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## Use of Agricultural Wastes as Bio Filter Media in Aerobic Sewage Treatment

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### ABSTRACT

The using of agriculture waste as a bio filter media to treat the domestic wastewater before its disposal is considered to be one of the ways to protect the environment. Rice husk and ficus trees trimming stalks were used in this study as a media in bio filter reactor where biological actions take place. A pilot consists from two units was applied with 60 cm depth of each type of agricultural wastes to be used. One of them worked as a standard rate bio filter reactor, and the other as a high rate bio filter reactor. A flow of 8 hours per day of domestic wastewater was sprayed at the top of each unit. The removal ratios of high rate bio filter reactor are higher than that of standard rate bio filter reactor for wastewater parameter (COD, BOD) with the using of both types of agricultural wastes. With the using of rice husk media, the average removal ratio of COD was 24.80% and 36.84%, of BOD was 24.42% and 36.69% for (S.R.) and (H.R.) respectively. On the other hand, with the using of ficus tree trimming stalks, The average removal ratio of COD was 27.24% and 69.48%, of BOD was 27.18% and 69.48% for (S.R.) and (H.R.) respectively. These values illustrated the possibility of applying the both types, rice husk and ficus trees trimming stalks as bio filter media, note that, the ficus tree trimming stalks is the best for applying.

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## INTRODUCTION

The problem of the environmental pollution is created by continuous and accelerated disposal of wastes. One of the main problems is the contamination of stream bodies with wastewater; this requires, under the dire need of fresh water, the treatment of wastewater before disposed into stream bodies.

Treated wastewater is either reused or disposed into the environment. The most common means of treated wastewater disposal is summarize by discharge and dilution into ambient waters, and land application, where the wastewater seep into the ground and recharging underlying ground water aquifers, Metcalf and Eddy (1999).

The residues of agricultural wastes have no economic value and their amount causes many environmental problems. So, the researches in these days focus on the using of agricultural wastes as a low cost natural material in the wastewater treatment.

This paper is mainly devoted to study the efficiency of the reuse of two types of agricultural wastes, rice husk and ficus tree trimming stalks as a natural media in both types of bio filter reactors, high rate and standard rate, for treating domestic wastewater. It was used as a low cost material for solving the disposal environment problems

Hashem *et al* (2009), studied using cotton wood as a media into three forms. Column scale were carried out to test the removal efficiency of the sewage parameters TSS, COD, BOD, N and P for each form at constant flow of 1 L/h by changing the depth of the media to three different depths. The results indicated that the removal efficiency was maximum at fine and medium forms when depth is 20 cm.

Three forms of almond shells were studied as a media by El Nadi (2009). A laboratory batch scale experiments were carried out at constant flow of 1 L/h. The removal ratios for the sewage parameters TSS, COD, BOD, N and P were varied between 35 – 65% with maximum values at depth 20 cm of the media of fine size.

El Nadi *et al* (2009) had worked also on sunflower stalks as a media for sewage treatment using the batch lab scale system. The removal efficiencies of the sewage parameters TSS, COD, BOD, N and P for each form at

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constant flow of 1 L/h were varied between 30 – 65% due to the depth and form of the media. The results showed that the removal ratios were maximum at depth 20 cm of the fine and medium forms.

El Sergany, F. (2009), studied the Using of Sugar cane stalks as a media to remove sewage parameters TSS, COD, BOD, N and P by using filtration physical and biological meanings. The test was applied on three forms and three depths inside 3 continuous batch reactor columns with 1 L/h continuous flow. The results indicated that, the maximum removal efficiencies were at depth of 20 cm with fine form.

El Sergany, F. (2012), in her study on rice husk under anoxic conditions proved the success of applications due to the removal efficiencies resulted between 60 -85% for all parameters with maximum values at media depth = 30 Cm and fine media form less than 0.5 cm size. These results emphasized the environmentally effectiveness of using of rice husks wastes as a biophysical media for wastewater treatment.

El Nadi *et al* (2013) studied the application of ficus trees pruning results as a bio filter media under anaerobic anoxic conditions. The achieved removal ratios for BOD was 80.31% , 77.60% for COD, 78.34% TSS and 93.30% for N& P.

Mohan *et al* (2008), in his study for removal of heavy metals lead, copper, zinc and manganese by using a fixed bed column of raw rice husk showed that, the rice husk worked with high efficiency as adsorbent matter for the studied heavy metals with good timing for operation.

## MATERIALS AND METHODS

Rice husk and ficus tree trimming stalks were used without any treatment except cut to pieces of 2 cm which is the best size for bio filter efficiency (2012). Each type was put in a plastic mesh bags have a characteristic flexibility to form it in the applied dimensions. **Figures (1) and (2)** show photos for the used rice husk and ficus tree trimming stalks, respectively.



**Fig. 1:** Rice husk.



**Fig. 2:** Ficus trees trimming stalks

The experimental work was conducted for each type of agricultural waste for both types of bio filter reactor. A tank of 2 m<sup>3</sup> located at 3.00 m height from the ground was fed the pilot columns with sewage flow for 6 working days per week for 8 working hours per day. The pilot consisted of two parallel columns reactors, with 50 cm diameter & 2.00m height, one worked as standard rate bio filter (S.R.) and the second as high rate bio filter (H.R.) with recirculation water. **Figures (3) & (4)** shows photo for pilot component. A pump of power 0.25 hp was used for re-circulated flow of (H.R.).

A 10 cm depth of gravel put at the reactor bottom used as a media support layer, to prevent the escape of applied media particles and the effluent clogging.

The applied media of each type, rice husk and ficus tree trimming stalks were put as media for treatment over the gravel support with depth of 60 cm.

The wastewater was sprayed at the top of the pipe by using perforated spiral hose of diameter 0.25 inch for (S.R.) and 0.75 inch for (H.R.). This made to achieve the complete aerobic action.

Sampling was started after one week of the pilot operation start up. It were taken from three locations, influent raw wastewater of the pilot, effluent treated wastewater of standard rate bio filter pilot unit, and effluent treated wastewater of high rate bio filter pilot unit. The following parameters were measured according to the American standard methods for water and wastewater examinations (2005):

1. Chemical oxygen demand (COD).
2. Biochemical oxygen demand (BOD).

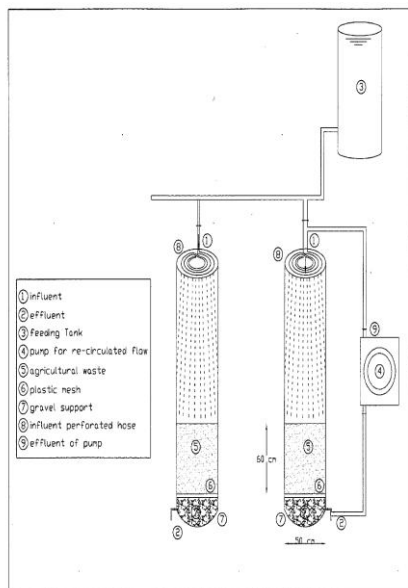


Fig. 3: Pilot Components.



Fig. 4: Pilot Photo.

## RESULTS AND DISCUSSIONS

Removal ratios of wastewater parameter COD & BOD with the use of both types of agricultural wastes, rice husk and ficus tree trimming stalks are illustrating in table (1), and figures from (4) to (7). Each of these figures shows the variation of parameters removal ratios during the experimental period.

Figures (5) & (6) show that, the concentration of chemical oxygen demand (COD) and biochemical oxygen demand (BOD) in raw wastewater (R.W.W.) was decreasing due to using of (H.R.) and (S.R.) where biological action takes place.

The small decreasing in (COD) and (BOD) concentrations in the using of (S.R.) **in first sample**, may occurred due to decreasing in dissolved oxygen that caused late in biological action. It can be seen that at the second sample after 10 days the S.R. had achieved almost the same removal efficiency of the H.R. that means it enters to operation. The difference between the two types of biological filters in the removal efficiencies was very small after stability of action.

**Table 1:** Removal Ratios for Wastewater Parameters.

Day	Sample	Rice husk used				Ficus tree trimming used			
		COD (Ppm)	BOD (Ppm)	Temp. °C	pH	COD (Ppm)	BOD (Ppm)	Temp. °C	pH
1-6									
7	R.W.W	358.9	279.1	17.8	7.55	177.70	126.70	21.50	7.87
	S.R.	322.3	247.9	16.7	7.60	162.90	116.40	22.10	7.99
	H.R.	256.4	198.3	16.4	7.75	29.60	21.15	22.90	8.16
10	R.W.W	368.8	273.2	17.0	6.91	270.50	200.50	22.50	7.89
	S.R.	219.8	162.8	16.9	7.08	105.80	78.40	22.50	8.08
	H.R.	205.6	152.3	18.3	7.80	47.05	34.85	24.20	8.24
14	R.W.W	648.0	480.0	17.70	7.62	293.00	217.10	20.10	7.57
	S.R.	354.0	262.0	17.20	7.75	156.40	89.90	18.70	7.97
	H.R.	351.0	260.0	17.50	7.80	68.50	44.80	20.60	8.05
17	R.W.W	370.2	274.2	17.60	7.63	313.30	232.07	21.60	7.80
	S.R.	218.1	161.6	17.10	7.75	178.20	132.00	21.40	7.95
	H.R.	203.5	150.7	17.80	7.90	108.30	80.00	22.00	8.14

R.W.W = Raw Wastewater

S.R. = Standard Rate Biological Filter

H.R. = High Rate Biological Filter

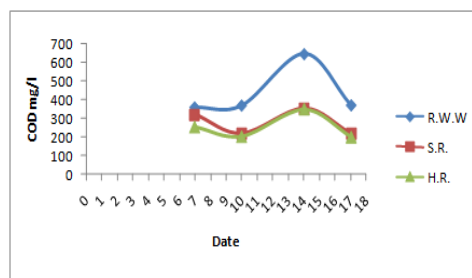


Fig. 5: COD Results due to rice husk using.

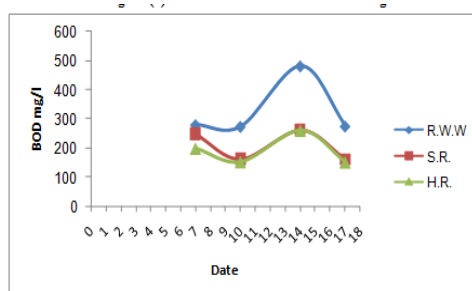


Fig. 6: BOD Results due to rice husk using.

The removal efficiency was slightly improved with the increase of the influent loads from 29 % to 46% for double influent load.

With rice husk media, the removal efficiency for COD and BOD were between 40% and 46%, in (S.R.) and between 28% and 46% in (H.R.). Even these results were less than the produced by El Sergany [6] but this for our work here was under aerobic conditions not anoxic case that produced higher removal efficiency due to adsorption taking place, addition to the using of (R.W.W.) not using of pre-treatment sewage that also produced higher removal efficiency even the influent to the bio filters was raw wastewater with low organic load.

Figures (7) & (8) illustrate that, with the ficus trees trimming stalks the COD and BOD removal ratios were affected by the type of bio filter reactor, where biological action takes place. The removal ratios due to using of (H.R.) were higher than that due to using (S.R.). This could be due to the very high inlet loads on both filters that may make the effect of the high concentration of dissolved oxygen in (H.R.) more noticeable because of wastewater recirculation.

The small variation in COD removal ratio in the using of (S.R.), **in first sample**, may occurred due to the start up late in the standard rate biological filter due to the decrease in dissolved oxygen that caused late in biological action.

The removal efficiencies for COD and BOD were between 43% and 61% in (S.R.) unit while they were between 65 % and 83%, in (H.R.).

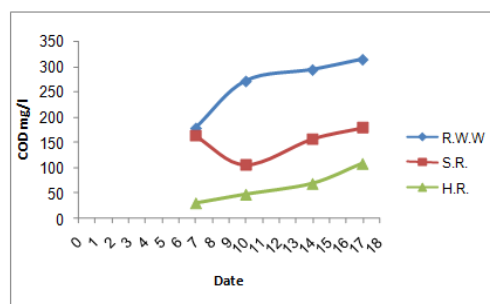


Fig. 7: COD Results due to ficus using.

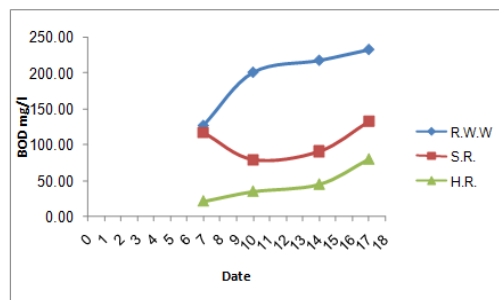


Fig. 8: BOD Results due to ficus using.

In general, the ficus trees trimming stalks application was successful than rice husk in removal ratios for COD & BOD but under small and medium loads up to 270ppm COD & 200ppm BOD. This high efficiency decreased about 18% with higher loads.

It was very noticeable that the effect of bio filters type. In the using of ficus tree trimming stalks, the removal ratio of COD and BOD due to using of (H.R.) is higher than that due to using of (S.R.) during all runs. While, in the using of rice husk, the removal ratio of COD and BOD due to using SR was approaching to the using of HR during the time run.

### CONCLUSIONS:

The research concluded that the both types of agricultural wastes used in this research were successful as biomedica filter for sewage treatment.

The removal efficiencies were high even the influent to the bio filters was raw wastewater with high organic load (about 2 - 3.5 ppm the optimum limit (BOD = 100 – 150ppm) for Bio filter.

The results illustrate that, the type of bio filter affected on the removal ratio of the wastewater parameter COD and BOD during the use of rice husk and ficus trees trimming stalks as a media in each.

The investigated results showed that, the ficus tree trimming stalks is the best for field working applications.

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