

Treatment of Domestic Wastewater by Natural Adsorbents Using Multimedia Filter Technology

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Abstract – This paper intends to provide an overall vision of multimedia filter technology as an alternative method for treating waste water. Treated water is used for irrigation, toilet flushing, car washing, gardening, firefighting, etc. Filtration technology is the simplest and low cost treatment technology based on the principle of attached growth process. Multimedia Filters represent a significant improvement over single media filters. A multimedia filter model was developed by G.I. sheet for treatment of domestic wastewater. Different packing media are used such as Activated carbon, sugarcane bagasse, sand and grass mulch.

Index Terms – Activated carbon, sugarcane bagasse, Domestic wastewater, Filtration, Multimedia Filter.

1. INTRODUCTION

Because of the scarcity of clean water, treated wastewater potentially provides an alternative source for irrigation, flushing, gardening. The domestic wastewater is characterized in terms of its physical, chemical and biological composition. The composition changes depending on the location of the source, seasonal variation, climate, time of day, water consumption and population. Composition refers to the actual amounts of physical, chemical and biological constituents present in wastewater. Wastewater treatment may include mechanical, biological, and physical-chemical methods. Selection of a wastewater treatment method depends on pollutant origin. One wastewater treatment using physical-chemical methods is adsorption, which has the advantages of being fast, cheap, and universal. For removing organic pollutants from water, different low-cost materials are used as adsorbents, including agricultural products, industrial wastes, and activated carbon.

Besides that, the purpose of wastewater treatment is to remove pollutants that can harm the aquatic environment if they are discharged into it. Because of the deleterious effects of low

dissolved oxygen concentrations on aquatic life, wastewater treatment focused on the removal of pollutant that would deplete the DO in receiving water. Filtration is one of the oldest and simplest methods of removing 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.

In general domestic waste water includes black water (fecal sewage) and grey water (wash water from dishwashers, washing machines sinks and bath tubs etc.). Black water accounts 32.5% of domestic waste water while grey water accounts for 67.5%. Domestic waste water is categorized as organic pollutant.

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 like colour, 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 intends to provide an overall vision of multimedia filter technology as an alternative method for treating waste water. Treated water used for irrigation, toilet flushing, car washing, gardening, fire fighting, etc.

2. PRACTICAL EXPERIENCES OF THE RELATED WORK

Simonis in 2012 studied the manufacturing of a low-cost ceramic water filter [19] and filter system for the elimination of common pathogenic bacteria and suspended solids. A micro porous ceramic water filter in which clay was mixed with rice husk in a ratio 2:1 by weight and a cylindrical shaped filter was manufactured by traditional oven drying and then burning in a kiln at a specified sintering temperature. After being coated with a silver nitrate solution for preventing the growth of microbes, the filter was tested for removal of suspended solids and pathogens.

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

Rehman et al. (2012) aimed towards designing and construction of an efficient plastic media-trickling filter (TF) for the treatment of domestic wastewater. A shower rose was used as a wastewater distribution system supported on top of a stone media bed. A net distance between the bottom of the shower rose and top of the filter bed surface was 9 inches. It was run under different treatment times (12, 24, 36 and 48 hrs) at 5-15°C. After 48 hrs HRT, treated wastewater was then passed through SF. Parameters like COD, BOD₅, TSS, turbidity, NO₃, NO₂, SO₄, PO₄ and pathogenic indicator microbes were monitored after treatment of 12, 24, 36 and 48 hrs. Maximum efficiency of TF was observed after 48 hrs treatment 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, turbidity and 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.

Milan. M. Lakdawala*1 and Yogesh. S. Patel, The effect of low cost material Bagasse Fly ash to the removal of COD Contributing component of combined waste water of Sugar Industry.

The study aimed towards minimizing the industrial pollution, advanced wastewater treatment techniques, such as adsorption,

are economically and environmentally essential in the removal of organic and inorganic compounds from industrial wastewater. The present study focuses on the use of low cost adsorbent sugarcane bagasse fly ash to adsorb COD content of the combined wastewater of the sugar industry. Bagasse Fly ash with a specific surface area of 2637.784 cm²/gm is used as a clarifier for the combined waste water of a sugar mill at room temperature. The different dosage of bagasse fly ash is kept in contact for 24 hours and analyzed before and after treatment. The results of COD removal are up to 27.04% and follow the Freundlich and Langmuir adsorption isotherm.

Dr. Ravindra Gaikwad Pravara Rural Engineering College Loni Removal of Dyes from Dye Effluent by Using Sugarcane Bagasse Ash as an Adsorbent. Sugar cane bagasse ash, an agricultural by-product, acts as an effective adsorbent for the removal of dyes from aqueous solution. Batch adsorption study was investigated for the removal of Acid Orange-II from aqueous solution. Adsorbents are very efficient in decolorized diluted solution. The effects of bed depth on breakthrough curve, effects of flow rate on breakthrough curve were investigated. The removal of dyes at different flow rates (contact time), bed height, initial dye concentration, column diameter, pH & temperature by Sugarcane Bagasse Ash as an adsorbent has been studied. It is found that percent adsorption of dyes increases by decreasing flow rate from 2 lit/hr to 1 lit/hr, by increasing bed height from 15cm to 45cm, by decreasing initial concentration 150mg/lit to 100mg/lit, by increasing column diameter from 2.54cm to 3.5cm, by maintaining neutral pH & at temperature 45°C than 25°C & 35°C. The result shows that, bagasse ash is a good adsorbent for dye effluent treatment.

Rasima Abdul Rasid, Department of Chemical and Process Engineering, Faculty of Engineering Universiti Kebangsaan Malaysia (UKM) Biofilm and Multimedia Filtration for Rainwater Treatment Based on the results of this study, it has been shown that the biofilm and multimedia filters are effective, since the filtration media combine the filtration properties of several materials. It has been shown in the results that with a biofilm attached to the GAC surface which consists of bacteria held in an excreted polysaccharide coating, the uptake rate and quantity of metal ions extracted from the samples can be significantly increased. This system is ideally suited from an economic point of view for locations being a low cost technology requiring low initial expenditure, zero power need, no maintenance cost and self-dependent operation even for areas where there is normal seasonal rains.

3. AIMS AND OBJECTIVES

Designing the low-cost sand filter model and treatment of waste water by filtration process using low-cost natural adsorbents and study the performance of multimedia filter with different packing media such as activated carbon, sugarcane bagasse, sand and grass mulch was the objective of the experimental study. The removal efficiency of physio-

chemical parameters was studied. Treated water use for Irrigation, toilet flushing, car washing, gardening, fire fighting, etc.

4. EXPERIMENTAL WORK

MATERIALS AND METHODS:

COLLECTION OF ADSORBENTS:

The adsorbent used for this study are sugarcane bagasse, Activated Carbon and sand and was collected from the local market.

PREPARATION OF ADSORBENT:

Adsorbent of Sugarcane Bagasse (SB):

The sugar cane bagasse was soaked in 0.1 M HCl solution for 18 hours and then washed with distilled water to ensure complete removal of all the dirt particles, lignin and coloring materials present. After that the Bagasse was dried in oven at 120-130°C and grinded in home mixer.



SUGARCANE BAGASSE



ACTIVATED CARBON



Grass Mulch Sand Filter Design

Filtration model:

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 constructed from metal plate precisely gauge 22. The rectangular 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 medium where various filtering materials were placed.



FILTER MODEL

Analysis and Working of Model:

The domestic wastewater was collected from local drainage system. The wastewater from inlet tank enters the inlet chamber and flows in down flow regime sequence. The compartments were packed with Sugarcane Bagasse, Activated Carbon, Sand and Grass mulch in down flow regime respectively. The wastewater was collected in the collecting chamber with chlorination and after reaching the outlet level the treated effluent was collected in the outlet tank.

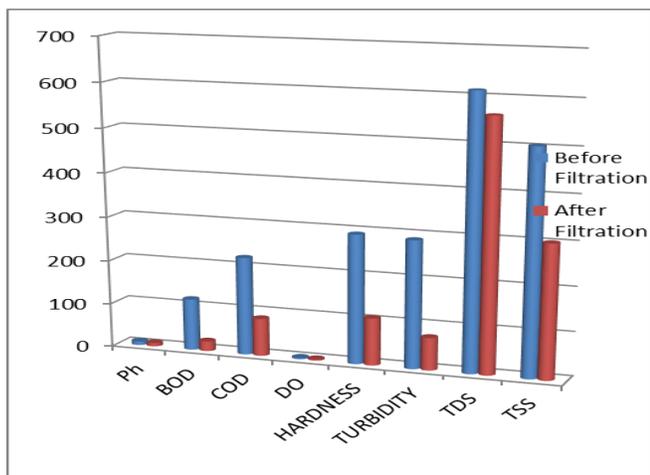
5. RESULTS AND DISCUSSION

It was observed that that adsorbent materials such as Sugarcane Bagasse, Activated Carbon media may prove to be more efficient in improving the effluent quality in terms of its physio-chemical content. It was also observed that the experimental filter model will significantly assist in the removal of BOD, COD, TSS, TDS, DO, HARDNESS, EC and will also improve the pH quality of the effluent. Hence, 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. with proper maintenance and care.

Comparison of parameters Before & After Filtration:

<u>S.n</u> <u>o</u>	<u>Parameters</u>	<u>Units</u>	<u>BeforeFiltrat</u> <u>ion</u>	<u>After</u> <u>Filtratio</u> <u>n</u>
1	Ph	-----	8.3	7.9

2	Color	hazen	gray	Light
3	Odor	-----	non offensive	non offensive
4	BOD	mg/l	117.9	22.6
5	COD	mg/l	223	86
6	DO	mg/l	3.1	2.9
7	Hardness	mg/l	293	107.7
8	Turbidity	NTU	289	74.3
9	TDS	mg/l	613	563
10	TSS	mg/l	504	302
11	Alkalinity	mg/l	189	87.3



6. CONCLUSIONS

Based on the results of this study, it can be concluded that sugarcane bagasse have good performance to adsorb of oil by-product from polluted water especially for high concentration of pollutant and the Multimedia Filter process had given an excellent results and significantly assist in the removal of Ph, TDS, BOD, COD, TSS, DO, hardness, EC and will improve the physio-chemical quality of the effluent. It can also be concluded from the study that the Multi – Media filter may be considered as efficient pre-treatment process for wastewater treatment. Also, the above media may enhance the performance of the treatment system. Hence, this technology is environment friendly and cost effective.

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