TREATMENT OF WASTEWATER USING COCOPEAT BIOFILTER

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Abstract: Cocopeat is the dust obtained from grounded coconut shells, once the fibers have been removed. It can be incorporated into biofilter for the treatment of wastewater. The performance evaluation of cocopeat prepared from coconut shells in treating sewage wastewater, textile wastewater and dairy wastewater was studied. cocopeat biofilter was constructed using cocopeat, pebble and coco coir and wastewater samples were filtered through biofilter. Parameters like BOD, COD, Ammonia, Nitrate, TSS, Sulphate, phosphorus, chromium, TDS and TS were determined before and after treatment of wastewater samples. Analysis of sewage effluent showed that reduction in BOD, COD, Ammonia, Nitrate, TSS, and Phosphorous was 90% ,85%, 92.86% ,81.82%, 77.78% and 70.10% respectively at 22 days HRT. Similarly, in Textile wastewater BOD, COD, TS, Chromium and TDS were reduced up to 92% ,81%, 64.75, 95% and 62.5% respectively whereas in dairy waste water BOD was reduced upto 95.09 %, COD was reduced upto 94.9%, Oil and grease was reduced upto 75%, TDS was reduced upto 66%, TS was reduced upto 69.9%, TSS was reduced upto 76% and sulphate was reduced upto 53%. During the period of investigation, it was observed that cocopeat filtration system was efficient to treat dairy, textile and sewage wastewater also it occupied less space, had low construction cost and was easy to install.

Index Terms **- Cocopeat, Biofilter, Coir, Dairy, Textile, Sewage, Wastewater, HRT.**

INTRODUCTION

Pollution of water is serious problem in the world which reduces water availability for us. Improper treatment of wastewater causes serious environmental degradation. The advanced technologies used for the waste water treatment are limited especially in developing countries due to high cost and low feasibility. Inadequate sanitation has significant impact on the economies of developing countries (World bank 2008). The study estimates that total economic impact of inadequate sanitation in India amounts to Rs2.44 trillion (US$53.8 billion) a year. Sewage water mostly consist of Black water (water from flush toilets combined with human waste that it flushes away) and Grey water (It includes waste water that is generated from bathing, washing dishes, laundry etc.). Cocopeat, is the by-product of coconut processing plants and comes from outer husk of the coconut (Verdonce1983). Cocopeat is the dust obtained from crushed coconut shells and can be used in the development of low cost wastewater management systems to improve sanitation. Coconut is cultivated as commercial crop in India. Cocopeat is used in the construction of biofilter to treat digester or septic tank effluent so that it can be safely used for agriculture and landscape irrigation or discharged into the environment. When wastewater passes through the biofilter suspended solids are trapped and organic matter is consumed by microorganisms living in the filter, resulting significant reduction of pollution constituents in the final effluent. For the present study textile, dairy and sewage wastewater was used as Textile industry is one of the largest water consuming industries in the world and its wastewater contain many pollutants such as dyes, degradable organics, detergents, stabilizing agent, inorganic salts, and heavy metal. A large amount of wastewater is being generated by all these processes, which contains many pollutants like reactive dyes, chemicals, high chemical oxygen demand (COD), biological oxygen demand (BOD), organic compounds. While dairy industry is considered to be the largest source of food processing wastewater in many countries, large quantity of wastewater originates due to their different operations and products. The organic substance in the wastes largely comes from their various products, though the dairy wastes are biodegradable but are very strong in nature and Sewage is considered as wastewater consisting largely human excreta and wash water, but at times it may have industrial and agricultural waste (e.g. waste from livestock i.e. chicken, cattle, horse, etc.) that enter the sewage system. In general sewage contains about 95.5% water and 0.1 to 0.5% organic and inorganic material.

MATERIALS AND METHODS

Production of Cocopeat- Coconut husks were obtained from waste dump site located near temples. Husks were sun dried for six weeks and further processing was done. Husks were beaten to remove fiber and powder was obtained which is called cocopeat. Cocopeat was then stored immediately after removal of fibers. It was stored to get stabilized, as during storage ageing process begins which stabilize the cocopeat. Cocopeat was stored for at least two months. After this period cocopeat was sieved to remove remaining fibers. Then cocopeat was further treated i.e. Washed several times to remove the freely soluble elements such as potassium, sodium and chloride. Cocopeat was then dried in sun till the moisture content in it was completely removed.

Sewage wastewater, Textile wastewater and Dairy wastewater- Primary treated sewage, textile and dairy wastewater was collected from treatment plant. The parameters of raw wastewater samples and post cocopeat biofiltration treatment process were determined according to APHA &AWWA 22nd Ed. and those were BOD (biochemical oxygen demand), COD (chemical oxygen demand), TDS (total dissolved solid), TSS (total suspended solid), Ammonia, Phosphorous, Turbidity, Nitrate and pH.

1) Sundried Husk

2) Cocopeat Powder

3) Washing of Cocopeat

4) Dried Cocopeat

Preparation of cocopeat biofilter unit- The biofilter was constructed in a cylindrical shaped plastic bottle having radius 0.05m and height 0.3m. The bottom layer was filled with 2cm gravel which acts as a supporting media and middle layer was filled with cocopeat and upper layer with coco-coir (fiber) which was about 6cm. Coco-coir prevents spreading of bad smell as well as helps in even distribution of wastewater effluent. The area of constructed biofilter was 1099cm^2 or 0.1099m^2. The filtered water was collected in a beaker and dosing of wastewater was done intermittently in batch. The photograph of experimental set up in laboratory is shown below.

5) Cocopeat Biofilter Unit

RESULTS AND DISCUSSION

Table 1: Analysis of Parameters before and after treatment: (Sewage Wastewater)

Parameter	Initial Conc.,mg/L	1st day (HRT)	% removal	3rd day (HRT)	% removal	7th day (HRT)	% removal	Permissible limit, mg/L
BOD	147.4	147.4	-	16.214	89	14.74	90	30
COD	515	515	-	103	80	77.25	85	250
Phosphorous	26.75	26.75	-	21	21.50	8	70.10	-
TSS	900	900	-	800	11.1	200	77.78	100
Nitrate	1.1	1.1	-	0.8	27.27	0.55	50	10
NH_4	2.8	2.56	8.57	0.32	88.58	0.2	92.86	-

Table 2: Analysis of Parameters before and after treatment: (Textile Wastewater)

Parameter	Initial conc.,	1st day	%	3rd day	%	7th day	%	Permissible

	mg/L	(HRT)	removal	(HRT)	removal	(HRT)	removal	limit, mg/L
BOD	424	360.4	15	89.04	79	33.92	92	30
COD	1370	1233	10	342.5	75	260.3	81	250
TS	3400	3000	11.76	1200	64.70	206	93.94	-
TDS	1600	1600	-	600	62.5	515	67.81	-

Table 3: Analysis of Parameters before and after treatment: (Dairy Wastewater)

Parameter	Initial conc., mg/L	1st day (HRT)	% removal	3rd day (HRT)	% removal	7th day (HRT)	% removal	Permissible limit, mg/L
BOD	2100	1900	9.25	1100	47.61	103	95.09	30
COD	6200	5704	8	3348	46	316.2	94.9	250
Oil & Grease	1100	900	18.18	700	36.36	275	75	10
TS	4000	3569	17	2451	43	1204	72	-
TDS	2700	2403	11	2300	14.81	1026	66	-
TSS	1300	1153.1	11.3	1079	17	312	76	100

The organic matter present in wastewater is expressed in terms of COD. The heterotroph bacteria play an important role in decomposition of organics in biofiltration system. The removal rate of COD & BOD was about 85% & 90% respectively. After 3rd days of operation of biofilter COD elimination rate was low this may be due to the acclimatization process of microorganisms but later after 7th day the removal efficiency of organic matter increased to 80- 90 % this may be due to the fact that microbes were well developed which was evident from the bacterial layer which was visually observed on the Nutrient Agar Media, indicating biofilm formation and development in the cocopeat biofilter aswell. The optimum result was obtained after 3rd days of treatment for sewage wastewater using cocopeat biofilter whereas textile and dairy effluent needs more than 7 days treatment to meet permissible limit. Ammonia can be oxidized biologically in the biofiltration system through nitrification process. The Concentration of ammonia decreased from 2.8 mg/L to 0.2 mg/L after treatment of wastewater using cocopeat biofilter.

CONCLUSION

In the cocopeat biofilter treatment process of Sewage wastewater, Textile wastewater and Dairy wastewater, various quality characteristics were studied and it was found that initially the pH of dairy waste water sample was more alkaline but due to the implemented cocopeat filtration the pH was brought up much near to neutral whereas the pH of sewage and textile sample were almost in neutral range. In sewage wastewater the removal efficiency of BOD was about 90%, COD was about 85%, Ammonia was about 92.86%, Nitrate was about 82%, Phosphorous was about 70.10 % and TSS was about 77% by using cocopeat biofilter. Similarly, in Textile wastewater sample using cocopeat biofilter BOD was removed about 92%, COD was removed about 81%, Chromium was about 95%, TS was about 64.7% and TDS was about 62.5 % whereas in Dairy wastewater BOD was removed about 95.09%, COD was removed about 94.9%, Oil and Grease was about 75%, TS was removed about 72%, TDS was removed about 66%, TSS was removed about 76% and Sulphate was removed about 53% using cocopeat biofilter.

This treated water can be used for irrigation of saplings, landscape vegetation and for certain agricultural crops. This technology has benefits in terms of low cost, low maintenance, less space requirement and simplicity of installation. Cocopeat is locally renewable resources in coconut rich countries. When the life of media is expended it can be safely used as nutrient rich fertilizer. Cocopeat biofiltration may represent a viable technology for treating septic tank or digester effluent. This system works more effectively when wastewater is dosed intermittently.

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