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USING AGRICULTUREAL WASTE FOR TREATING POLLUTION INSIDE water STREAM

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الملخص العربي:

تعتبر مشكلة تلوث المسطحات المائية في مصر من أهم المشاكل البيئية نتيجة التخلص من مياه الصرف المنزلية دون معالجة في الغالب. وبحسب كمية التلوث المتزايدة ، فإن عملية التنقية الذاتية، والتي تعتمد بشكل أساسي على البكتيريا والطحالب، تصبح غير فعالة، لذلك هناك حاجة لإيجاد ما يساعد هذه العملية في تحسين خصائص المسطحات المائية.
وقد استخدمت هذه الدراسة قش الأرز كوسط مفاعل حيوي منخفض التكلفة حيث تمر المياه الملوثة من خلاله. يؤدي إلى زيادة الأكسجين المذاب بنسبة تصل إلى 40.58٪ ، وتقليل COD و BOD بنسبة مئوية تصل إلى 74.29٪ و 82.4٪ على التوالي. كما أنه يقلل من المواد الصلبة الذائبة الكلية والعكارة بنسبة تصل إلى 51.5٪ و 78.95٪ على التوالي مما ساعد على تحسين عملية التنقية الذاتية في المسطحات المائية من خلال مسافة أقل من المطلوب لاستعادة المجري لصلاحية مياهه لإعادة الاستخدام بما لايقل عن 60%.

ABSTRACT

Water bodies are facing many problems in Egypt. The most important one is disposing of domestic wastewater mostly without treatment. According to increasing amount of pollution self purification process, which depends mainly on bacteria and algae, become not effective so, it is needed to find what helps this process to improve characteristics of water bodies. This study used rice husk as a low cost bioreactor packing media where polluted water pass through it. It is led to increase dissolved oxygen by percent up to 40.58%, decrease COD and BOD by percents up to 74.29% & 82.4% respectively. It is also decrease total dissolved solids and turbidity by percents up to 51.5% & 78.95% respectively which helped to improve the self - purification process in water bodies through a less distance than required.

INTRODUCTION

The idea of the Reuse of agricultural drainage water is one of the most important issues as a non-conventional water resource which could be used for agricultural practices because the water resources become limited. Unfortunately, the reuse of the polluted drainage water has the potential of causing serious problems of soil degradation, reduction in crop productivity and quality, and human health hazards [1].

There are various sources for drain water contamination. The sources are either direct or indirect sources such as industrial effluent, sewage or wastewater effluent ,direct run off, oil spillage, dumping garbage also it could be the change in water temperature, chemical composition, also air and soil pollution. If the pollution comes from a single source, such as an oil spill, it is called point-source pollution. If the pollution comes from many sources, it is called nonpoint-source pollution **[2]**.

The ability of the stream to restore itself from pollutants is known as self-purification. This process is a natural process that involves chemical, physical and biological actions working at the same time together. These actions work on the biological pollutants to oxidize them to emerge a sufficient amount of dissolved oxygen. The polluted water affects negatively the self-purification of the water stream itself. It leaves contaminant sediments that lead to the contamination of the whole stream bed and the emergent of odor and the excess algal growth on the surface of the stream. And finally, it will affect the color and the shape of the stream **[3]**.

Protection and recovering of water quality has been of a great concern nowadays. Economically, the presence of unclean waters inhibits the economic development. The unavailability of industrial and agricultural activities in the area leads to the degradation of economic growth of the community **[3].**

Thus, the reuse of agricultural drainage becomes essential to be a non-conventional water resource. This is by improving the quality of the heavily polluted agriculture drainage water to be suitable for irrigation practices. The enhancement process is to be by bio-reactors to achieve sustainability and cost-effective treatment technique and also to be safe for the environment and the human health **[1].**

The treatment of agricultural drainage water presents a challenge due to the complex chemical characteristics of most drainage waters **[2]**. There are various types of treatment process and techniques for agricultural drainage. The treatment is divided to procedures and technique.

The choice of treatment procedures depends on the degree, type of pollution, the reuse methodology, the land availability, the financial cost and the required degree of treatment, also the amount of treated wastewater required Several scenarios for drainage water treatment are used to achieve the reuse possibility target according to the treatment procedure and its location as follows:-

1. At the stream body ends.
2. Nearby the stream body.
3. Inside the stream body itself.

In this study the inside stream treatment procedure will be applied. The treatment improves the natural self-purification action to treat the whole volume of the drain flow. In the opposite of previous methods this solution does not need any land for the treatment for it is made inside the stream body to encourage the natural self-purification action or enhance the water quality to ease the self-purification to take very short distance after this treatment. This also, minimizes the treatment cost to its lower value **[**4]

Several methods of treatment could be applied inside stream all of them depends on the biodegradation concept for removal of pollutants. One of the lowest cost of these methods is the application of the agriculture waste inside the stream.

LITREATURE REVIEW

The application of bio-reactors is a unique treatment method to enhance the water quality. It's known worldwide as natural technologies. The bio-treatment is an innovative and sustainable method using natural processes involving algae application, agricultural wastes introduction and wetland vegetation, soils, and their associated microbial assemblages to improve water quality. Applying the agricultural wastes as bio reactor is the most innovative method of these procedures **[5]**.

A research made to remove heavy metals from wastewater, proved that the agricultural wastes have the role of adsorbents for the Elimination of heavy metals. The heavy metal ions such as copper, cadmium, mercury, zinc, chromium and lead ions do not degrade into harmless elements. Studies on the treatment of effluent using the agricultural wastes showed high efficiency in heavy metals adsorption from a stream. In addition to that the usage of this treatment technique has a low cost and is relatively connected to the low cost of agricultural waste such as rice husk, sugarcane bagasse, sawdust, coconut husk, neem bark, oil palm shell **[4].**

F. O. Obi1 identified the definition agricultural wastes as the remains from the growth and processing of raw agricultural products such as vegetables, fruits, meat, poultry, crops, and dairy products. They may contain beneficiary material that can benefit man with low economic values. Their composition will depend on the system and type of agricultural activities and they could be liquids, slurries, or solids **[5]**. The results of the research proved that the agricultural wastes have the role of adsorbents for the Elimination of Heavy Metals. The heavy metal ions such as copper, cadmium, mercury, zinc, chromium and lead ions do not degrade into harmless elements. Studies on the treatment of effluent using the agricultural wastes showed high efficiency in heavy metals adsorption from a stream. In addition to that the usage of this treatment technique has a low cost and is relatively connected tothe low cost of agricultural waste such as rice husk, sugarcane bagasse, sawdust, coconut husk, neem bark, oil palm shell **[6]**.

Several studies applied the agricultural wastes direct as an adsorbent in the treatment of industrial wastewater of low amounts before its disposal in the environment to minimize the treatment cost and get very cheap solution for environment protection without increasing the manufacturing cost that reflect on the industry success **[5]**. Several types of agricultural wastes were applied depending on the area available agricultural wastes. These applications were for different purposes as its application as biodegradable material for encourages the biological action to take place inside the stream **[5]**. Or heavy metals removal or generally enhancing the water quality **[6]**.

One of these successful agricultural wastes was the Rice husk which is used for pollution control inside water stream bodies after the sewage disposal points by working as biodegradable material to encourage the biological action to take place that minimize the time and distance for self-purification required by 70-80 %. This showed the success of application **[6]**. Rice husk was applied in adsorption treatment of dye industrial wastewater to remove heavy metals and dye from it before its disposal. It was studied to replace the currently expensive material as activated carbon.

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These applications were for different purposes as biodegradable material for encourages the biological action to take place inside the stream **[2]**, or heavy metals removal **[3]** or generally enhancing the water quality. One of these successful agricultural wastes was the rice husk which is used for pollution control inside water stream bodies after the sewage disposal points by working as biodegradable material to encourage the biological action to take place that minimize the time and distance for self-purification required by 70-80 %. This showed the success of application **[4]**. Rice husk was applied in adsorption treatment of dye industrial wastewater to remove heavy metals and dyes from it before its disposal. It was studied to replace the currently expensive material as activated carbon.

Introducing agricultural wastes to agricultural drainage for its treatment is one of the suitable techniques. The agricultural wastes act as a natural adsorption media for heavy metals and other elements. It's considered a management procedure for controlling pollution from surface runoff that is contaminated by chemicals in fertilizer, pesticides, animal slurry, crop residues or irrigation water. Water flows from one end to another over the surface, and the effluent comes out from the other end suitable for irrigation needs **[6]**.

El Nadi, et al., **[5]** used Biomass wastes as filter bio-media for wastewater treatment. Almond shells and sunflower stalks were tested for the removal efficiencies of the sewage parameters TSS, COD, BOD, N and P variable media thickness and constant flow. The study results showed that the removal efficiencies were positively proportionalwith media length. The study proved that almond shells and sunflower stalks were effective media for wastewater treatment.

***El Sergany* [6]** used sugar cane stalks as a filter media using adsorption filtration and biological meanings. The test was applied to know the best removal efficiency of COD, BOD, TSS, N and P from wastewater. The study concluded that the removal efficiencies ranged for all measured parameters from 70 to 85% as a maximum value for fine form and from 63 to 67% as a minimum value for coarse form **[5].**

Ahmed, R.A., et al, **[8]** had studied the application of several types of agricultural wastes as bio media in the biological filter unit for wastewater treatment. The results shows the success of the application of rice husk, trimming ficus trees and cotton stalks to remove TSS,COD & BOD with ratios between 88 to 91 % with layer thickness between 60 & 100 cm. Also, it shows the long working age of the media to more than one year without deformation or erosion.

The previous studies lead to check the application of agricultural wastes inside the stream body as bioreactor. ***Abdel Fatah, M*.[9]** in her study applied agriculture wastes as biodegradable material inside the water stream body to improve self-purification process which is affected by disposed domestic sewage pollution to be done in very shorter distance.

Agricultural wastes contribute in enhancement of water quality. The presence of the Agricultural wastes such as sugarcane bagasse, rice husk, sawdust, coconut husk, oil palm shell, neem bark in a polluted water body's shows enhancement in water quality regarding heavy metals to be ready for reuse **[2]**.

MATERIAL AND METHODS

The study was carried out on a pilot plant that was constructed by EU research project named "drains water quality enhancement". The pilot was built inside Faqous Wastewater Treatment plant held nearby Baher El Baqar agricultural drain in El Sharkiyah Governorate, Egypt The pilot consisted from five parallel channels simulates drain streams each with dimensions 40 cm width, 70 cm wall depth and 10 m length. They started and ended with two crossing channels as feeding and disposing channels each with the same depth and width 1.0 m.this pilot fed by agricultural drain water using a submersible pump erected inside the drain above the bed by 50 cm delivered through 4 inch force main pipe to the feeding crossing channel that distribute water on the five longitudinal main channels.

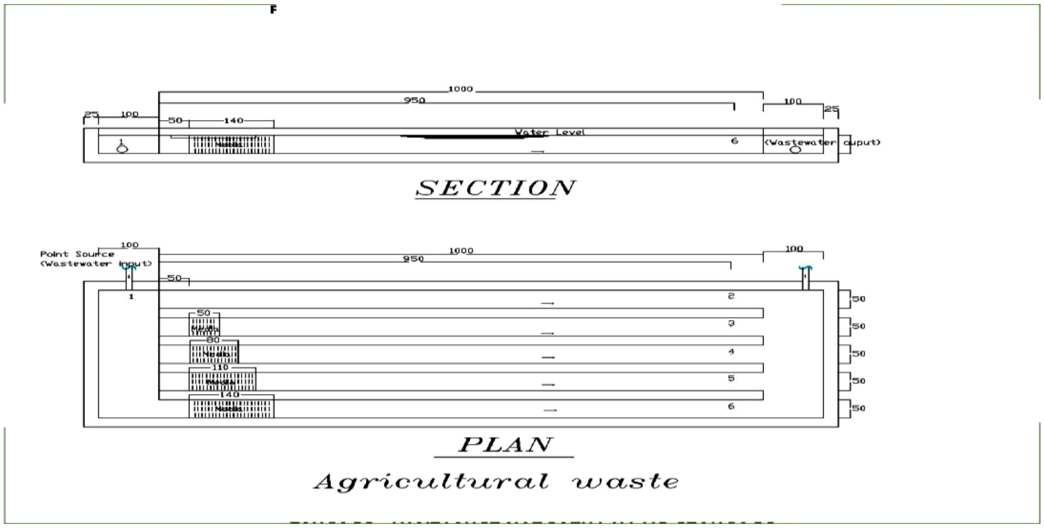

Figure (1) Plan and Section of the Applied Pilot

Table 1 Rice Husk media application procedure

Channel No.	Treatment Method	Applied agriculture waste (Rice Husk)
CH1	Without treatment	
CH2	Rice husk length50 cm	
CH3	Rice husk length80 cm	
CH4	Rice husk length110 cm	
CH5	Rice husk length140 cm	

The channels effluent collected in the disposal crossing channel that drained to the agricultural drain by 6 inch. The applied solutions are put in four from the five parallel channels after its starting edge by 0.5 m with variable lengths from 0.5 to 1.40 m.

- **Feeding Pump**

  Using submersible pump of 10 l/s and head 10 m takes water from drain to channels by force main pipe of 4 inch diameter.

- **Channels**

  Five parallel channels with dimensions of 40cm width, 70cm depth and length of 10m. Fed and drained by two perpendicular channels one at beginning and the second at end of the five channels each with same depth and with width 1.00 m

- **Used Treatment Unit**

  Erecting treatment unit after water channel inlet by 0.5 m with different lengths as showed in table 1

- **Disposal Pipe**

  The 6 inch pipe takes the treated water and throws it into the drain again.

Four different sampling locations were applied by taken three samples for each during the day for all channels. The first group at 9.00 am in the morning, the second at 1.00 pm after noon and the third at 6.00 pm in the evening to simulate the variation during the day and the average reading in each location simulates the day measuring for this location. Before starting the treatment run one preparation week was made to prepare the pilot for the treatment. The samples locations were as follows.

1-at inlet

2- inside channel after treatment unit by1meter

3-at ch. Middle after 5m from channel beginning.

4-at ch. Outlet after 10 m from channel beginning.

All measurements were made according to the American standard methods for water &wastewater Examinations **[10]** in the Faquos WWTP laboratory. The measured parameters are taken for all samples:

1. Dissolved Oxygen (DO).
2. Biological Oxygen Demand (BOD),
3. Chemical Oxygen Demand (COD),
4. Total Suspended Solids (TSS).
5. Heavy Metals (HM),

RESULTS AND DISSCUTION

The first run used agricultural waste media from rice husk as a biodegradable media with size of channel width and water depth and variable length ranged between 50, 80, 110 &140cm one for each channel from 2 to 5 and left first channel without any media as buffer. The run covers period of six weeks from first of December 2020 to fifth of January 2021.

Figures (2, 3) and table (2) illustrate DO average variations in agricultural waste media experiment for all channels from distance zero to distance ten meter

Table (2) Average DO Variations

Distance (m)	DO of Effluent water with different Distances				
	Ch1	Ch2	Ch3	Ch4	Ch5
0	0.9	0.9	0.9	0.9	0.9
After media by 1 m	0.9	1.6	1.6	1.8	1.8
5	0.9	1.1	1.3	1.4	1.6
10	0.9	1.3	1.1	1.30	1.39

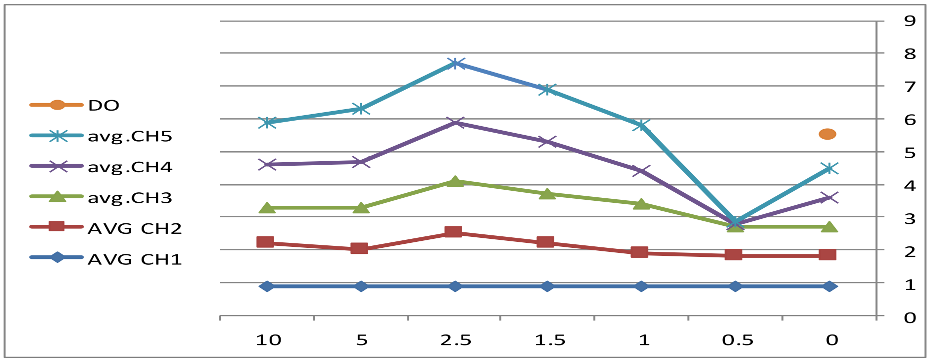

Figure (2) Average Effluent DO

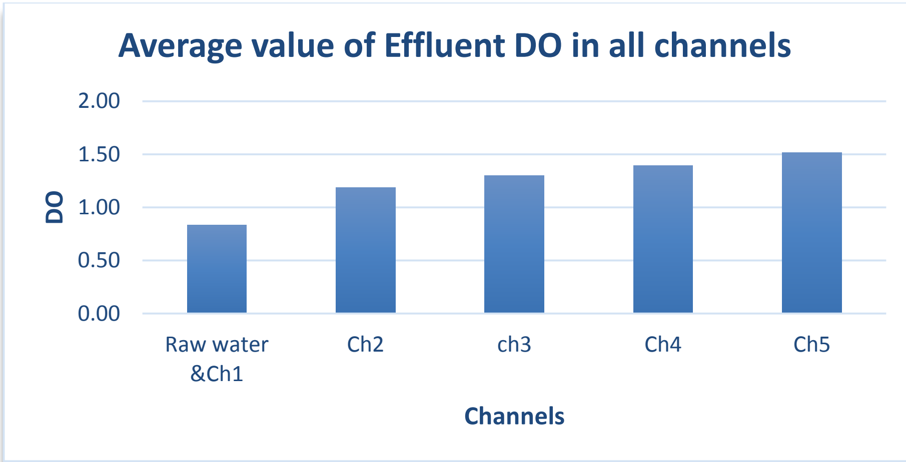

Figure (3) Average Effluent DO

DO increased with rice husk in general between 0.9, 1.3 mg/l for ch2, ch3 and ch4 for length between 50, 110 cm with an average increase ratio 40.4%.

When agriculture waste length was increased to 140cm in ch5, DO reached between 0.9, 1.39 mg/l with an average increase ratio 54%. The maximum value of DO was between 1.6, 1.39 mg/l and occurred when the length was increase

After one meter of using the media DO in water was increased from 2.5m to 5m the DO was decreased because the death of bacteria for the increase of biological action in drain that consumed the DO. From 5m to 10 m the ratio was increase again for self-purification. It is clear from the results that the greater length of agriculture waste has a direct effect in increasing DO in water after one meter from media used for treatment.

Figures (4, 5) and table (3) BOD average Variations in Agricultural Waste Media Experiment for all channels from distance zero to distance ten meter

Table (3) Average BOD Variations

Distance (m)	BOD of Effluent water with different Distances				
	Ch1	Ch2	Ch3	Ch4	Ch5
0	500	500	500	500	500
After media by 1 m	500	260	200	160	100
5	500	410	350	290	120
10	500	400	310	290	90

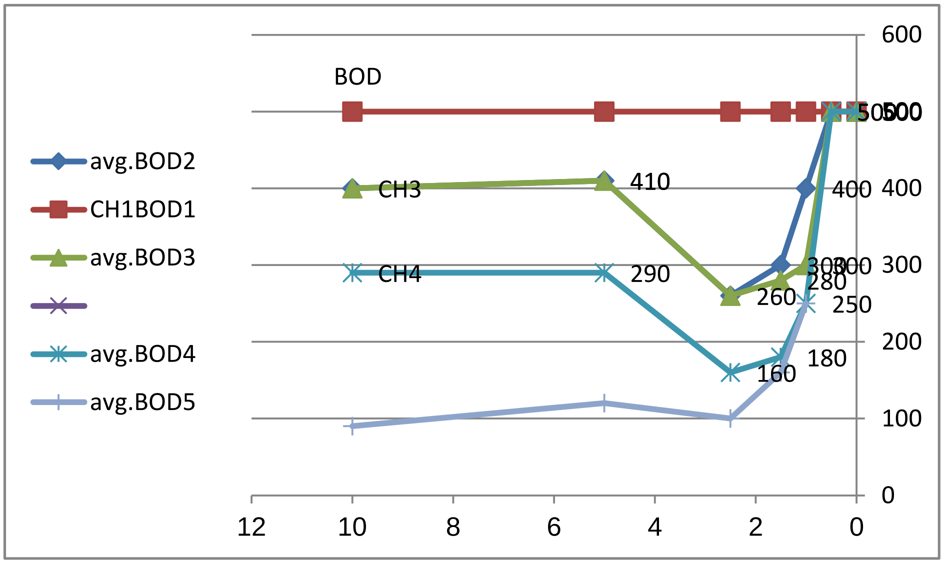

Figure (4) BOD Daily Variations

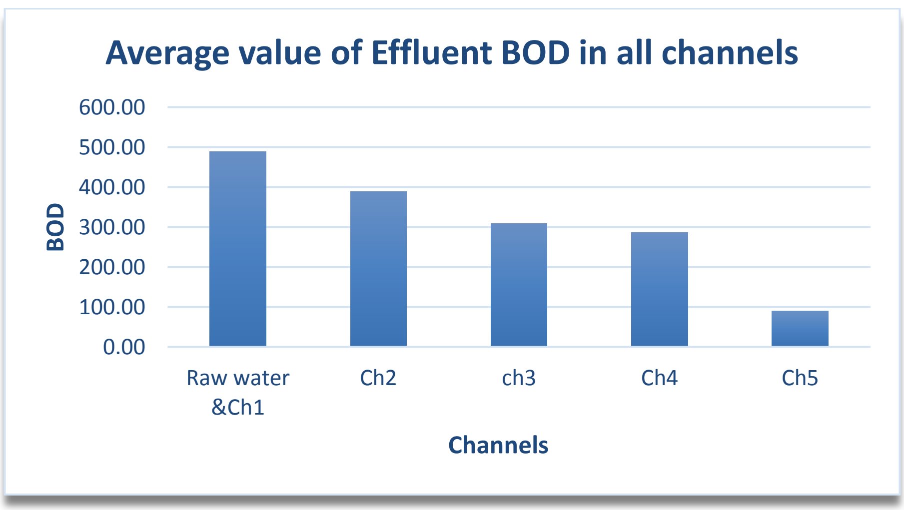

Figure (5) Average Effluent BOD

It was found that BOD decreased with Rice Husk in general between 100, 410 mg/l according to the length of the media and the distance after it. After one meter from the media with lengths 50, 80, 110 cm, it reached 260,200,160 mg/l from 500mg/l with an average removal ratio 68%. The value of BOD varied between 120, 100 mg/l in case of length 140cm with an average removal ratio 80%. When length is increased increasing the BOD removal from one meter to 2.5 meter .but at 5 meter ,BOD removal ratio decrease it reached to 18% for biological action and bacteria death from 2.5m to 5m., BOD varied between 400, 90 mg/l with an average removal ratio 82.4% with length 140 and the end of pilot for self-purification. It is clear from the results that the greater length of Rice Husk after one meter from the media has an influence in increasing the BOD removal.

Figure (6,7) and table (4) COD average Variations in Agricultural Waste Media Experiment for all channels from distance zero to distance ten meter

Table (4) Average COD Variations

Distance (m)	COD of Effluent water with different Distances				
	Ch1	Ch2	Ch3	Ch4	Ch5
0	1200	1200	1200	1200	1200
After media by 1 m	1200	600	570	520	300
5	1200	970	780	680	420
10	1200	880	700	600	380

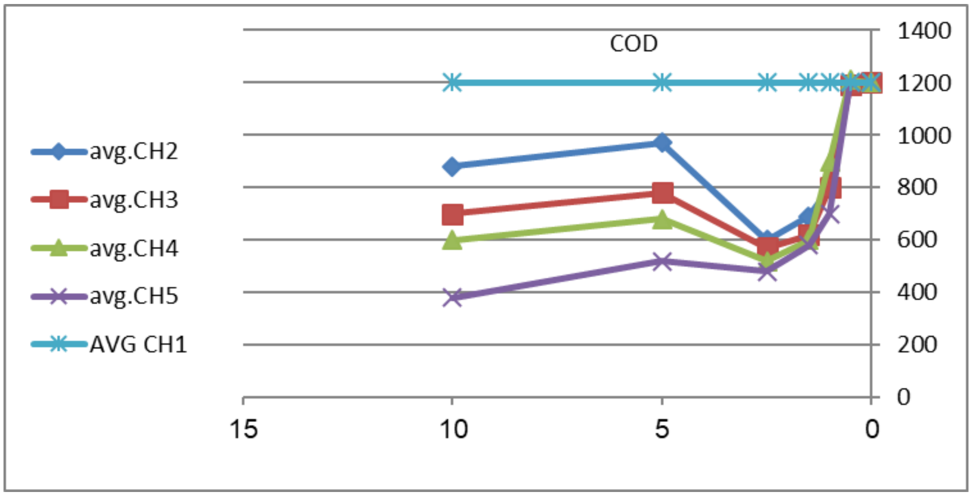

Figure (6) COD Daily Variations

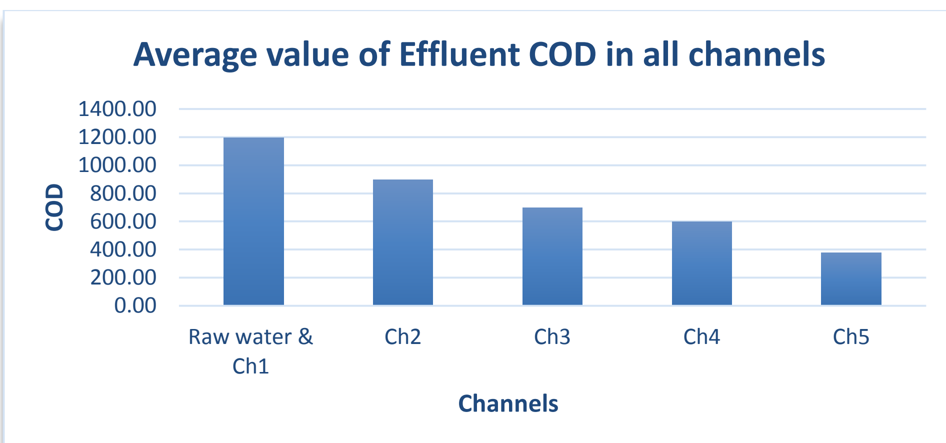

Figure (7) Average Effluent COD

From the results obtained, it was found that COD decreased with Rice Husk from 1200 mg/l to be between 888, 380 mg/l according to length of the media and the distance from used. With length 50 cm, it reached 1200,880 mg/l with an average removal ratio 26.68%. The value of COD varied between 1200, 700 mg/l in case of length 80 cm with an average removal ratio 41.6 %. When length was 110cm, COD varied between 300, 380 mg/l with an average removal ratio 75%. The minimum value of COD was 380 mg/l and occurred with length was 140cm with average removal ratio was 68.4%. It is clear from the results that the greater length of the media has an influence in increasing COD removal ratio, this occurs as a result of excess dissolved oxygen in the water, also after one meter we notice that the minimum value of COD was 300mg/l, from 2.5m to 5m the value was increase for biological action and bacteria death, after 10 meter COD was decrease again because self –purification of the drain.

Figure (8) and table (5) TSS average Variations in Agricultural Waste Media Experiment for all channels from distance zero to distance ten meter

Table (5) Average TSS Variations

Distance (m)	TSS of Effluent water with different Distances				
	Ch1	Ch2	Ch3	Ch4	Ch5
0	554	554	554	554	554
After media by 1 m	554	370	360	380	370
5	554	290	290	230	185
10	554	254	204	200	70

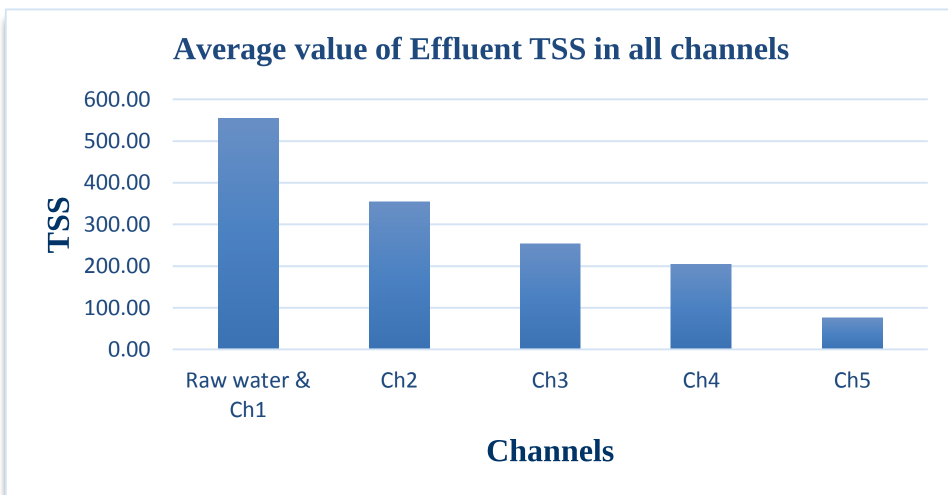

Figure (8) Average Effluent TSS

TSS decreased with Rice Husk in general from 554 mg/l to be between 254, 70 mg/l according to the length of media and the distance from the media. With the length 50cm reached 554, 254 mg/l with an average removal ratio 54.2%. The value of TSS varied between 554, 204 mg/l in case of the length 80 with an average removal ratio 63.17%. When the length of the media was 110cm, TSS varied between 554, 200 mg/l with an average removal ratio 64%. The minimum value of TSS was 70 mg/l as a constant value and occurred when the the length was 140cm with an average removal ratio was 87.4%. It is clear from the results that the greater length of the media has an influence in increasing the TSS removal ratio.

Figures (9) and table (6) illustrate HM average Variations in Agricultural Waste Media Experiment for all channels from distance zero to distance ten meter

Table (6) Average HM Variations

Distance (m)	HM of Effluent water with different Distances				
	Ch1	Ch2	Ch3	Ch4	Ch5
0	1.27	1.27	1.27	1.27	1.27
After media by 1 m	1.27	1.04	1.4	1.05	0.9
5	1.27	1.03	1.0	0.7	0.4
10	1.27	1.09	.09	0.6	0.28

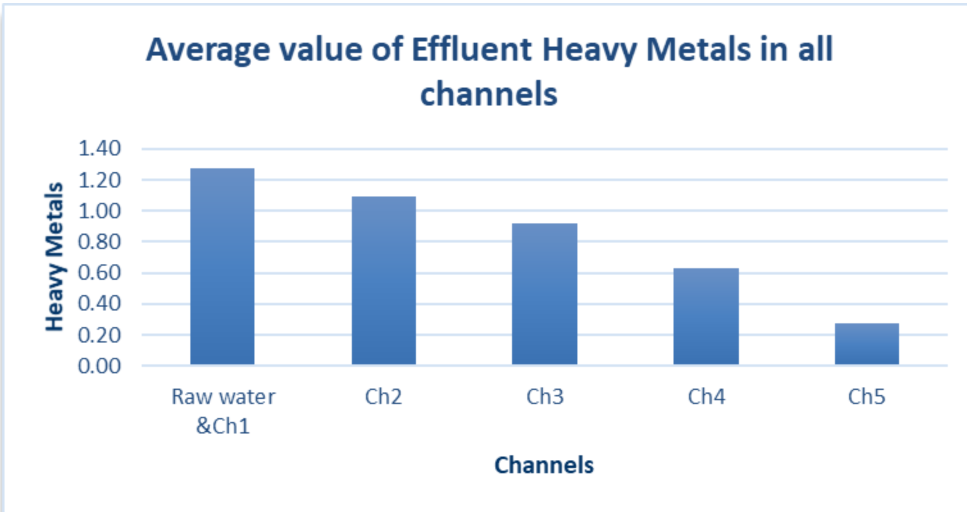

Figure (9) Average Effluent Heavy Metals

Heavy metals decreased with rice husk in general between 1.27, 0.28 mg/l according to the length of the media with length was 50 cm, it reached 1.27,1.09 mg/l with an average removal ratio 14.2%. the value of heavy metals varied between 1.27, 0.9 mg/l in case of length 80 cm with an average removal ratio 29.6%. when the length reached to 110cm , heavy metals varied between 1.27, 0.6 mg/l in this case which use this media for treating raw water. the six weeks period of the experiment was from 1 st of march to 12th of april 2020 since the effect of weather for bacterial action will be better in summer. we notice that after one meter from used media the minimum value of hm after 2.5cm for biological action in the drain and death bacteria it was increase the value of hm . at the end of pilot at distance 10 m the value was decrease again for self-purification enhancement.

CONCLUSIONS

The study resulted the following conclusions that help in the treatment of the agricultural drains water for reuse purposes with very cheap and easy operated solution as the agriculture waste treatment by Rice Husk.

1. Using Rice Husk method increase removal ratio of BOD by 82.4 %, also increase removal ratio of COD by 90%. This is because of when the dissolved oxygen percentage is high as in this method, due to the Rice Husk acts as an of bio-reactors is a unique treatment method to enhance the water quality. for the introduction of oxygen, this leads to an increase in the removal rate of the BOD,TSS,HM & COD.
2. Using rice husk can be applied in agricultural drains to improve quality with low cost in operation and maintenance.

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