International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL INVESTIGATION ON TREATMENT OF INSTITUTIONAL WASTEWATER BY USING COIR MEDIA TRICKLING FILTER

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Abstract - Water pollution has become a major environmental concern for public and environmental health in developing countries. Institutional wastewater treatment was conducted in trickling filter in laboratory. The wastewater contains more COD and calcium carbonate. The coconut shell charcoal was used as an absorbent. The coir were used a support medium for microbial growth, in order to verify its capacity to remove the organic matter, measured in terms of biochemical oxygen demand (BOD_3) and chemical oxygen demand (COD). Other parameters such as calcium carbonate and sodium hydroxide were also measured. The results obtained, when compared to result from similar coir supporting medium, indicated that this support medium may substitute with advantages, under specific conditions, the traditional media. The turbidity removal efficiency for coir respectively was 4.5 to 3.24 and other parameter such as total dissolved solids, total suspended solids, biological oxygen demand, chemical oxygen demand, calcium carbonate and sodium hydroxide, pH.

***Key Words*: Trickling filters, coconut shell charcoal, coir, biofilm, alternative support media, and wastewater treatment.**

1. INTRODUCTION

A trickling filter is an aerobic wastewater process simple to build and operated. It is commonly used for industrial effluent and domestic sewage treatment. Its operation consists on passing the effluent to be treated over a fixed bed of support medium. A biological film grows on the surface of the medium. The biological activity of the film will be able to stabilize the organic constituents of the effluent. The biofilm is part of the time in contact with the flowing wastewater, and part of the time exposed to the air for oxygen uptake. The degree of stabilization achieved depends on many factors, such as: volumetric and organic loading, kind of support medium, temperature, ventilation among others, but it hardly achieves values beyond 85% in terms of BOD_3 removal.

The most advantages of using natural waste material are reduction of sludge as well as the effectiveness in reducing the concentrations. The treatment of wastewater is important in now a day to reuse the wastewater and reduce the water scarcity. In the research coconut shell carbonate is used to remove C_aCO_3, N_aOH in the institution wastewater. The parameter such as pH, COD, BOD, TDS, and TSS is also investigated.

2. LITERATURE REVIEW

[A] L.Machunda [Defluoridation of water supplies using coconut shells activated carbon] – 2016

The coconut shells activated carbon is chemically activated provides better F absorption hence increases its potential as a naturally available at a low cost agro waste. Coupling of coconut shell activated carbon with other techniques could improve the defluridation efficiency and color removal thus reducing treatment costs, the use of properly activated coconut shells carbon of particle size increase its surface area hence increasing its fluoride adsorption. The color adsorption properly appeals a dual value of coconut shells activated carbon for water treatment, the efficiency of coconut shells activated carbo F uptake was not to a large extent at the mercy of competing ions. It is envisaged during this study that a properly activated coconut shells are suitable absorbents for defluoridation that could be effective in rural areas of Tanzania due to its local availability and the possibility of processing the material locally.

[B] Marcos R. Vianna [Wastewater treatment in trickling filter using luffa cylindrical as biofilm supporting medium] - 2018

The study showed that, for specific conditions, the peeled dehydrated fruit of Luffa cyllindrica can be used as support medium in trickling filters. It shows that trickling filters that use Luffa cyllindrica as support medium can be a suitable and sustainable alternative for domestic sewage treatment in this state. The average reduction of the organic content offered by Luffa cyllindrica filters was higher than the calculated with formulas traditionally used in the projects of biologic trickling filters, such as NRC, British, Velz and Galler & Gotaas.

[C] Glen T Daigger [Trickling filter and trickling filter suspended growth process design and operation]- 2017

Water is a key component in determining the quality of our lives today, people are concerned about the quality of the water they drinks although water covers more than 70% of the Earth, only 1% of the Earth's water is available as a source of drinking. Water is known as a natural solvent. Before it reaches the consumer's tap, it comes into contact with many different substances, including organic and inorganic matter, chemicals, and other contaminants. Thus, water needs to be treated. Water with standard quality is used for drinking, washing, industrial and agricultural activities and others. Water quantity varies from source to source and quality requirement varies according to its usage

[D] Umesh M [Trickling Filter Technology for Treating Abattoir Wastewater] -2017

The coir removes a BOD, COD, nutrients such as nitrates, sulphates, chlorides were achieved. The operation trouble faced during the study was foul odor emission due to the early decomposition of the fibers. The cost of Areca fibers used for the treatment of 25liters of wastewater was about Rs.70, which is economical than compared to Agava fibres which costs about Rs.120. However the treatment efficiency of Agava was found to be higher than that of Areca fibres. The treated wastewater can be used for gardening and other domestic purposes like washing and cleaning purposes. The spent fibres were rich in nutrient values and can be used as a organic manure.

3. MATERIALS AND METHODS

3.1 MATERIALS

Coir and coconut shell charcoal are used to remove the calcium carbonate and sodium hydroxide. It is a daily home needed material and waste material also.

3.2 ABSORBENT PREPARATION

Coir is collected at grove where cut into small pieces and washed then dried at room temperature. The coconut shell charcoal is broken and making a charcoal and it's a mixing absorbent. Charcoal is collected at local market and washed and dried at room temperature.

3.3 WASTEWATER

The waste water sample is collected from the effluent of Sree Sakthi Engineering College, Karamadai, Coimbatore, Tamilnadu. It was bottled in a container and was taken to the laboratory for further process and analysis.

3.4 ANALYSIS OF MATERIALS

3.4.1 GRAVEL

Gravel is the original media used in trickling filters. It is generally field stone or crushed stone. Typically, the gravels are approximately 2 mm. It is a bottom layer of trickling filter. It is important that the media is uniform to allow sufficient ventilation through the void space.

Fig -1: GRAVEL

3.4.2 SAND STONE

They capture particles near the surface of the bed and are usually cleaned by scraping away the top layer or sand that contains the particles. Trickling filter: they consist of larger sand grains supported by gravel and capture particles throughout the bed. The layers of sand may be supported on gravel, which permits the filtered water to move freely to the under drains, and allows the wash water to move uniformly upwards.

Fig -2: SAND STONE

3.4.3 RIVER SAND

River sand is used as filter media. Anthrafilt is made from anthracite, which is a type of coal- stone that burns without smoke or flames. It is cheaper has been able to give a high rate of filtration. The running water of sand had some kind of mineral properties its can be useful to filtration process. River sand commonly we can get and we can take for one time and it can be using a long lifetime making a proper backwashing.

Fig -3: RIVER SAND

3.4.4 CHARCOAL

Carbon filtering is a method of filtering that use a bed of activated carbon to remove contaminates and impurities, using chemical adsorption. Each particles, or granule, of carbon provides a large surface area, or pore structure, allowing contaminates the maximum possible exposure to the active sites within the filter media. Active charcoal carbon filters are most effective at removing chlorine particles such as sediment, volatile organic components, taste and odor from water.

Fig -4: CHARCOAL

3.4.5 COIR

Usually processed coir used in the agricultural sector, especially of characteristics other than coir absorbs water used in industry. Coir was function as the main filter to screen out large solids such as algae. This material can withstand suspended solids due to the physical characteristics of the coir solids capable of withstanding large. This material is as a substitute for the existing filter material on the market. Pollutant will be absorbed during the treatment process.

Fig -5: COIR

3.4.6 COTTON CLOTH

The cloth is effective because most pathogens are attached to particles and plankton, particularly a type of zooplankton called copepods, within the water. By passing the water through an effective filter, most cholera bacteria and other pathogens are removed.

Fig -6: COTTON CLOTH

3.4.7 COCONUT SHELL CHARCOAL

Compared to other types of activated carbon, coconut-shell based activated carbon filters have the highest hardness, which makes them ideal for water purification.

Apart from these unique properties, coconut shells are also an eco-friendly and a renewable resource for water purification. Coconut fruits are harvested three times per year and their harvest has no negative impact on the coconut trees and will continue to grow throughout the year. Further advantages of the coconut-shell based activated carbon lie in the following: coconut shell carbon filters absorb volatile organic chemicals, pesticides and herbicides, disinfection by-products like THM, remove halogens from water and improve appearance and taste of drinking water.

Fig -7: COCONUT SHELL CHARCOAL

3.5 TRICKLING FILTER

The trickling filter tank is fixed with the layer absorbent of cotton cloth, coir, charcoal is followed by river sand passing through 0.6mm sieve and gravel.

Fig -8: TRICKLING FILTER MODEL

3.6 AERATION PROCESS

Aeration is the process by which air is circulated through, mixed with or dissolved in a liquid or substance. Aeration is used in liquids, soils and foods to improve quality and reduce contamination.

In institutional water conditioning, one of the major objectives of aeration is to remove carbon dioxide. Aeration is also used to oxidize soluble iron and manganese to insoluble precipitates. It can also reduce ammonia and hydrogen sulfide (stripping), and is an effective method of bacteria control.

Fig -9: AERATION PROCESS

3.7 FILTRATION PROCESS

In the filtration, process providing the 5 litres of water and get the 4.9 litre of water gain.

Fig -10: TRICKLING FILTER MODEL

4. METHODOLOGY

- The wastewater was collected in our institution and Coconut shell charcoal (10gm per lit) used as a coagulant in the wastewater and rest for 30 minutes.
- And the water undergoes aerated for 20 minutes.
- After the solution is rested for 30 minutes. The wastewater allowed into the filtration bed.

5. RESULTS

Table No- 1: Result of Wastewater

PARAMETERS	INITIAL VALUE	FINAL VALUE	UNITS
pH	8.93	8.85	-
Turbidity	3.69	3.24	NTU
COD	2124	1856	mg/L
BOD	96	80	mg/L
Total dissolved solids	20874	18448	mg/L
Total suspended solids	923	892	mg/L
Calcium carbonate	722.96	661.88	mg/L
Sodium hydroxide	663	650	mg/L

5.1 pH

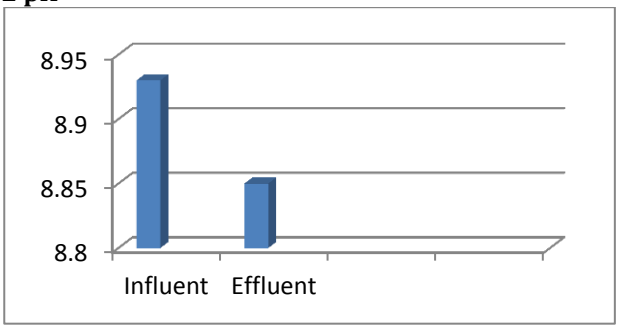

CHART – 1 Typical graph differentiating the influent and effluent pH

5.2 TURBIDITY

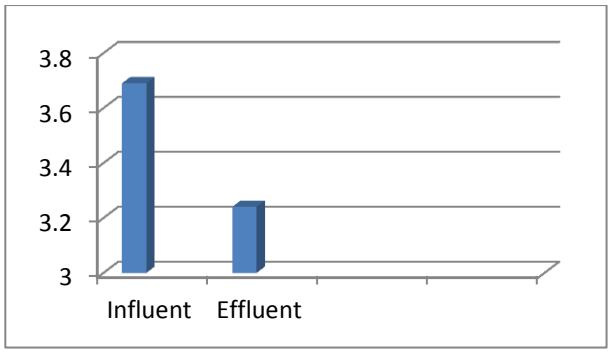

CHART – 2 Typical graph differentiating the influent and effluent of turbidity

5.3 CHEMICAL OXYGEN DEMAND

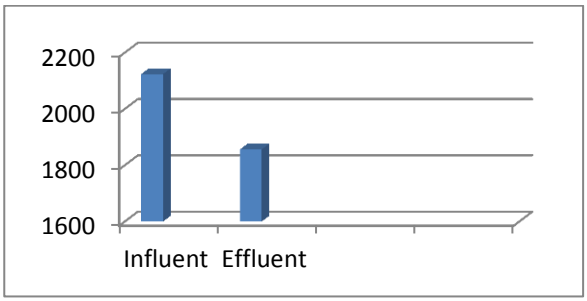

CHART – 3 Typical graph differentiating the influent and effluent of chemical oxygen demand

5.4 BIOCHEMICAL OXYGEN DEMAND

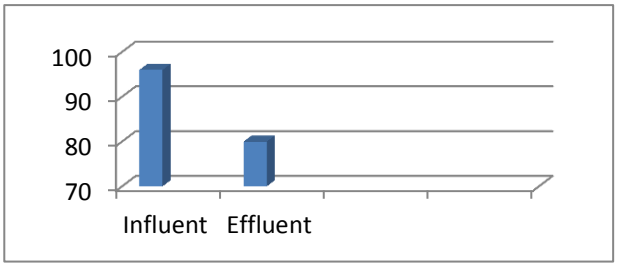

CHART – 4 Typical graph differentiating the influent and effluent of biochemical oxygen demand

5.5 TOTAL DISSOLVED SOLIDS

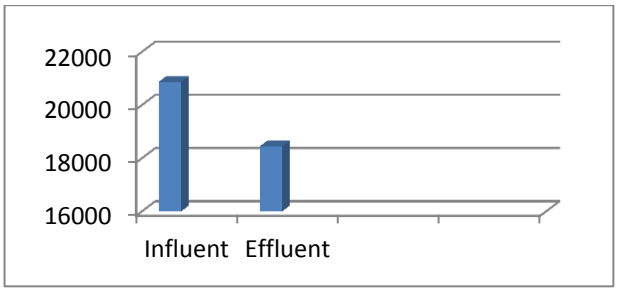

CHART – 5 Typical graph differentiating the influent and effluent of total dissolved solids.

5.6 TOTAL SUSPENDED SOLIDS

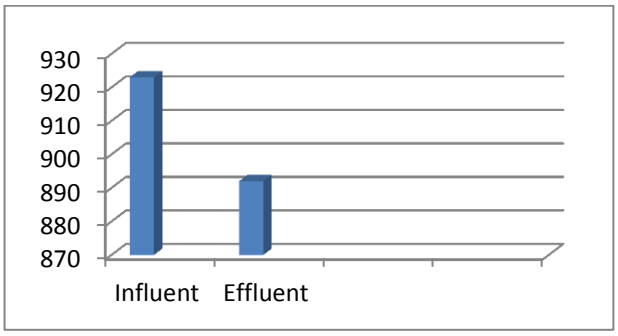

CHART – 6 Typical graph differentiating the influent and effluent of total suspended solids

5.7 CALCIUM CARBONATE

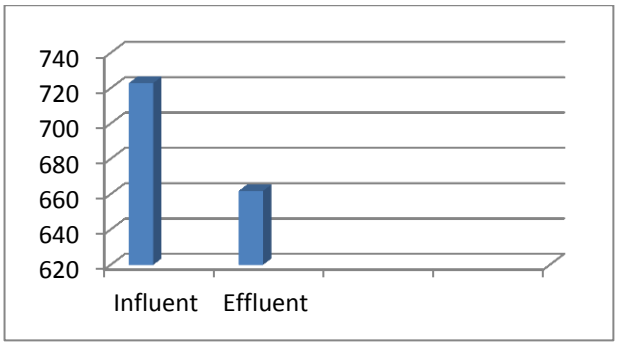

CHART – 7 Typical graph differentiating the influent and effluent of calcium carbonate

5.8 SODIUM HYDROXIDE

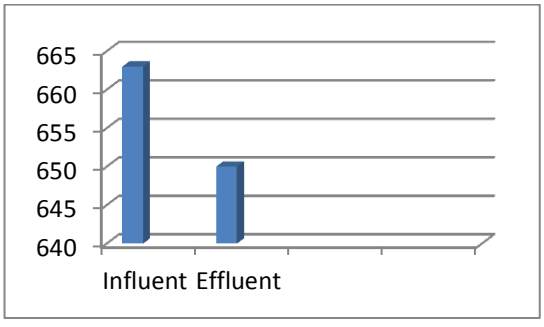

CHART – 8 Typical graph differentiating the influent and effluent of sodium hydroxide

6. CONCLUSIONS

The study showed that, for specific conditions, the coir can be used as support medium in trickling filters. A comparison between the results obtained for the studied parameters and the values is very low. The reduction of calcium carbonate and sodium hydroxide is less. There was considerable reduction in pH, total solids, COD, BOD and turbidity. No formation of sludge. Using a coconut shell charcoal is reducing the calcium carbonate level. The coir removes a turbidity, total dissolved solids and COD. The trickling filters that use coir as support medium can be a suitable and sustainable alternative for institution wastewater treatment.

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