniques of wastewater are expensive, since they have large requirements of land and continuous supply of energy. It is necessary for treating domestic waste waters which will low cost and having any significant negative impacts on the environment. The main objective of the dissertation is to find the economical way to treat the domestic waste water and tosolve the problem of water in water scarce area.Filtration is one of the oldest and simplest methods ofremoving those contaminants. Generally, filtration methods include slow sand and rapid sand filtration. Reliable operation for sand filtration is possible when the raw water has low turbidity and low suspended solids. For this reason, when surface waters are highly turbid, ordinary sand filters could not be used effectively. Therefore, the roughing filters are used as pretreatment systems prior to sand filtration. Furthermore, roughing filters could reduce organic matters from wastewater. Therefore, roughing filters can be used to polish wastewater before it is discharged to the environment.

2. PRACTICAL EXPERIENCES OF THERELATED WORK

Successful combinations included Ativated carbon,sugarcane bagasse, wheat husk,sand and grass mulch as filter media. The study showed that roughingfiltration may be considered as efficient pretreatmentprocess incase surface water is used as water supply.

Affam and Adlan (2009).This study was conducted to investigate the removal of COD, BOD, turbidity and colour from leachate using vertical upflow filtrationtechnique.

Limestone media with a density of 2554 kg/m3 was crushed and graded in sizes of4 - 8 mm, 8 - 12 mm, and 12 - 18 mm. The three media size ranges (4 - 8 mm, 8 - 12 mm, and 12 - 18 mm) were used to assess the influence of flow rate, pore size and media density on BOD, COD, colour and turbidity removal efficiency. Filter media size were stacked in decreasing size from bottom towards the top for all experiments. The media was washed with 20 liters of dilution water before leachate was passed through the column. Five hydraulic loading rates (100 mL/min, 80 mL/min, 60 mL/min, 40 mL/min and 20 mL/min) were initially assessed in this study to determine the influence of interstitial fluid velocity on removal efficiency of the various parameters. Trial runs were done before the main experiment at an interval of 24 h analysis. Leachate was between pH 7.94 to 8.12 before experiments but increased to pH 8.42 after the filtration process. Maximum headloss at steady flow rate 20mL/min was 0.5 cm. The optimum treatment was achieved with 4–8 mm, 8–12 mm & 12–18 mm media size in combination and removal efficiency was 22 to 81%, 22 to 75%, 32 to 86%, and 36 to 62% for BOD, COD, turbidity and colour, respectively. Vertical upflowroughing filter can be used for pretreatment of leachate before further treatment.

Rehman et al. (2012) aimed towards designing and construction of efficient plastic media-trickling filter (TF) for the treatment of domestic wastewater. A shower rose was used as wastewater distributionsystem supported on the top of stone media bed. A net distance between the bottom of shower rose and top offilter bed surface was 9 inches. The flow of water was controlled by electric dimmer connected to the water pump. It was run under different treatment times (12, 24, 36 and 48 hrs) at 5-15ºC. After 48 hrsHRT,treated wastewater was then passed through SF. Parameters like COD, BOD5, TSS, turbidity, NO3, NO2, SO4, PO4 and pathogenic indicator microbeswere monitored after treatment of 12, 24, 36 and 48hrs. The efficiency of the TF was improved with increase of time from 12 to 48 hrs. Maximum efficiency of TF was observed after 48 hrstreatment viz. 93.45, 93, 86.25, 57.8, 63.15, 25, 32.43, 99.95 and 86.3% reduction from the zero time value for BOD5, COD, TSS, PO4, SO4, NO3, NO2, turbidityand fecal coliforms respectively. Finally 48 hrs treated sample was passed through sand filter (SF) for further final polishing and approximately, 95.72, 95, 100, 73.5, 65.8, 58.3, 37.83, 100 and 91.5% reduction in BOD5, COD, TSS, PO4, SO4, NO3, NO2, turbidity and fecal coliforms was observed. This study showed that plastic media-trickling filter along with sand filter is a promising technology for wastewater treatment and can be scaled up for small communities in the developing countries.

Mukhopadhay and Majumder (2008)constructed a pilot plant in the Department of Water Resources Engineering, Jadavpur University to investigate the possibility of horizontal roughing filter‘s ability totreat waste water. The structure of the plant was made up from the fiber glass sheeting which consisted of three chambers of each measuring 450 mm × 300 mm. The filter medium namely gravel was placed in the three separate chambers starting from the coarse size to the finer ones in the direction of flow and the whole system was operated in series. The first compartment was filled up of gravel size 15 mm–10 mm having the average size 12.5 mm the second compartment consisted of average gravel size 7.5 mm and the third one of average size 2.5 mm. Each compartment was being separated by the perforated fiber glass partition to avoid mixing of the gravels of different chambers. The filter bed was provided with the under drainage system to enable flushing after a certain running period of interval for hydraulic sludge extraction by observing the filter resistance. A constant flow rate of 0.75 m/h was maintained through all the compartments by the help of a peristaltic pump. The suspended solids (SS) concentration of raw water for all the chambers at the inlet and the SS concentration at the out let was measured by the help of standard procedure describe in the Standard methods. The experiment was carried out both in low flow (dry season) and high flow (rainy season) periods during the span of 70 days. The local pond water was used as raw water which has the concentration of suspended solids ranges from 40 mg/ℓ to 150 mg/ℓ. According toWeglin’s design guideline this range is medium range of concentration (100–300) mg/ℓ for which filtrationrate is 0.75 m/h – 10 m/h are recommended. So a constant flow 0.75 m/h was chosen in carrying out the project.

Hgazy,ElKhateeb,Amira,andKamel(2007) mentioned that the combination of cement kiln dust and rice straw as a filter was an efficient and low cost technology for waste water treatment and reuse.

Bangladesh (Huq etal.,2010). HussamandMunir(2007)reported that a two-bucket system filter (one bucket filled with coarse and fine sand and the other with wood charcoal and brick chips) produced arsenic-free safe drinking water approved by the Bangladesh Government.

El-Gendy A. S., Sabry T. I., El-Gohary F. A. (2012), The Use ofAn Aerobic Biological Filter for Improving The EffluentQuality of A Two-Stage Anaerobic System, SixteenthInternational Water Technology Conference, IWTC 16,Istanbul, Turkey.

R.K. Sinha, G Bharambe, U Chaudhari, Sewage treatment by vermin filtration with synchronous treatment of sludge by earthworm: a low-cost sustainable over conventional technology over conventional systems with potential for decentralization, Environmentalist, 28 (2008) 409.

Al-Rawi S. M. (2009). Introducing sand filter cappingfor turbidity removal for Potable watertreatment plants, Environment Research Center (ERC),Mosul University, Mosul, Iraq. International Journalof Water Resources and Environmental Engineering Vol. 1 (1), pp. 011.

Simonis in 2012 studied the manufacturing a low-cost ceramic water filter [19] and filtersystem for the elimination of common pathogenic bacteria and suspended solids. A microporousceramic water filter in which clay was mixed with rice husk in a ration 2:1 by weightand a cylindrical shaped filter was manufactured by tradition oven drying and then burningin kiln at specified sintering temperature. After being coated with silver nitrate solution forpreventing the growth of microbes, the filter was tested for removal of suspended solids andpathogens.

Hamid Sarkheil, JavadTavakoli, Reza Behnood. Oil by-Product Removal from Aqueous Solution using Sugarcane Bagasse as Absorbent.International Journal of Emerging Science and Engineering (IJESE)ISSN: 2319–6378, Volume-2 Issue-9, July 2014.

Rajesh N Patel1,2, Santanu Bandyopadhyay1, Anuradda Ganesh*1 Indian Institute of Technology, Bombay, Mumbai, India.Selective Extraction Of Phenols FromSugarcane Bagasse Pyrolysis Oil.

Mohammad Mirjalili1*, Mahmood B. Tabatabai1 and Loghman Karimi2 Novel herbal adsorbent based on wheat husk for reactive dye removal from aqueous solutions The study showed that the wheat husk can beused as an adsorbent for the removal of C.I. Reactive Yellow 15 from aqueous solutions. Wheat husk is easilyavailable in large quantities and the treatment method ofbio-sorbent seems to be economical. Different effective parameters in the decolorisation process of dye solutionwere studied. The amount of dye sorbet was found tovary with initial solution pH, cotact time, stirring speed and treatment of the wheat husk.

3. AIMS AND OBJECTIVES

The aim of the study was to upgrade the conventional treatment processes by developing the multimedia filter for domestic wastewater treatment. Designing the Low-cost sand filter model and treatment of sample by filtration process using low-cost natural adsorbents and study the performance of multimedia filter with different packing media such as Ativated carbon, sugarcane bagasse, wheat husk, sand and grass mulch was the objective of the experimental study. The removal efficiency of physic-chemical parameters was studied.Treated water use for Irrigation, toilet flushing, car washing, gardening, firefighting, etc.

4. MATERIALS AND METHODS

Filter Media:

The selection of a suitable filter media is an important part in the design of operation and multimedia filter process in order to meet the required effluent quality. Removal efficiency increases with decreasing filter media size and increasing filter bed depth. Filter media provides large surface area to enhance the microbial growth. Therefore it plays a key role in maintaining a high amount of active biomass and a variety of microbial populations. In multimedia filter three different types of media were used such as activated carbon, wheat husk and sugarcane bagasse and grass mulch.

ACTIVATED CARBON

SUGARCANE BAGASSE

WHEAT HUSK

5. EXPERIMENTAL SETUP

Filtration tank

The model of multimedia filter of GI sheet was designed for a family according to census of India, 2011 & BIS and then developed.The filtration tank was constructedfrom metal plate precisely gauge 22. Therectangular filtration tank is 1 m high, 0.3 m long and 0.3 m wide as shown in Figure. The tank has a compartment of the filter mediumwhere various filtering materials were placed.

The model consists of natural adsorbent's compartments placed in series with downflow regime packed with different packing media. The depth of the media was kept accordingly. The inlet and outlet arrangement were provided at appropriate locations for feeding and withdrawal of influent and effluent.

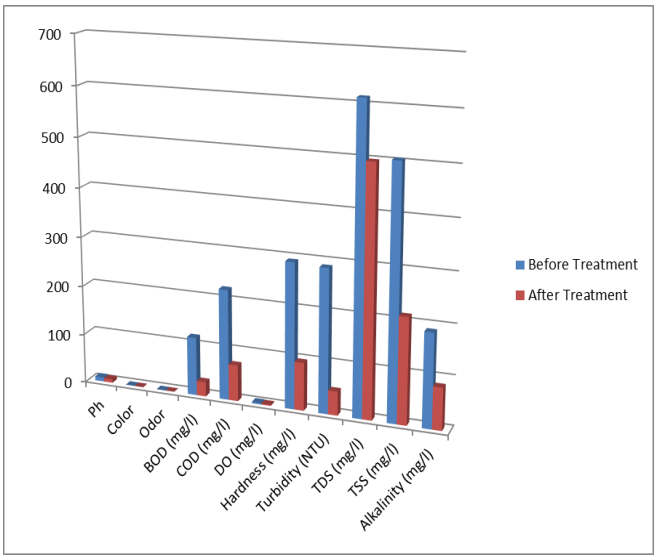
The domestic wastewater was collected from local drainage system The wastewater from inlet tank enters the inlet chamber and flows in sequence i.e. from the first compartment to the last compartment and then enters the collecting chamber and was collected from the outlet. The first compartment was packed with grass mulch &wheat husk. The second compartment was packed with sugarcane bagasse. The third compartment was packed with Activated Carbon, Sand and grass mulch. The wastewater was allowed to flow from the first compartment to the third compartment in the down flow regime. The wastewater was collected in the collecting chamber and after reaching the outlet level the treated effluent was collected in the outlet tank.

6. RESULTS AND DISCUSSION

During the study, influent and effluent samples were taken regularly and the concentrations of BOD, COD, TDS, TSSetc. were tested according to the standard methods. The multimedia filter gave the good results for removal efficiency for BOD was 74%, COD was 67%, TSS was 57%,Turbidity was 83%, TDS was 18%,Alkalinity was 55%and Hardness was 67.2% was obtained.The results of present investigation that this filter will be found to be an effective adsorbent filter for the removal of impurities from the domestic waste water and the treated waste water use for Irrigation, toilet flushing, car washing, gardening, firefighting, etc. The filter may be require little maintenance, provided the units will be properly designed and operation will be kept within general guidelines.

Comparisons of different exiting parameters of waste water before filtration & after filtration.

S.no	Parameters	Units	Before Filtration	After Filtration
1	Ph	------	8.3	7.1
2	Color	hazen	gray	Light
3	Odor	------	non offensive	non offensive
4	BOD	mg/l	117.9	29.5
5	COD	mg/l	223	73
6	DO	mg/l	3.1	2.3
7	Hardness	mg/l	293	96.6
8	Turbidity	NTU	289	48.3
9	TDS	mg/l	613	498
10	TSS	mg/l	504	213
11	Alkalinity	mg/l	189	85.2



7. CONCLUSIONS

From this experimental study it is concluded that the Multimedia Filter process had given an excellent results and significantly assist in theremoval of Ph, TDS, BOD, COD, TSS, TDS, DO, hardness, EC and will improve the physio-chemical quality of the effluent.Treated water use for Irrigation, toilet flushing, car washing, gardening, firefighting, etc.

The studyrevealed that the system will performed well for the future need and have less cost of production and maintenance. This project will help to understand a new approach of anenvironmental friendly low cost filtration techniquewhich can be used commonly in the every household.

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