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PERFORMANCE EVALUATION OF LANDFILL LEACHATE TREATMENT USING COIR PITH AND COCONUT SHELL AS ACTIVATED CARBON ”

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Abstract: The report deals with evaluation of the performance of Landfill Leachate treatment using natural adsorbents. Inorganic and organic pollutants present in the Leachate continue to pose major problems in receiving water bodies and to the environment. To overcome such problems, natural adsorbent materials are used to minimise their negativeenvironmental impact. In order to find out the effective natural adsorbents for the treatment of landfill leachate, two locally available low cost adsorbents such as Coir Pith coconut shell and activated carbon. Several studies suggest that pollutants such as heavy metals, industrial dyes, pharmaceuticals, organic contaminants can be successfully adsorbed on to coconut biomass. The abundance in availability, renewability and high adsorption are the useful advantages conferred by coconut by- products. This review has focused on all the valuablestudies reported on the facile valorization of various coconut palm wastes such as shell, husk, coir etc.

Keywords - Adsorbent, Leachate, Biomass.

I. INTRODUCTION

Water pollution is a serious environmental problem in the world, which reduces the availability of water for use. Improper treatment of wastewater including leachate from waste disposal sites causes serious environmental degradation. The use of advanced technologies for treating wastewater, however, is limited especially in developing countries due to their high cost and low feasibility. In order to solve this problem it is essential to develop sustainable, low environmental impact and low cost wastewater treatment systems. The utilization of local-available biomass resources as natural biofilm support media for the wastewater treatment is of an increasing interest for applications due to its low cost and low technology. Coconut-fiber biofilm treatment system (COTS), for example, has been introduced at some local authorities in Sri Lanka to treat the

collected sewage and leachate at waste disposal sites [1]. It has been reported that the COTS performed well for treating wastewater under the proper maintenance and operation. However, the overall performance of the biofilm reactor is directly related to the surface area (of biofilm) per unit volume of the support material [2]. The formation of biofilms on various organic, inorganic and synthetic support materials like pumice stone, polysulfone, ceramic material, polysterene, sepiolite, PVC, diabase, polyurethane and bentonite has been investigated [3; 2; 4]. Natural lignocellulosic materials can be alternatives to the predominant inorganic support material used as a biofilm support.Natural lignocellulosic supports are abundant in developing countries, have lower costs, possess comparable surface area per unit volume, while having high porosity,low specific gravity and high bacterial adsorption/adhesion [5]. Organic material can perform a dual activity by providing substrate for the bacterial metabolism while the morerecalcitrant lignocelulosics can simultaneously function as a support material because of its slower degradation rates [6]. Thus organic fiber can show potential as natural biofilm supports in wastewater treatment over a wide range of organic loading rate and wastewater strength. [7] Studied removal of nutrients in the denitrification system using coconut coir fiber for the biological treatment of aquaculture wastewater. Greater consistency in the case of COD removal of upto 81% was observed at nitrogen loading rate120 mg l^{-1} where coconut coir was used as support medium. In this context, Coconut fiber (*Cocos nucifera* L) used as the biofilm support material. Because the fiber of coconut is richin hard organic matters such as cellulose and lignin with high specific surface area and wetting ability, it seems suitable for microorganism’s adhesion and biofilm formation. The

present work is intended to study the application of coconut fiber biofilm treatment system (COTS) for nutrient removal from simulated synthetic wastewater. However, mechanism of wastewater treatment in the COTS and quantitative analysis for designing and optimizing the system are not fully understood. Therefore, in this study we have carried out microcosm experiments in the laboratory for evaluating wastewater treatment mechanism and efficiency in the COTS.

II. LIMITATIONS

The most common problem with coir is it can have an extremely high salt content, especially in lower grades. Coir high in salts should be leached before use. Coir has a lower cation-exchange capacity and it is high in phosphorous and potassium. Growers switching from sphagnum peat to coir need to change their fertilizer practices.

III. LITERATURE REVIEW

1) ***Pavan. S. Kamble, Tauseef Ahmad. Ansari, Bharti R. Gautam, Raju A. Bondre.*** Activated carbon is useful in drinking water treatment because it acts as an adsorbent, andeffectively removes particles and organics from water. In Physico-chemical treatment, theseparation of suspended particles from the liquid phase is usually carried out by the processes like coagulation, flocculation, and sedimentation. These organics are of great concern in water treatment because they react with many disinfectants, especially chlorine, and cause the formation of disinfection by-products. The increasing pH suggests that the filter media is good for pH regulation as it increases the pH constantly closer to neutral from the acidic range. The C.O.D. removal percentage was found to be 76.96%. Hence, the filter media was good for the removal of C.O.D. The dissolved oxygen content of leachate at the initial stage is found to be 5.8 ppm and after passing the leachate through filter media the dissolved oxygen content is increased and it comes out to be 7.2 ppm. This reading was taken on an alternate day; it was observed that if the leachate is passed through filter media the D.O. content in the leachate is increased.

2) ***Chaitrali Sanjay Kulkarni, Dr. Saswati Datta.*** In most countries, sanitary landfilling is nowadays the most common thanks to eliminating municipal solid wastes (MSW). In spiteof the many advantages, the generation of heavily polluted leachates, presenting significant variations in both volumetric flow and chemical composition, constitutes a major drawback. Year after year, the popularity of landfill leachate impact on the environment has forced authorities to repair more and more stringent requirements for pollution control. This paper may be a study of landfill leachate treatments. Landfill leachate may be a significant polluting factor of the environment. The leachate generation may be a major problem of municipal landfill sites or dump yards. The leachate may be a toxic black liquid leached from the landfill containing dissolved and suspended matter in it. Leachate may be a product formed when precipitation or atmospheric moisture enters the landfill that's undergoing degradation. The leachate contains organic and inorganic compounds, heavy metals, and pathogens, if not collected they will pollute both surface and groundwater.

3) ***Prof Rangari P.J, Prof. Priyanka Chavan.*** Activated carbon is broadly defined to include a wide range of amorphous carbon-based materials prepared in such a way that exhibits a high degree of porosity and an extended surface area. For many centuries activated carbon was used in the form of carbonized wood. The earliest known use of carbon in the form of wood chars by the Egyptians and Sumerians was in 3750 BC for the reduction of ores in the manufacturing of bronze, domestic smokeless fuel, and medicinal application. In 1500 BC, Egyptian papyri were used as adsorbents for odorous vapors from putrefying wounds and from within the abdominal tract. The wrecks of Phoenician trading ships suggest that drinking water was stored in charred wooden barrels. This practice was certainly still in use in the 18th century for extending the use of potable wateron long sea voyages. This Paper deals with an extensive literature survey on the present research work. This literature search provides background and guides for the entire study.This Paper includes the review on the historical appraisal of activated carbon, activated carbon preparation methods, application of activated carbon, wastewater treatment methods, classification of textile dyes and effect of process parameters on activated carbon preparation and adsorption studies.

4) ***J.K. Anuradha De Silvaa*, A.K. Karunaratnea, V.A. Sumanasinghea.*** Treatment of wastewater is one of the major challenges in developing countries. Improper management of wastewater may cause serious health and environmental problems. There are many wastewater treatment methods in the world and these techniques need expertise knowledge, infrastructure facilities and high maintenance cost. In the context of developing countries, having. Low cost and environmental friendly waste water treatmentTherefore, studying on the plausibility of wastewater treatment using attached growth microbial biofilms on coconut fiber may evidence for the fact that coconut fiber biofilm treatment systems could be used in the above need, as a reliable method.

5) ***Nirmala Kumudini Dharmaratne, Norio Tanaka.*** The utilization of local-available biomass resources as natural biofilm support media for the wastewater treatment is an increasing interest for applications due to its low cost and low technology. The fiber of coconut (Cocos nucifera L.) is rich in hard organic matters with high specific surface area and wetting ability, it seems suitable for microorganisms adhesion and biofilm formation.This study we have carried out microcosm experiments in the laboratory for evaluating wastewater treatment mechanism and efficiency in the Coconut-fiber biofilm treatment system (COTS). A synthetic leachate solution was used as a wastewater in this study. The string of coconut-fiber was put inside the treatment tank with two conditions: low fiber density (LFD) and high fiber density

(HFD). The synthetic leachate solution flowed into the treatment tank from the supply tank through the peristaltic pump at a rate of 870 cm3/day (two-weeks retention time). Flow schedule of microcosm experiment was separated into two stages such as circulation stage and treatment stage. After the 70 days of startup Chemical Oxygen Demand (COD) removal efficiency of HFD tank 629 was 42% compared to blank tank. Biological Oxygen Demand (BOD) and Total Organic Carbon (TOC) removal efficiencies of HFD tank were 48% and 28% respectively. The maximum NH4+-N removal efficiency was recorded after the 14 days of startup. It was around 45% in HFD tank. The condition of the COTS somehow seems to contribute to remove organic matter from the wastewater

6) ***Ania James, Deepika Yadav.*** Water pollution is a grave concern in the 21st century. The challenge is to devise techniques to treat water that are facile, does not involve toxic resources or by- products, and are not energy-intensive. Adsorption using agricultural wastes seems to be a promising approach. Parts of coconut palm such as shell, husk, coir etc in their native or modified form can be used for wastewater treatment. Several studiessuggest that pollutants such as heavy metals, industrial dyes, pharmaceuticals, organic contaminants can be successfully adsorbed on to coconut biomass. The abundance in availability, renewability and high adsorption are the useful advantages conferred by coconut by- products. This review has focused on all the valuable studies reported on the facile valorization of various coconut palm wastes such as shell, husk, coir etc. for remediation of pollutants from waste water since the year 2010. The chemical modifications of the adsorbents and their capacities for removal of various contaminants have been mentioned. Various computer software modelling studies and reuse of the bioadsorbents have been included. Most of the data has been given in tabulated form for ease of understanding. The important advancements, challenges and future prospective have also been discussed along with compilation of all the relevant scientific reports of thelast decade on the potential of coconut refuse for waste water treatment. The main aim of this review is to highlight the importance of utilization of biomass, particularly those that lie waste, for remediation of environmental pollution in a sustainable management.

IV. MATERIALS USED FOR CONSTRUCTION OF MODEL

- Sand
- Fly ash
- Coconut shell (activated carbon)
- Coir pith

◦ ***SAND***

Sand is a naturally occurring granular material composed of finely divided rock andmineral particles. A layer of sand is also used in the filter media to make it effective. Here River sand is used which was sieved manually passed through 4.75mm and retained on 2.45mm sieve.

◦ ***.FLYASH***

Fly ash is collected from thermal power plant. It is used as an adsorbent for the removal of pollutant from waste water which meets the dual goals of disposal and treatment. Fly ash, also known as flue-ash, is one of the residues generated in combustion. During combustion, mineral impurities in the coal (clay, feldspar, quartz, and shale) fuse in suspension and float out of the combustion chamber with the exhaust gases. As the fused material rises, it cools and solidifies into spherical glassy particles called fly ash.

- ***COCONUTSHELL (ACTIVATED CARBON)***

The use of lignocellulosic material for remediation of waste water is a green technique. Coconut shell contains lignocellulose and is one of the commercial varieties of low-cost adsorbents.

- ***COIR PITH***

Coir pith has gained wide attention as effective bio-adsorbents due to the significant adsorption potential for the removal of various aquatic pollutants. Cost-effectiveness, abundant availability and renewability makes them as an economical alternative for water treatment and waste remediation.

V. PUZZLE STATEMENT

Efficient wastewater treatment is critical for the world. There is unprecedented environmental pressure being exerted on the environment by the rapidly expanding population. This growing population requires adequate clean groundwater to drink. (4) Theenvironment demands relatively unpolluted surface water in streams and lakes to maintainthe flora and fauna that humans have come to rely upon for food and recreation. Moeller estimates that 80% of the total disease burden in developing countries comes from waterborne illness. .Diarrhea still claims an estimated 2,000,000 children a year. (2), Chinareports that 300,000,000 of its citizens lack safe drinking water (3). In the USA, 95% of the population in rural areas receives its. Drinking water from groundwater-recharged wells(US Environmental Protection Agency, 1998). Water purification is the ultimate technique to ensure safe drinking water. Activated carbon is useful in drinking water treatment because it acts as an adsorbent, and effectively remove particles and organics from water. These organics are of great concern in water treatment because they react with many disinfectants, especially chlorine, and cause the formation of disinfection-by-products. (1) Activated carbon is one of the best tools which can be used to reduce risks to human health and provide an aesthetically pleasing product at reasonable cost. The reason that activated carbon is such an effective adsorbent material is due to its large number of cavernous pores.

VI. PURPOSE

Activated carbon is used to purify liquids and gases in a variety of applications, including municipal drinking water, food and beverage processing, odor removal, industrial pollution control, and point-of-use filters in the home. Public awareness and the concern about safe drinking water have driven consumers to install point-of-use carbon systems in their homes, further purifying the water that they drink.

VII. OBJECTIVE

1. To Remove impurities present from waste water and make it reusable.
2. Try to find other alternatives for usable water such as Recycling and Reusingof wastewater.
3. Improvement to existing source & effective management to cater perspectivewater demand.
4. Effective management of raw & treated water. To produce water usingfacilities which can be constructed and operated at a reasonable cost

VIII. COCONUT FIBER BIOFILM TREATMENT SYSTEM

Coconut fiber biofilm treatment system (COTS) consists of three tanks such as receiving tank, sedimentation tank and treatment tanks. Receiving tank is used to collect the wastewater initially; then, it is discharged to the sedimentation tank to settle down the heavy particles in the bottom of the sedimentation tank. Thereafter, settled supernatant flows into the treatment tank where the strings of coconut fibers present (Sato *et al.*, 2017). Also, the biofilm is formed, degradation process is started and treated water is discharged as effluent from the treatment tank. The outline of the COTS of Balangoda urban council is shown in Figure 3 (Sato, 2013).This treatment system is mostly practiced in South and South-East Asian countries like India, Sri Lanka and Malaysia (Manoj and Vasudevan, 2012). However, coconut fibers have been used in the treatment process to eliminatehydrogen sulfide (Filho *et al.*, 2010). Figure 4 shows the countries that use coconut fiber as biofilm for treatment of wastewater. COTS is mainly practiced in Asian countries such as Sri Lanka, India, Bangladesh, Vietnam and Malaysia. Coconut fibers are used as absorbent and biofilm surface to treat wastewater methodically (Gonzalez *et al.*, 2008).

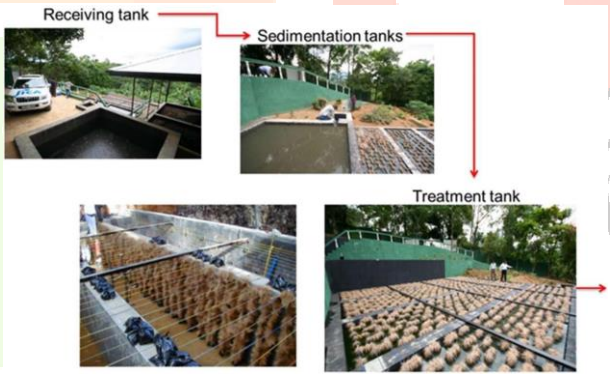

Figure: The outline of coconut fiber biofilm treatment system (COTS) inBalangoda urban council, Sri Lanka (Sato, 2013).

Figure: The countries that use coconut fibers as biofilm surface to treatwastewater.

IX. CONCLUSION

Coconut shell and coir pith is an inexpensive and effective for removal of cod , TS , and maintain ph level due to its high adsorption capacity and property of behave as a activated carbon. Environmental pollution issues can also be minimised by using coconut waste in lechate treatment.This technique is highly advantageous, inexpensive and cost-effective and in turn there will be utilization of a waste which would be otherwise simply dumped. Various literaturereviews also gave a remarkable evidence of removal of wide range of pesticides from coconut shell activated carbon. Thus, this improvisation can be rendered as a novel method for drinking water treatment taking environment into concern.The development of this new technology has turned from a fascinating alternative approach which offers a wide range of advantages when implemented

X. REFERENCE

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