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STUDIES ON NATURAL FIBRES AS FIXED AERATED BEDS FOR DOMESTIC WASTEWATER TREATMENT

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Abstract - Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. This paper discuss about natural fibers and its applications. Also, this paper concentrates on biomaterials progress in the field of orthopedics. An effort to utilize the advantages offered by renewable resources for the development of bio composite materials based on bio epoxy resin and natural fibers such as Agave sisalana, Areca husk fibres. In the present study efforts have been made to check the efficiency of two different fibrous materials, Agave sisalana fibers and Areca husk fibers used as filter media at different contact periods. To study the comparative removal efficiency of COD, BOD, sulphate, nitrate using Agave sisalana and Areca husk fibers on 15cm filter media and 30cm filter media.

Key Words: **Natural Fibrous Materials,Agava sisalana, Areca husk, Mixed media treatment.**

1. INTRODUCTION

Wastewater is liquid waste discharged by domestic residences, commercial properties, industry, agriculture, which often contains some contaminants that result from the mixing of wastewater from different sources. Wastewater obtained from various sources need to be treated very effectively in order to create a hygienic environment. If proper arrangements for collection, treatment and disposal of all the waste produce from city or town are not made, they will go on accumulating and create a foul condition that the safety of the structures such that building, roads will be damaged due to accumulation of wastewater in the foundations. In addition to this, disease causing bacteria will breed up in the stagnant water and the health of the public will be in danger.

The principal aim of wastewater treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. Therefore in the interest of the community of the town or city it is most essential to collect, treat and dispose of all the wastewater of the city in such a way that it may not cause harm to the people residing in the town. The extent and the type of treatment required, however depends on the character and quality of both sewage and sources of disposal available.

1.1 WASTEWATER GENERATION AND TREATMENT

It is estimated that about 38,254 million litres per day (MLD) of wastewater is generated in urban centres comprising Class I cities and Class II towns having population of more than 50,000 (accounting for more than 70 per cent of the total urban population). The municipal wastewater treatment capacity developed so far is about 11,787 MLD, that is about 31 per cent of wastewater generation in these two classes of urban centres. The status of wastewater generation and treatment capacity developed over the decades in urban centres. In view of the population increase, demand of freshwater for all uses will become unmanageable. It is estimated that the projected wastewater from urban centres may cross 120,000 MLD by 2051 and that rural India will also generate not less than 50,000 MLD in view of water supply designs for community supplies in rural areas.

1.2 WASTEWATER TREATMENT TECHNOLOGIES

Wastewater Treatment Plant is a facility designed to receive the waste from domestic, commercial, and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. The principal objective of wastewater treatment is generally to allow human and industrial effluents to be disposed off without danger to human health or unacceptable damage to the natural environment.

1.3 BIOFILTRATION

Filtration is one of the most important treatment processes used in water and wastewater treatment. In water treatment, it is used to purify the surface water for potable use whereas in wastewater treatment, the main purpose of filtration is to produce effluent of high quality so that it can be reused for various purposes. Any type of filter with attached biomass on the filter-media can be defined as a biofilter. It can be the trickling filter in the wastewater treatment plant, or horizontal rock filter in a polluted stream, or granular activated carbon (GAC) or sand filter in water treatment plant.

2. NATURAL FIBRE

Natural fibres can be defined as bio-based fibres or fibres from vegetable and animal origin. This definition includes all natural cellulosic fibres (cotton, jute, sisal, coir, fl ax, hemp, abaca, ramie, etc.) and protein based fibres such as wool and silk. Excluded here are mineral fibres such as asbestos that occur naturally but are not bio based. Asbestos containing products are not considered sustainable due to the well known health risk, that resulted in prohibition of its use in many countries. On the other hand there are manmade cellulose fibres (e.g. viscose-rayon and cellulose acetate) that are produced with chemical procedures from pulped wood or other sources (cotton, bamboo). Similarly, regenerated (soybean) protein, polymer fibre (bio-polyester, PHA, PLA) and chitosan fibre are examples of semi-synthetic products that are based on renewable resources.

2.1. AGAVA SISALANA

Agave sisalana, consist of a rosette of sword-shaped leaves about 1.5–2 metres (4.9–6.6 ft) tall. Young leaves may have a few minute teeth along their margins, but lose them as they mature. The sisal plant has a 7–10 year life-span and typically produces 200– 250 commercially usable leaves. Each leaf contains an average of around 1000 fibres. The fibres account for only about 4% of the plant by weight. Sisal is considered a plant of the tropics and subtropics, since production benefits from temperatures above 25 degrees Celsius and sunshine.

Fig -1: photo view of Agava sisalana

Fibre is extracted by a process known as decortication, where leaves are crushed and beaten by a rotating wheel set with blunt knives, so that only fibres remain. The production is typically on large scale, the leaves are transported to a central decortication plant, where water is used to wash away the waste parts of the leaf. The fibre is then dried, brushed and baled for export. Proper drying is important as fibre quality depends largely on moisture content. Artificial drying has been found to result in generally better grades of fibre than sun drying, but is not always feasible in the developing countries where sisal is produced .Fibre is subsequently cleaned by brushing. Dry fibres are machine combed and sorted into various grades, largely on the basis of the previous in-field separation of leaves into size groups.

2.2. ARECA HUSK

Among all the natural fiber-reinforcing materials, areca appears to be a promising material because it is inexpensive, availability is abundant and a very high potential perennial crop. It belongs to the species Areca catechu L., under the family palmecea and originated in the Malaya peninsular, East India. Major industrial cultivation is in East India and other countries in Asia. The husk of the Areca is a hard fibrous portion covering the endosperm. It constitutes 30–45% of the total volume of the fruit. Areca husk fibers are predominantly composed of hemicelluloses and not of cellulose. Areca fibers contain 13 to 24.6% of lignin, 35 to 64.8% of hemicelluloses, 4.4% of ash content and remaining 8 to 25% of water content. The fibers adjoining the inner layer are irregularly lignified group of cells called hard fibers and the portions of the middle layer contain soft fibers.

Fig -2: photo view of Areca husk

2.3. NATURAL FIBRE FILTER TO IMPROVE WASTEWATER TREATMENT

Natural fibres such as flax or coconut could be used to develop a natural fibre filter to enhance treatment at wastewater treatment plants particularly in rural areas and developing countries. There is already a lot of knowledge about these fibres, for example flax fibre is traditionally used by Maori in many different ways, but this knowledge has not been applied to wastewater treatment. It might also be possible to treat the fibre in some way (eg slightly charing it) to enhance its performance.

3. RESULTS AND DISCUSSION

3.1 REMOVAL EFFICIENCY USING AGAVA SISALANA

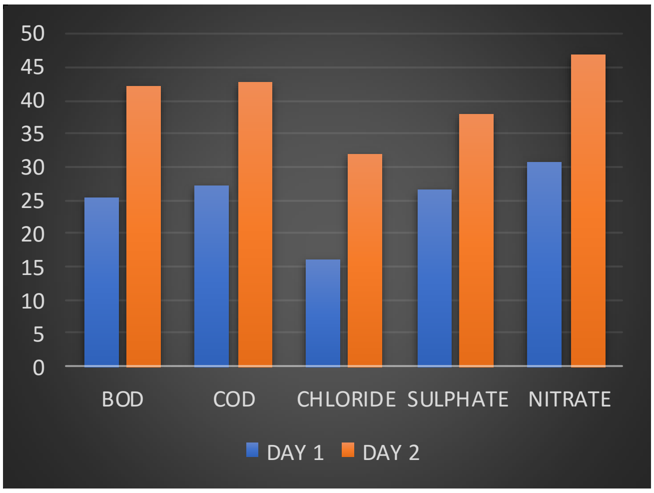

Chart – 1: Removal Efficiency Using 15 Cm Agava Sisalana Filter Bed

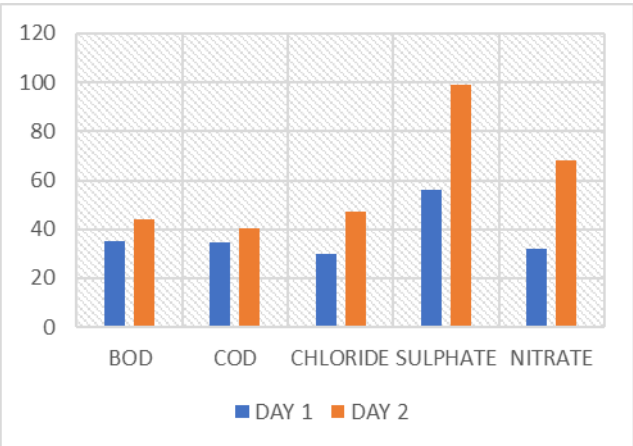

Chart – 2: Removal Efficiency Using 30 Cm Agava Sisalana Filter Bed

3.2 REMOVAL EFFICIENCY USING ARECA HUSK

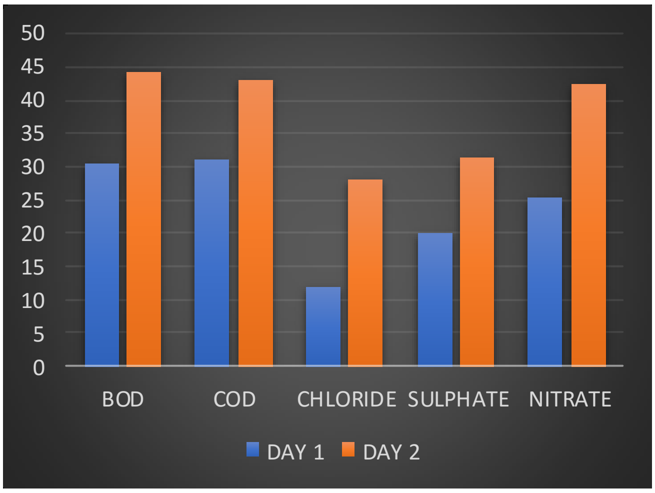

Chart – 3 : Removal Efficiency Using 15 Cm Areca Husk Filter Bed

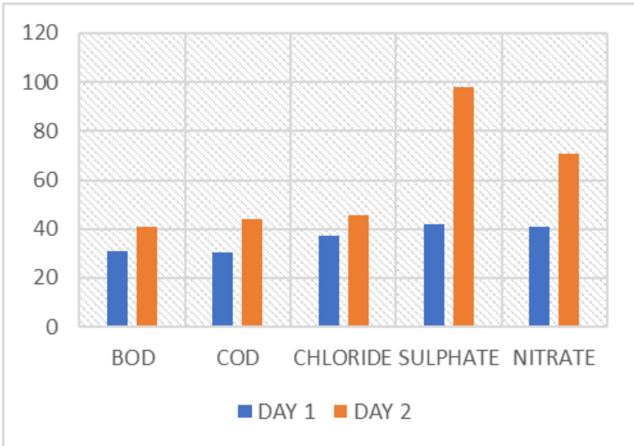

Chart – 4: Removal Efficiency Using 30 Cm Areca Husk Filter Bed

3.1 REMOVAL EFFICIENCY USING COMBINED FILTER BEDS

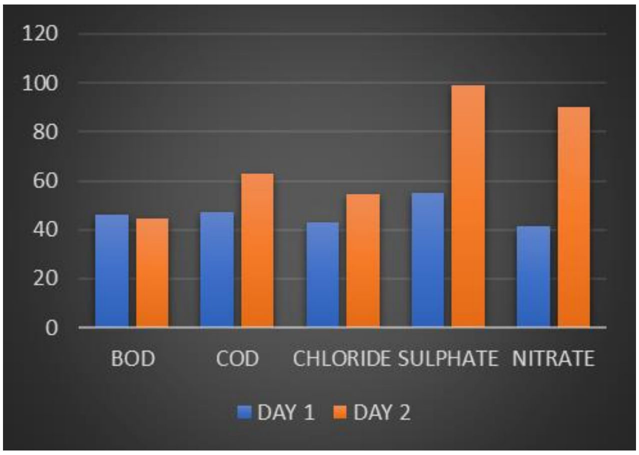

Chart – 4 : Removal Efficiency Using Combined filter Bed

4. CONCLUSIONS

1. Considerable reduction in BOD, COD, nutrients such as nitrates, sulphates, chlorides were achieved.

2. The removal efficiency of BOD and COD by using Agava as filter media was found to be 54.7% and 54% respectively, for 15 cm depth which was higher than that of Areca which was found to be 51.18% and 51% respectively.

3. The removal efficiency of BOD and COD by using Agava as filter media was found to be 65.24% and 66.6% respectively, for 30 cm depth which was higher than that of Areca which was found to be 59% and 60.30% respectively.

4. The removal efficiency for BOD and COD were found to be 74% and 76% respectively, when both the filter medias were combined.

5. The treated wastewater can be used for gardening and other domestic purposes like washing and cleaning purposes.

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