Leachate Treatment by Applying M.B.B.R Technology with Manufactured Additive from Agricultural Waste and Filtration through Brick Scraps

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Abstract: Sanitary landfilling is one of traditional effective method in solid waste disposal. The solid waste dumped in large pre-equipped area. The solid waste start to decompose to generate gases such as methane and also liquids such as leachate. The leachate is very serious environmental enemy especially for surface water, groundwater, and soil because it contains a sever contaminants such as toxic matters and heavy metals. Leachate treatment methods used globally such as activated sludge, sequential batch reactor and moving bed biofilm reactors. The M.B.B.R method have been chosen to be used in this research as a result of high removal efficiency achieved. In this research we proposed a combination between biological treatment using moving bed biofilm reactor (M.B.B.R) and physical treatment through settling and filtration processes to enhance the leachate physiochemical properties to be used in irrigation purpose for minimizing the gap between fresh water requirements and raw water availability. The filtration process applied by using a brick scraps filter as applying recycled material usage concept. A micro scale pilot had been constructed for leachate treatment by using four rectangular glass tanks with total volume of 54 liters and working volume of 45 liters. The first tank is considered as primary settling tank. The second tank is M.B.B.R unit. The third tank is final settling tank. The last tank is collection tank and Preceded by brick scraps filtration column. A treatment additive had been manufactured by using agricultural waste such as sugarcane and palm leaf for enhancing the treatment efficiency. A numerous trial has been accomplished, till the satisfactory results achieved. Applying a 12-hour aeration cycle with adding a combination between sugarcane and palm leaf additives enhance the physiochemical parameters largely and the effluent is satisfying the environmental laws to be used in irrigation purposes. The removal efficiency of COD, BOD, TSS, NH_3, TKN and TP reach 99.31%, 98.80%, 99.33%, 97.33%, 99.79% and 76.48%. All physiochemical testing had been conducted at the national research center.

Keywords: M.B.B.R, Leachate treatment, Brick scraps filtration, Agricultural waste, Sugarcane, Palm leaf.

1. Introduction

Solid waste is one of environmental burden. There are various technics for disposal of solid waste. One of these technics is sanitary landfilling. Sanitary landfill is an excavated huge area, lined and prepared with liquid collection system for the generated liquids due to decomposition of wastes. Also, a gas collection system must be installed to collect and benefits the gases generated. The generated liquid is highly polluted and toxic to the environment (surface water, ground water and soil). Many researchers try to treat leachate by different methods such using biological treatment, physical treatment and chemical treatment.(Khoo et al., 2020)

The biological treatment methods used worldwide for leachate treatment are activated sludge, sequential batch reactor, rotating biological contactors, aeration ditch and moving bed biofilm reactor. (Khoo et al., 2020). It is concluded that the most efficient and promising technic in treating leachate by applying M.B.B.R. The majority of treatment methods achieve an enhancement at leachate physiochemical parameters that can be disposed as influent to wastewater treatment plant.(Aziz et al., 2010; Sartaj et al., 2010)

The moving bed biofilm reactor is a biological treatment technic adapted from activated sludge process and bio-filter process. A small plastic carrier with density lower than water is moving continuously and suspended in reactor. These carriers are kept moving by aeration system and also by using mechanical mixer. A biomass is grown on the carrier elements surface. A usual contact between the carriers and liquid is continues due to suspension and floating status.(Borkar et al., 2013)

MBBR as biological treatment offers a compact design to enhance the advantages of it than activated sludge and also produce higher quality effluent and smaller foot print.(G.-H. Chen et al., 2020)

Nanoparticles (INNPT nanomaterial) were Imported by El-Watanya company for development, investment and trade, Egypt. The composition of INNPT nanomaterial (weight %) is CaO (35-40%), Al_2O_3 (40-45%), Fe_2O_3 (5-15%) and SiO_2 (2-3%). It is in powder form material. It was used in treating wastewater and leachate and also achieved a promising result. (Mahmoud et al., 2018)

Agricultural waste is also, a huge environmental problem due to the miss employing it in other industries or be recycled. Agricultural waste consists of 32% of the whole generated waste in Egypt. When the technological methods applied in agriculture activities such cultivation and harvesting process, the agricultural volume increased and makes an environmental pollution. Actually, the agricultural wastes reach about 35 million tons per year. The classification of the generated agricultural waste differs from one village to another and also from agricultural land to another due to the farmers always change the cultivated crops for many reasons such as the most profitable crops, the suitable crops may cultivate in this land and also, they are forced to cultivate crops that increase the fertility of land.(Abou Hussein & Sawan, 2010; Hassan et al., 2014)

Additives manufactured from agricultural waste used in treatment of wastewater and achieved a great result and had a promising future. (Gautam & Saini, 2020)

Additives made from sugarcane (bagasse) and palm leaf used in many treatment approaches on wastewater and also in heavy metal removals. The target of using agricultural waste manufactured additives is to eliminate the huge pollution load from environment by recycling the waste to be used in a good manner.(Elfeki et al., 2017)

Sugarcane is essentially consisting of stem and straw. Sugarcane is composed from fibers (10-16%) and broth (84-90%). After extracting cane juice from the sugarcane, the residual fibers of the stem are named bagasse. Bagasse chemically composed of cellulose (38.4–45.5%), hemicellulose (22.7–27.0%) and lignin (22.7–27.0%). Cellulose, and hemicellulose fractions are composed of mixture of carbohydrates polymers.(Canilha et al., 2012)

Lignin is a complex aromatic macromolecule produced by radical polymerization of three phenyl-propane alcohols: p-coumarilic, coniferilic, and synapilic. Lignin and hemicelluloses in the plant cell wall interact with the cellulose elementary fibrils, protecting them from chemical and/or biological degradation. (Kuhad et al., 1997)

The composition and distribution of lignin are responsible for the recalcitrance of lignocellulosic materials to enzymatic hydrolysis, restricting enzyme accessibility; hence, the process of delignification will increase enzymatic hydrolysis conversion rates (Taherzadeh & Karimi, 2007) Although lignin is mainly used as a fuel, it can be chemically modified to be used as a chelating agent (Gonçalves & Soto-Oviedo, 2002), for heavy metal removal from wastewater (Stewart, 2008), or as a precursor material for the manufacture of high-value products such as activated carbon (Fierro et al., 2008), surfactants (Chum et al., 1985), and adhesives (Benar & others, 1992; Canilha et al., 2012).

Palm leaf is made up of three primary components: cellulose, hemicellulose, and lignin, with the addition of oil and protein as minor constituents. On average, cellulose, hemicellulose, and lignin content varies from 40–50%, 20–35%, and 15–35%, respectively. (Macedo et al., 2008)

Cellulose is a partially crystalline linear polysaccharide made up containing long chains of up to 3,000 glucose units. The only difference between hemicellulose and cellulose is the number of schharide units (hemicelluloses consists of the lower number of sccharide units). All have average percent elemental concentrations of 44.4 wt.% carbon, 49.4 wt.% oxygen, and 6.2 wt.% hydrogen. Lignin's molecular components are more complex. It is made up of a three-dimensional polymer of phenylpropane units that are bound together by C–O–C or C–C bonds. As a result, the elemental composition is higher in carbon percentage (62 wt.%) and lower in oxygen percentage (32 wt. percent). The ether and C–C bond interact with the cellulose and hemicellulose as well as the phenylpropane groups. As a consequence, lignin serves as a cementing material for lignocellulosic structures. (Jibril et al., 2008)

Many agricultural byproducts have been used as sources for activated carbon such as coconut shells, wood, almond shell, olive stone, oil palm shell, nutshell, peanuts, apricot stone, and date stone. They are well documented in most of the reviews on low-cost adsorbent and precursor by different authors. (Ahmaruzzaman, 2008; Bhatnagar & Sillanpää, 2010; Crini, 2006; Demirbas, 2008, 2009; V K Gupta & others, 2009; Vinod K Gupta et al., 2010; Hashem et al., 2007; Ioannidou

& Zabaniotou, 2007; Miretzky & Cirelli, 2010; Mohan & Pittman Jr, 2006; Rafatullah et al., 2010; San Miguel et al., 2006)

It is unfortunate that not much have been said about byproducts of date palm as low-cost adsorbent and as a precursor for the production of activated carbon. Although millions of tons of date palm waste are generated annually in different date palm-growing countries. The industrial utilization of these wastes as an adsorbent will also solve the problem of its disposal. (Bóta et al., 1997)

Palm leaf had a numerous application such as heavy metals removal(Banat et al., 2002; El-Hendawy, 2009), dyes removal (Crini, 2006; Reife & Freeman, 1996; Robinson et al., 2001), phenolic pollutants removal (Abdulkarim et al., 2002; Banat et al., 2004; Okasha et al., 2010), pesticides removal (Danish et al., 2010; H El Bakouri et al., 2009; Hicham El Bakouri et al., 2009) and miscellaneous pollutants removal like sulfur removal (Bamufleh, 2009), COD removal (El-Naas et al., 2010), nitrogen removal (Al-Muhtaseb, 2010)and phosphorus removal (Riahi et al., 2009)

Also, the recycling of construction and demolition waste is a great approach to minimize the waste volume threaten the environment. Pottery scraps and brick scraps recycled by reuse them in treatment technologies such as filtration. The construction and demolition waste in Egypt form around 44 % from the whole generated waste. (Bansal & Singh, 2014; Dahlbo et al., 2015; Jain et al., 2020; Tam & Tam, 2006)

It is concluded that it is a promising way to treat the leachate by applying M.B.B.R with using an additive of INNPT or sugarcane additives or palm leaf additives.

2-MATERIAL AND METHODS

This research is aimed to find a biological treatment convenient to leachate treatment with using manufactured additives from agricultural waste. Also, use the effluent of treatment in irrigation purpose. The proposed approach for leachate treatment by applying a combination of physical , biological and chemical treatment methods. The physical treatment represented in settling process. Biological treatment shown in applying moving bed biofilm reactor (M.B.B.R) technology. Chemical treatment applied in using various additive such as nanoparticles additive (INNPT) or manufactured from agricultural waste such as sugarcane and palm leaf.

2-1 Raw leachate sample:

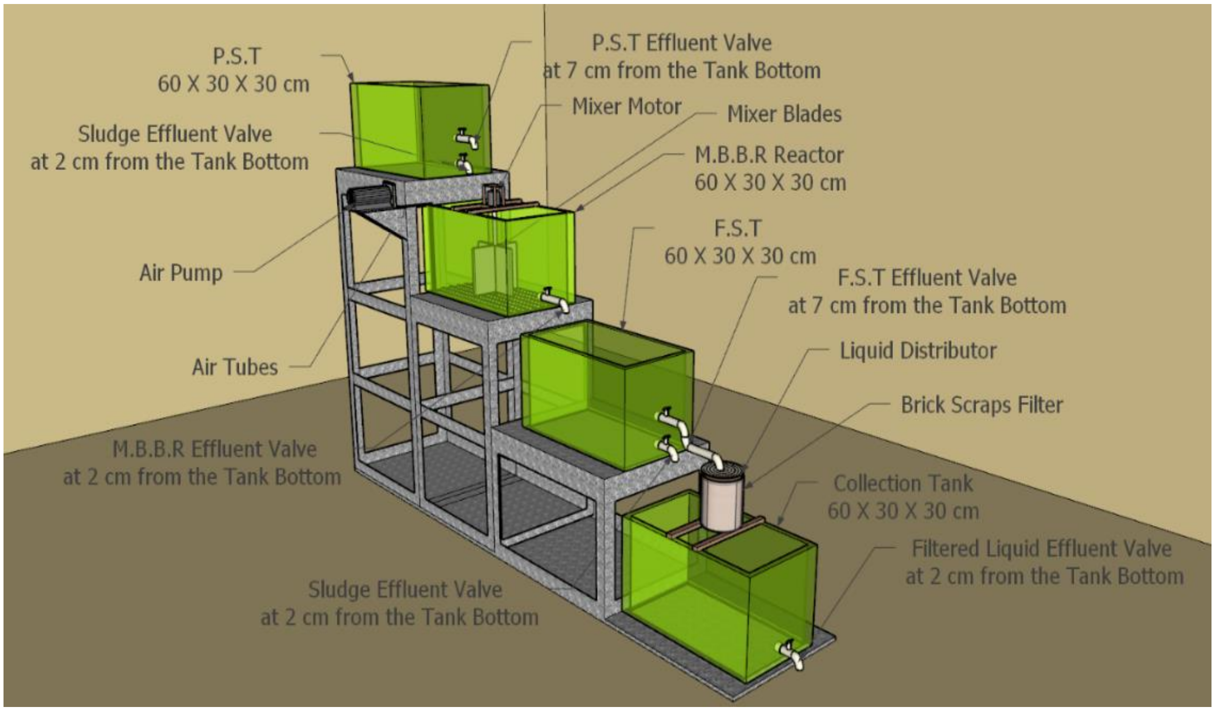
A raw leachate sample was taken from old sanitary landfill Al-Wafa and Al-Amal at the fifth settlement at New Cairo district in Egypt. The raw sample volume collected from the sanitary landfill was a 48 barrel of 20 liters volume. All the samples collected from the same leachate bond. Raw Sample were collected and transferred immediately for the experiments according to the standard methods. (Association et al., 2010)

2-2 Raw leachate identification:

Characterization of raw and treated leachate was tested by gauging some physiochemical parameters to determine the sample character and properties. Chemical oxygen demand (COD), biological oxygen demand (BOD5), pH, total suspended solids (TSS), Ammonia (NH3), Total Kjeldahl nitrogen (TKN) and Total phosphorus (TP). All these parameters measured according to the standard methods of water and wastewater examination. (Association et al., 2010). All testing procedures are conducted at national research center.

2-3 Pilot Description:

A four glass rectangular tanks with dimensions L*B*d of 60*30*30 cm with a total volume of 54 liters and freeboard of 5 cm. the first tank is the primary settling tank (P.S.T). The detention time of the leachate at P.S.T is 4 hours. The second tank is moving bed biofilm reactor (M.B.B.R) unit supplied with aeration system and mechanical mixer. The hydraulic retention time (HRT) of leachate inside the reactor is 24 hours. The third tank is final settling tank (F.S.T). The detention time of the leachate at F.S.T is 4 hours. The fourth tank is the collection tank. Before the collection tank the effluent of F.S.T was filtered through out the column of brick scraps then the filter effluent collected at collection tank. Figure(1) shows the schematic skitch of the used pilot.



Figure(1) : The schematic skitch of the treatment system for leachate.

2-4 M.B.B.R unit:
An M.B.B.R unit is a glass tank of 54 liters of total volume and 45 liters working volume. Bioplastic carriers and aeration system with mechanical mixer for enhancing the aeration and suspension status of biocarriers inside the reactor. The biocarriers dimension is 30 millimeters in diameter and 20 millimeters in height. The biocarrier specific area is 376.7 m2/m3. The biocarriers prepared by using another aeration tank for 12 hours aeration for wastewater and sludge collected from the final settling tank for a wastewater treatment plant. The air pump work with constant rate of 2 liter/min.

2-5 Nanoparticles additives (INNPT):
Nanoparticles (INNPT nanomaterial) were Imported by El-Watanya company for development, investment and trade, Egypt. The composition of INNPT nanomaterial (weight %) is CaO (35-40%), Al2O3 (40-45%), Fe2O3 (5-15%) and SiO2 (2-3%). It is in powder form material. The optimum dose determined by running a jar test with different doses (2-4-6-8 and 10 mg/L) and the last jar is a control one. Measuring turbidity after running the test with visual decision for the six jars and choosing the clearest with minimum turbidity value so the dose of this jar is the optimum one. The optimum dose was 6 mg/L. It is added in the treatment trial at the beginning of the M.B.B.R cycle.

2-6 Agricultural waste manufactured additives:
2-6-1 Sugarcane (bagasse) manufactured additive:
It is prepared by the following methodology

- The squeezed sugarcane straw collected and transferred to the work place.
- Sun drying the straws by spreading it in open, good ventilated and sunny area.
- Let the straws dried for five days to ensure the evaporation of all residual liquids.
- After sun draying (for 5 continues days) the collected dried straws prepared for grinding process to be in powder form.

The optimum dose determined by running a jar test with different doses (2-4-6-8 and 10 mg/L) and the last jar is a control one. Measuring turbidity after running the test beside visual decision for the six jars and choosing the clearest with minimum turbidity value so the dose of this jar is the optimum one. The optimum dose was 8 mg/L. It is added in the treatment trial at the beginning of the M.B.B.R cycle. This additive coded in the research by “manufactured additive A”

2-6-2 Palm leaf manufactured additive:
It is prepared by the following methodology

- The Palm Leaves collected and transferred to the work place.
- Sun drying the Palm Leaves by spreading it in open, good ventilated and sunny area.
- Let the straws dried for five days to ensure the evaporation of all residual liquids.

- After sun draying (for 5 continues days) the collected dried Palm Leaves additives prepared for grinding process to be in powder form.

The optimum dose determined by running a jar test with different doses. A three trials executed to find out the optimal dosage. The first trial doses are (2-4-6-8 and 10 mg/L) and the last jar is a control one. The second trial doses are (10-12-14-16 and 18 mg/L) and the last jar is a control one. The third trial doses are (18-20-22-24 and 26 mg/L) and the last jar is a control one. Measuring turbidity after running the test for each trial beside visual decision for the six jars and choosing the clearest with minimum turbidity value so the dose of this jar is the optimum one. The optimum dose was 24 mg/L. It is added in the treatment trial at the beginning of the M.B.B.R cycle. This additive coded in the research by “manufactured additive B”.

2-6-3 Mixed manufactured additive:
It is prepared by the following methodology

- The sugarcane manufactured additive prepared as previously described. “manufactured additive A”
- The optimal dose determined according the jar test as previously conducted (i.e., the optimal dose found to be 8 mg/L).
- The palm leaf manufactured additive prepared as previously described. “manufactured additive B”.
- The optimal dose determined according the jar test as previously conducted (i.e., the optimal dose found to be 24 mg/L).
- A new manufactured additive will be prepared by weighting the optimum dose from each additive “A” and “B”. The newly generated additive will be renamed as “manufactured additive C”.

The optimum dose determined by running a jar test with different doses. A two trials executed to find out the optimal dosage. The first trial doses are (2-4-6-8 and 10 mg/L) and the last jar is a control one. The second trial doses are (10-12-14-16 and 18 mg/L) and the last jar is a control one. Measuring turbidity after running the test for each trial beside visual decision for the six jars and chose the clearest with minimum turbidity value so the dose of this jar is the optimum one. The optimum dose was 14 mg/L. It is added in the treatment trial at the beginning of the M.B.B.R cycle. This additive coded in the research by “manufactured additive C”

2-7 Brick scraps filter:
A plastic column with 40 centimeters diameter and 60 centimeters height. The plastic container filled with brick scraps such as construction and demolition waste. It is collected from the construction or demolition sites. The filter prepared by using 3 layers of brick scraps with different sizes. Fine, medium and large size of brick scraps placed from the bottom of the filter to the top. Each layer is 20 cm thickness. The fine sized brick scraps (10-20 mm) placed at the filter perforated bottom. The medium sized brick scraps (50-120 mm) placed above the fine sized layer with a

plastic textile spacer. The large sized brick scraps (120-200 mm) placed above the medium sized layer with a plastic textile spacer. The filter bottom is perforated to let the filtered leachate to pass and collected in collection tank. The perforation diameter is 5 mm. there are three identical sits of the brick scraps filtration column to be replaced every 24 hours. The set is replaced after the trial was ended and before starting a new one. The removes sit is backwashed then air dried for 48 hours then installed again in the treatment system.

2-8 Treatment trials:

Six treatment trials had been executed to reach the maximum removal efficacy and achieve the lowest physiochemical parameters for the leachate to be used for the irrigation process after satisfying the environmental laws for reusing purposes. The list below shows the treatment trials:

1. Trial 1: 8-hour aeration cycle without additives.
2. Trial 2: 12-hour aeration cycle without additives.
3. Trial 3: 12-hour aeration cycle with INNPT additives.
4. Trial 4: 12-hour aeration cycle with Sugarcane (bagasse) additives [manufactured additive A].
5. Trial 5: 12-hour aeration cycle with Palm leaf additives [manufactured additive B].
6. Trial6: 12-hour aeration cycle with mixed agricultural manufactured additives[manufactured additive C].

Each trial applied for three continual days. The samples taken analyzed at national research center.

3-RESULTS AND DISCUSION:

3-1 Raw sample:

The raw samples results shown at table 1 for the used leachate for the six treatment trials. The raw leachate quality assessed by a physiochemical parameter's analysis. It is clear that the quality of raw leachate used in the treatment trials was very bad due to showing high organic pollution represent in the COD, BOD, NH3, TKN and TP. These values indicate that the sanitary landfill is very ancient and the generated leachate threaten the surrounding environment of the landfill. The measured COD and BOD values is higher than reported by (M Sinan Bilgili et al., 2008; Memmet Sinan Bilgili et al., 2006; Cameron & Koch, 1980; Kheradmand et al., 2010; Sartaj et al., 2010; Thabet et al., 2009; Timur & Özturk, 1999). Also, these values are lower than reported by (Andrés et al., 2004; Kamaruddin et al., 2013; Wei et al., 2012; Yahmed et al., 2009).

The values of T.S.S are lower than reported by (Zhang et al., 2011). Also, the values of TKN are higher than reported by (Zhang et al., 2011). The values of NH3 are higher than reported by (Bhalla et al., 2012). And also lower than reported by (Bashir et al., 2010). According to the raw samples values shown in table 1 , the leachate is classified as intermediate generated and ensure that the landfill age ranged from 10 – 20 years. (Aziz et al., 2010; Bhalla et al., 2012; Khoo et al., 2020; Nazrieza et al., 2015; Zainol et al., 2012).

Table 1 : Characterization of raw leachate samples used in the six treatment trials

Trial No.	Samples Name	Parameters						
		COD	**BOD**	**P.H**	**TSS**	**NH3**	**TKN**	**TP**
Trial 1	Raw 1-Day 1 - (8) hr. cycle-w/o additive	12000	4000	6.5	7200	1150	3600	28
	Raw 1-Day 2 - (8) hr. cycle-w/o additive	12650	4320	6.6	7000	1210	3820	29
	Raw 1-Day 3 - (8) hr. cycle-w/o additive	12860	4730	6.5	6810	1380	3990	29
	Avg-Raw-(12) hr. cycle-w/o additive	13283	4790	6.6	7767	1347	3900	28
Trial 2	Raw 1-Day 1 - (12) hr. cycle-w/o additive	13000	4600	6.6	8100	1270	3800	30
	Raw 1-Day 2 - (12) hr. cycle-w/o additive	13350	4820	6.6	7700	1350	3910	28
	Raw 1-Day 3 - (12) hr. cycle-w/o additive	13500	4950	6.5	7500	1420	3990	26.5
	Avg-Raw-(12) hr. cycle-w/o additive	13283	4790	6.6	7767	1347	3900	28
Trial 3	Raw 1-Day 1 - (12) hr. cycle-with INNPT additive	12350	4390	6.7	7300	1250	3650	29
	Raw 1-Day 2 - (12) hr. cycle-with INNPT additive	12470	4460	6.7	7160	1320	3790	28
	Raw 1-Day 3 - (12) hr. cycle-with INNPT additive	12520	4500	6.7	6980	1400	3870	29
	Avg-Raw-(12) hr. cycle-with INNPT additive	12447	4450	6.7	7147	1323	3770	29
Trial 4	Raw 1-Day 1 - (12) hr. cycle-with Manufactured additive(A)	12250	4150	6.6	7400	1200	3500	27
	Raw 1-Day 2 - (12) hr. cycle-with Manufactured additive(A)	12430	4270	6.7	7240	1280	3690	26
	Raw 1-Day 3 - (12) hr. cycle-with Manufactured additive(A)	12550	4360	6.7	7170	1330	3760	25
	Avg-Raw-(12) hr. cycle-with Manufactured additive(A)	12410	4260	6.7	7270	1270	3650	26
Trial 5	Raw 1-Day 1 - (12) hr. cycle-with Manufactured additive(B)	12400	4510	6.5	7600	1380	3720	30
	Raw 1-Day 2 - (12) hr. cycle-with Manufactured additive(B)	12520	4630	6.5	7410	1460	3860	29
	Raw 1-Day 3 - (12) hr. cycle-with Manufactured additive(B)	12650	4740	6.6	7350	1510	3920	28
	Avg-Raw-(12) hr. cycle-with Manufactured additive(B)	12523	4627	6.5	7453	1450	3833	29

Trial 6	Raw 1-Day 1 - (12) hr. cycle-with Manufactured additive(C)	12600	4250	6.6	7000	1220	3550	28
	Raw 1-Day 2 - (12) hr. cycle-with Manufactured additive(C)	12850	4550	6.5	6790	1310	3720	28
	Raw 1-Day 3 - (12) hr. cycle-with Manufactured additive(C)	13100	4690	6.5	6650	1370	3790	29
	Avg-Raw-(12) hr. cycle-with Manufactured additive(C)	12850	4497	6.5	6813	1300	3687	28

The physiochemical parameters represented in table 1 are in similar range of leachate generated in Canada, China, Italy and Turkey according to reports of (Çeçen & Akta\cs, 2004; Di Palma et al., 2002; Henry et al., 1987; Lau et al., 2001; Lo, 1996; Lopez et al., 2004; Timur & Özturk, 1999; Wang & Shen, 2000)

3-2 Treatment trials results:

A series of treatment for the raw leachate has been done. In the following sections the results of six treatment trials had been displayed. The target to accomplish the values of trial samples according to the environmental law to be used as irrigation water. Tables from 2 to 7 shows the changing into physiochemical parameters for samples resulting from the six treatment trials. Also, the limits of law 48 for year 1982 which regulate the recycled water disposal and usage such be used in irrigation purposes. (Egyptian Government, 1982)

3-2-1 Trial 1 results:

Table 2 shows the samples physiochemical parameters achieved after treatment by using 8-hours aeration cycle without additives (Trial 1). This trial application took three continual days. The results of each day cleared in the table 2. The average results cleared in last section in table 2.

Table 2 : physiochemical parameters of trial 1 treatment samples

Trial No.	Samples Name	Parameters						
		COD	**BOD**	**P.H**	**TSS**	**NH3**	**TKN**	**TP**
Trial 1	Raw 1-Day 1 - (8) hr. cycle-w/o additive	12000	4000	6.5	7200	1150	3600	28
	After P.S.T-Day 1 - (8) hr. cycle-w/o additive-R.T=2hr	11850	3890	6.7	6800	1230	3760	25
	After P.S.T-Day 1 - (8) hr. cycle-w/o additive-R.T=3hr	11580	3700	6.7	4960	1320	3810	21
	After P.S.T-Day 1 - (8) hr. cycle-w/o additive-R.T=4hr	11000	3550	6.7	3300	1400	3920	17
	After aeration 8hr cycle-w/o additive-Day 1-stage 1	9050	3000	6.7	3320	1270	3280	16

	After aeration 8hr cycle-w/o additive-Day 1-stage 2	6320	2050	6.7	3370	890	2360	16
	After aeration 8hr cycle-w/o additive-Day 1-stage 3	4550	1520	6.8	3400	600	1650	15
	After F.S.T-Day 1 - (8) hr. cycle-w/o additive-R.T=4hr	3310	1000	6.7	1610	380	900	13
	After filtration-Day 1 - (8) hr. cycle-w/o additive	3170	760	6.7	500	140	430	9
	% removal	73.58	81	----	93.06	87.83	88.06	67.86
	Raw 1-Day 2 - (8) hr. cycle-w/o additive	12650	4320	6.6	7000	1210	3820	29
	After P.S.T-Day 2 - (8) hr. cycle-w/o additive-R.T=4hr	11260	3510	6.7	3360	1360	3970	18
	After aeration 8hr cycle-w/o additive-Day 2-stage 1	8890	2830	6.7	3370	1210	3260	17
	After aeration 8hr cycle-w/o additive-Day 2-stage 2	6370	2180	6.8	3380	710	2780	15
	After aeration 8hr cycle-w/o additive-Day 2-stage 3	4610	1670	6.8	3420	630	1720	15
	After F.S.T-Day 2 - (8) hr. cycle-w/o additive-R.T=4hr	3390	1120	6.7	1640	400	970	13
	After filtration-Day 2 - (8) hr. cycle-w/o additive	3230	840	6.7	510	160	510	11
	% removal	74.47	80.56	----	92.71	86.78	86.65	62.07
	Raw 1-Day 3 - (8) hr. cycle-w/o additive	12860	4730	6.5	6810	1380	3990	29
	After P.S.T-Day 3 - (8) hr. cycle-w/o additive-R.T=4hr	11320	3570	6.7	3280	1420	3950	17
	After aeration 8hr cycle-w/o additive-Day 3-stage 1	9230	2960	6.8	3300	1150	3190	16
	After aeration 8hr cycle-w/o additive-Day 3-stage 2	6720	2230	6.8	3390	560	2290	16
	After aeration 8hr cycle-w/o additive-Day 3-stage 3	4890	1710	6.8	3450	480	1540	15
	After F.S.T-Day 3 - (8) hr. cycle-w/o additive-R.T=4hr	4100	1250	6.7	1620	350	930	14
	After filtration-Day 3 - (8) hr. cycle-w/o additive	3310	880	6.7	500	150	460	10
	% removal	74.26	81.4	----	92.66	89.13	88.47	65.52
	Avg-Raw-(8) hr. cycle-w/o additive	12503	4350	6.5	7003	1247	3803	29
	Avg-After P.S.T-(8) hr. cycle-w/o additive-R.T=4hr	11193	3543	6.7	3313	1393	3947	17
	Avg-After aeration 8hr cycle-w/o additive-stage 1	9057	2930	6.7	3330	1210	3243	16

	Avg-After aeration 8hr cycle-w/o additive-stage 2	6470	2153	6.8	3380	720	2477	16
	Avg-After aeration 8hr cycle-w/o additive-stage 3	4683	1633	6.8	3423	570	1637	15
	Avg-After F.S.T-(8) hr. cycle-w/o additive-R.T=4hr	3600	1123	6.7	1623	377	933	13
	Avg-After filtration-(8) hr. cycle-w/o additive	3237	827	6.7	503	150	467	10
	% removal	74.1	80.98	----	92.81	87.91	87.73	65.15
Law 48 for 1982		100	60	6-9	60	40	10	10

It so clear that the process of treatment applied into trial 1 approach had been partially successful thus the values of physiochemical parameters decreased. But the values not reach the allowable environmental law limits of law 48 for year 1982. (Egyptian Government, 1982)

The primary settling basin had a great affect into the values of T.S.S which decreased greatly specially after retention time of 4 hours with minor effect on the COD, BOD and TP values decreased according to the activation of anaerobic bacteria which decompose the organic maters residuals which lead up to decrease the values of COD, BOD and TP. The enhancement of TSS values after choosing relatively reasonable retention time due to the gravity settling effect, which makes the large particulate materials and also the suspended solids of relatively higher in size and weight enforced to be settled. The removal percentage lower than reported at other researchers work (Ağdağ & Sponza, 2005; S. Chen et al., 2008)due to the application of higher retention time and also the lower strength of the raw leachate used. This process repeated for three days. Only sample had been taken after retention time of 4 hours.

The value of NH3 and TKN had been increased due to the absence of oxygen leads to the death of aerobic bacteria which break down the bacterial cell and let the cell components free to go which produce an increase in these concentrations. (Ohio EPA DSW, 2014)

Moving bed biofilm reactor unit had also a great removal performance into the physiochemical parameters. The aeration process applied for continues 8 hours for one day (i.e.,\ applied for three stages of aeration). The promising effect have been noticed that the physiochemical parameters decreased gradually until the final aeration stage for the first day ended. But the values of COD, BOD, NH3, TKN and TP not reached the required target. The percent removal of COD and BOD is little lower than reported by (Kettunen & Rintala, 1995) and this caused by the lower strength of raw leachate used in that research. And it is the same removal range reported by (Horan et al., 1997). The COD and BOD values enhancement can be explained as a result of the increasing the microorganism's activity in organics decomposing process due to the air supplying by aeration system in the M.B.B.R unit.

The removal percentage achieved in the NH3 and TKN values are the lower than removal percentage reported by (Loukidou & Zouboulis, 2001). The removal caused by nitrification-denitrification process. The nitrification process done through the Nitrosomas, Nitrospopira and Nitrospira. Any one of these microbes can convert the ammonia(NH3) to the nitrite (NO2-). Then the Nitrobacter microbes convert the nitrite (NO2-) to nitrate (NO3-) which leads to lowering the concentration of ammonia (NH3). The denitrification process converts the nitrate (NO3-) to nitrogen gas which allowed to be released into the atmosphere. The denitrification process done through the heterotrophic bacteria. This process causes a decrease in TKN concentration. (Teamaquafix.com, 2015)

The TP decreased due to the process of anaerobic- aerobic action. The anaerobic had been achieved inside the primary settling tank. The aerobic condition achieved inside the M.B.B.R reactor. This tricky condition responsible for generating a such microorganisms that have the ability of storing phosphorus inside the microorganism cell as polyphosphate which lead to concentration TP depletion. (Hydroflux Industrial Pty Ltd, 2018). The removal percentage of TP is more than reported by (Xue et al., 2015)

The TSS value increased inside the M.B.B.R unit due to the carrier's existence and also the treatment process which make the carriers treat the leachate by decomposing organics and convert it to in organic solids moving inside the reactors. (J. Xiong et al., 2018). After the final settling tank, the samples show a huge TSS concentration enhancement due to the suitable settling retention time. The all formed settable inorganic solids in M.B.B.R allowed to settle in this period. The little enhancement happens in the other physiochemical parameters due to the activation of anaerobic bacteria. (Renou et al., 2008)

The filtration process through the brick scraps enhances the physiochemical parameters generally due to retaining the residual unsettled solids and also through formation of biofilm sticked to the bricks surface. This biofilm can treat the leachate when filtration process happens. This concept was similar to trickling filter treatment idea. The filtration process also enhances the color of the filtered effluent but the enhancement in the physiochemical parameters is minor due to the absence of circulation of the effluent to enhance the generated biofilm.(Daud et al., 2009). The average removal percentage achieved through the filtration process is much similar in range of average removal reported by (Abood et al., 2014)

3-2-2 Trial 2 results:

Table 3 shows the samples physiochemical parameters achieved after treatment by using 12-hours aeration cycle without additives (Trial 2). This trial application took three continual days. The results of each day cleared in the table 3. The average results cleared in last section in table 3.

Table 3 : physiochemical parameters of trial 2 treatment samples

Trial No.	Samples Name	Parameters						
		COD	BOD	P.H	TSS	NH3	TKN	TP
Trial 2	Raw 1-Day 1 - (12) hr. cycle-w/o additive	13000	4600	6.6	8100	1270	3800	30
	After P.S.T-Day 1 - (12) hr. cycle-w/o additive-R.T=4hr	10890	3950	6.7	3900	1300	3960	24
	After aeration 12hr cycle-w/o additive-Day 1- stage 1	7300	2740	6.6	4150	620	2470	22
	After aeration 12hr cycle-w/o additive-Day 1- stage 2	3860	1620	6.5	4380	280	1310	19
	After F.S.T-Day 1 - (12) hr. cycle-w/o additive-R.T=4hr	3250	930	6.6	1400	230	760	11
	After filtration-Day 1 - (12) hr. cycle-w/o additive	2100	610	6.7	360	110	270	8
	% removal	83.85	86.74	----	95.56	91.34	92.89	73.33
	Raw 1-Day 2 - (12) hr. cycle-w/o additive	13350	4820	6.6	7700	1350	3910	28
	After P.S.T-Day 2 - (12) hr. cycle-w/o additive-R.T=4hr	11100	4150	6.7	3540	1380	3950	23
	After aeration 12hr cycle-w/o additive-Day 2- stage 1	7550	2860	6.6	3690	570	2380	19
	After aeration 12hr cycle-w/o additive-Day 2- stage 2	3600	1700	6.6	3740	310	1620	17
	After F.S.T-Day 2 - (12) hr. cycle-w/o additive-R.T=4hr	3000	970	6.7	1200	180	830	13
	After filtration-Day 2 - (12) hr. cycle-w/o additive	2350	730	6.7	310	130	380	7
	% removal	82.4	84.85	----	95.97	90.37	90.28	75
	Raw 1-Day 3 - (12) hr. cycle-w/o additive	13500	4950	6.5	7500	1420	3990	26.5
	After P.S.T-Day 3 - (12) hr. cycle-w/o additive-R.T=4hr	11300	4100	6.6	3200	1470	4050	19
	After aeration 12hr cycle-w/o additive-Day 3- stage 1	8500	2700	6.5	3360	860	2430	17.5
	After aeration 12hr cycle-w/o additive-Day 3- stage 2	4950	1690	6.5	3420	490	1610	15
	After F.S.T-Day 3 - (12) hr. cycle-w/o additive-R.T=4hr	3290	1140	6.6	1150	230	960	10
	After filtration-Day 3 - (12) hr. cycle-w/o additive	2430	680	6.7	390	140	410	7
	% removal	82	86.26	----	94.8	90.14	89.72	73.58
	Avg-Raw-(12) hr. cycle-w/o additive	13283	4790	6.6	7767	1347	3900	28

	Avg-After P.S.T-(12) hr. cycle-w/o additive-R.T=4hr	11097	4067	6.7	3547	1383	3987	22
	Avg-After aeration 12hr cycle-w/o additive-stage 1	7783	2767	6.6	3733	683	2427	20
	Avg-After aeration 12hr cycle-w/o additive-stage 2	4137	1670	6.5	3847	360	1513	17
	Avg-After F.S.T-(12) hr. cycle-w/o additive-R.T=4hr	3180	1013	6.6	1250	213	850	11
	Avg-After filtration-(12) hr. cycle-w/o additive	2293	673	6.7	353	127	353	7
	% removal	82.75	85.95	----	95.44	90.62	90.97	73.97
Law 48 for 1982		100	60	6-9	60	40	10	10

It so clear that the process of treatment applied into trial 2 approach had been more successful than trial 1. Thus, the values of physiochemical parameters decreased. This is because the increasing the aeration period from 8-hour to 12-hour per stage. The aeration process last for one day (i.e.,\ for 2 stages of aeration). But the values not reach the allowable environmental law limits of law 48 for year 1982 except the value of TP.

The primary settling basin had a great affect into the values of physiochemical parameters as discussed before in trial 1 treatment.

Moving bed biofilm reactor unit had also a great removal performance into the physiochemical parameters. The aeration process applied for continues 12 hours for one day (i.e.,\ applied for two stages of aeration). The promising effect have been noticed that the physiochemical parameters decreased gradually until the final aeration stage for the first day ended. But the values of COD, BOD, NH3, TKN and TP not reached the required target. The percent removal of COD and BOD is little lower than reported by (Kettunen & Rintala, 1995)and this caused by the lower strength of raw leachate used in that research. And it is little higher than reported by (Horan et al., 1997). The COD and BOD values enhancement can be explained as a result of the increasing the microorganism’s activity in organics decomposing process due to the air supplying by aeration system in the M.B.B.R unit.

The removal percentage achieved in the NH3 and TKN values are the little lower than reported by (Loukidou & Zouboulis, 2001)but higher than showed in trial 1. The removal caused by nitrification-denitrification process. The nitrification process done through the Nitrosomas, Nitrospopira and Nitrospira. Any one of these microbes can convert the ammonia(NH3) to the nitrite (NO2-). Then the Nitrobacter microbes convert the nitrite (NO2-) to nitrate (NO3-) which leads to lowering the concentration of ammonia (NH3). The denitrification process converts the nitrate (NO3-) to nitrogen gas which allowed to be released into the atmosphere. The denitrification process done through the heterotrophic bacteria. This process causes a decrease in TKN concentration. (Teamaquafix.com, 2015)

The TP decreased due to the process of anaerobic- aerobic action. The anaerobic had been achieved inside the primary settling tank. The aerobic condition achieved inside the M.B.B.R reactor. This tricky condition responsible for generating a such microorganisms that have the ability of storing phosphorus inside the microorganism cell as polyphosphate which lead to concentration TP depletion. (Hydroflux Industrial Pty Ltd, 2018). The removal percentage of TP is more than reported by (Xue et al., 2015)

The TSS value increased inside the M.B.B.R unit due to the carrier's existence and also the treatment process which make the carriers treat the leachate by decomposing organics and convert it to in organic solids moving inside the reactors. (J. Xiong et al., 2018)

After the final settling tank, the samples show a huge TSS concentration enhancement due to the suitable settling retention time. The all formed settable inorganic solids in M.B.B.R allowed to settle in this period. The little enhancement happens in the other physiochemical parameters due to the activation of anaerobic bacteria. (Renou et al., 2008)

The filtration process through the brick scraps enhances the physiochemical parameters generally due to retaining the residual unsettled solids and also through formation of biofilm sticked to the bricks surface. This biofilm can treat the leachate when filtration process happens. This concept was similar to trickling filter treatment idea. The filtration process also enhances the color of the filtered effluent but the enhancement in the physiochemical parameters is minor due to the absence of circulation of the effluent to enhance the generated biofilm. (Daud et al., 2009). The average removal percentage achieved through the filtration process is much similar in range of average removal reported by (Abood et al., 2014).

It was so clear that the second approach is more effective in removal efficiency so the remaining 4 treatment trials was applied using the 12-hour aeration cycle.

3-2-3 Trial 3 results:

Table 4 shows the samples physiochemical parameters achieved after treatment by using 12-hours aeration cycle with INNPT additives (Trial 3). This trial application took three continual days. The results of each day cleared in the table 4. The average results cleared in last section in table 4.

Table 4 : physiochemical parameters of trial 4 treatment samples

Trial No.	Samples Name	Parameters						
		COD	BOD	P.H	TSS	NH3	TKN	TP
Trial 3	Raw 1-Day 1 - (12) hr. cycle-with INNPT additive	12350	4390	6.7	7300	1250	3650	29
	After P.S.T-Day 1 - (12) hr. cycle-with INNPT additive-R.T=4hr	10000	3550	6.7	3620	1330	3710	24.5
	After aeration 12hr cycle-with INNPT additive-Day 1- stage 1	5640	2230	6.6	3730	920	1850	19
	After aeration 12hr cycle-with INNPT additive-Day 1- stage 2	1350	870	6.5	3810	480	670	14
	After F.S.T-Day 1 - (12) hr. cycle-with INNPT additive-R.T=4hr	150	85	6.6	260	270	120	9
	After filtration-Day 1 - (12) hr. cycle-with INNPT additive	65	45	6.6	43	30	7	6
	% removal	99.47	98.97	----	99.41	97.6	99.81	79.31
	Raw 1-Day 2 - (12) hr. cycle-with INNPT additive	12470	4460	6.7	7160	1320	3790	28
	After P.S.T-Day 2 - (12) hr. cycle-with INNPT additive-R.T=4hr	10130	3550	6.6	3450	1370	3840	23
	After aeration 12hr cycle-with INNPT additive-Day 2- stage 1	4780	1790	6.6	3560	910	1960	17.5
	After aeration 12hr cycle-with INNPT additive-Day 2- stage 2	1420	830	6.5	3630	560	720	13
	After F.S.T-Day 2 - (12) hr. cycle-with INNPT additive-R.T=4hr	170	90	6.5	240	290	145	10
	After filtration-Day 2 - (12) hr. cycle-with INNPT additive	69	52	6.5	40	32	8	7
	% removal	99.45	98.83	----	99.44	97.58	99.79	75
	Raw 1-Day 3 - (12) hr. cycle-with INNPT additive	12520	4500	6.7	6980	1400	3870	29
	After P.S.T-Day 3 - (12) hr. cycle-with INNPT additive-R.T=4hr	10200	3800	6.7	3420	1440	3920	23.5
	After aeration 12hr cycle-with INNPT additive-Day 3- stage 1	5240	2700	6.6	3530	970	2060	19.5
	After aeration 12hr cycle-with INNPT additive-Day 3- stage 2	1530	860	6.6	3590	610	780	14
	After F.S.T-Day 3 - (12) hr. cycle-with INNPT additive-R.T=4hr	190	80	6.5	200	300	150	9.5
	After filtration-Day 3 - (12) hr. cycle-with INNPT additive	73	50	6.5	37	33	8	7
	% removal	99.42	98.89	----	99.47	97.64	99.79	75.86

	Avg-Raw-(12) hr. cycle-with INNPT additive	12447	4450	6.7	7147	1323	3770	29
	Avg-After P.S.T-(12) hr. cycle-with INNPT additive-R.T=4hr	10110	3633	6.7	3497	1380	3823	24
	Avg-After aeration 12hr cycle-with INNPT additive-stage 1	5220	2240	6.6	3607	933	1957	19
	Avg-After aeration 12hr cycle-with INNPT additive-stage 2	1433	853	6.5	3677	550	723	14
	Avg-After F.S.T-(12) hr. cycle-with INNPT additive-R.T=4hr	170	85	6.5	233	287	138	10
	Avg-After filtration-(12) hr. cycle-with INNPT additive	69	49	6.5	40	32	8	7
	% removal	99.45	98.9	----	99.44	97.61	99.8	76.72
Law 48 for 1982		100	60	6-9	60	40	10	10

It is obvious the process of treatment applied into trial 3 approach had been very successful than trial 2. Thus, the values of physiochemical parameters decreased severely. This is because applying an aeration period of 12-hour per stage and also using INNPT additives which added at the start point of reaction inside the M.B.B.R reactor. The values of physiochemical parameters reach the allowable environmental law limits of law 48 for year 1982 and the effluent is allowed to be used in irrigation process.

The primary settling basin had a great affect into the values of physiochemical parameters as discussed before in trial 1 treatment.

Moving bed biofilm reactor unit had also a great removal performance into the physiochemical parameters. The aeration process applied for continues 12 hours for one day (i.e.,\ applied for two stages of aeration) with adding the INNPT additives. The fascinating effect have been noticed that the physiochemical parameters decreased greatly until the final aeration stage for the first day ended. But the values of COD, BOD, NH3, TKN and TP not reached the required target. The percent removal of COD and BOD is higher than reported by (Kettunen & Rintala, 1995) and (Horan et al., 1997) despite of the lower strength of raw leachate used in both researches. The COD and BOD values enhancement can be explained as a result of the increasing the microorganism’s activity in organics decomposing process due to the air supplying by aeration system in the M.B.B.R unit.

The removal percentage achieved in the NH3 and TKN values are little bit lower than reported by (Loukidou & Zouboulis, 2001)but higher than showed in trial 2. The removal caused by nitrification-denitrification process. The nitrification process done through the Nitrosomas, Nitrospopira and Nitrospira. Any one of these microbes can convert the ammonia(NH3) to the nitrite (NO2-). Then the Nitrobacter microbes convert the nitrite (NO2-) to nitrate (NO3-) which leads to lowering the concentration of ammonia (NH3). The denitrification process converts the nitrate (NO3-) to nitrogen gas which allowed to be released into the atmosphere. The denitrification process done through the heterotrophic bacteria. This process causes a decrease in TKN concentration. (Teamaquafix.com, 2015)

The TP decreased due to the process of anaerobic- aerobic action. The anaerobic had been achieved inside the primary settling tank. The aerobic condition achieved inside the M.B.B.R reactor. This tricky condition responsible for generating a such microorganisms that have the ability of storing phosphorus inside the microorganism cell as polyphosphate which lead to concentration TP depletion. (Hydroflux Industrial Pty Ltd, 2018). The removal percentage of TP is more than reported by (Xue et al., 2015)

The TSS value increased inside the M.B.B.R unit due to the carrier's existence and also the treatment process which make the carriers treat the leachate by decomposing organics and convert it to in organic solids moving inside the reactors. (J. Xiong et al., 2018)

The huge reduction in the physiochemical parameters happens due to the INNPT addition. This happened because of the action of coagulation inside the reactor of the colloidal maters and the suspended solids. Also, the powder form of the additive makes the active specific area is very large which leads to a higher rate of action and also the short interparticle diffusion distance. The addition inside the M.B.B.R reactor with continues aeration and mixing process makes the additive is more efficient due to the higher utilization of the adsorbents surfaces and ensuring the mass transfer.(Aziz et al., 2013; Mangkoedihardjo, 2007; Zaidi Ab et al., 2015). Also, the existence of iron (Fe) with magnetic properties in the INNPT composition which have been shown to be efficient at adsorbing, reductively converting, or degrading various organic and inorganic contaminants. (Kashitarash et al., 2012; Němeček et al., 2014; Noubactep, 2010; Palanisamy et al., 2013; Pavithra & Shanthakumar, 2017; Zaidi Ab et al., 2015)

After the final settling tank, the samples show a huge TSS concentration enhancement due to the suitable settling retention time. The all formed settable inorganic solids in M.B.B.R allowed to settle in this period. The little enhancement happens in the other physiochemical parameters due to the activation of anaerobic bacteria. (Renou et al., 2008)

The filtration process through the brick scraps enhances the physiochemical parameters generally due to retaining the residual unsettled solids and also through formation of biofilm sticked to the bricks surface. This biofilm can treat the leachate when filtration process happens. This concept was similar to trickling filter treatment idea. The filtration process also enhances the color of the filtered effluent but the enhancement in the physiochemical parameters is minor due to the absence of circulation of the effluent to enhance the generated biofilm. (Daud et al., 2009)

The average removal percentage achieved through the filtration process is much more higher in average removal reported by (Abood et al., 2014)

3-2-4 Trial 4 results:

Table 5 shows the samples physiochemical parameters achieved after treatment by using 12-hours aeration cycle with sugarcane (bagasse) additives (Trial 4). This trial application took three continual days. The results of each day cleared in the table 5. The average results cleared in last section in table 5.

Table 5 : physiochemical parameters of trial 5 treatment samples

Trial No.	Samples Name	Parameters						
		COD	BOD	P.H	TSS	NH3	TKN	TP
Trial 4	Raw 1-Day 1 - (12) hr. cycle-with Manufactured additive(A)	12250	4150	6.6	7400	1200	3500	27
	After P.S.T-Day 1 - (12) hr. cycle-with Manufactured additive(A)-R.T=4hr	10200	3410	6.7	3560	1320	3640	22.5
	After aeration 12hr cycle-with Manufactured additive(A)-Day 1- stage 1	6560	2480	6.6	3680	780	1970	17
	After aeration 12hr cycle-with Manufactured additive(A)-Day 1- stage 2	2750	1240	6.6	3750	360	830	13
	After F.S.T-Day 1 - (12) hr. cycle-with Manufactured additive(A)-R.T=4hr	200	110	6.5	80	170	310	11
	After filtration-Day 1 - (12) hr. cycle-with Manufactured additive(A)	70	46	6.5	45	90	35	10
	% removal	99.43	98.89	----	99.39	92.5	99	62.96
	Raw 1-Day 2 - (12) hr. cycle-with Manufactured additive(A)	12430	4270	6.7	7240	1280	3690	26
	After P.S.T-Day 2 - (12) hr. cycle-with Manufactured additive(A)-R.T=4hr	11000	3560	6.7	3480	1360	3750	21
	After aeration 12hr cycle-with Manufactured additive(A)-Day 2- stage 1	6820	2590	6.7	3540	870	2010	18.5
	After aeration 12hr cycle-with Manufactured additive(A)-Day 2- stage 2	2810	1330	6.6	3610	520	870	12
	After F.S.T-Day 2 - (12) hr. cycle-with Manufactured additive(A)-R.T=4hr	230	130	6.6	65	300	330	10.5
	After filtration-Day 2 - (12) hr. cycle-with Manufactured additive(A)	95	50	6.6	37	84	32	10
	% removal	99.26	98.83	----	99.49	93.44	99.13	61.54
	Raw 1-Day 3 - (12) hr. cycle-with Manufactured additive(A)	12550	4360	6.7	7170	1330	3760	25
	After P.S.T-Day 3 - (12) hr. cycle-with Manufactured additive(A)-R.T=4hr	11090	3670	6.7	3390	1420	3850	20.5
	After aeration 12hr cycle-with Manufactured additive(A)-Day 3- stage 1	6780	2510	6.6	3460	930	2100	17
	After aeration 12hr cycle-with Manufactured additive(A)-Day 3- stage 2	2680	1280	6.6	3580	580	950	13
	After F.S.T-Day 3 - (12) hr. cycle-with Manufactured additive(A)-R.T=4hr	185	115	6.6	58	310	300	11

	After filtration-Day 3 - (12) hr. cycle-with Manufactured additive(A)	60	46	6.5	32	85	34	9
	% removal	99.52	98.95	----	99.55	93.61	99.1	64
	Avg-Raw-(12) hr. cycle-with Manufactured additive(A)	12410	4260	6.7	7270	1270	3650	26
	Avg-After P.S.T-(12) hr. cycle-with Manufactured additive(A)-R.T=4hr	10763	3547	6.7	3477	1367	3747	21
	Avg-After aeration 12hr cycle-with Manufactured additive(A)- stage 1	6720	2527	6.6	3560	860	2027	18
	Avg-After aeration 12hr cycle-with Manufactured additive(A)- stage 2	2747	1283	6.6	3647	487	883	13
	Avg-After F.S.T-(12) hr. cycle-with Manufactured additive(A)-R.T=4hr	205	118	6.6	68	260	313	11
	Avg-After filtration-(12) hr. cycle-with Manufactured additive(A)	75	47	6.5	38	86	34	10
	% removal	99.4	98.89	----	99.48	93.18	99.08	62.83
Law 48 for 1982		100	60	6-9	60	40	10	10

In this treatment trial applied into trial 4 approach had been less successful than trial 3. Thus, the values of physiochemical parameters decreased severely. This is because applying an aeration period of 12-hour per stage and also using sugarcane (bagasse) additives which added at the start point of reaction inside the M.B.B.R reactor same as INNPT additive. Some values of physiochemical parameters reach the allowable environmental law limits of law 48 for year 1982 such as COD, BOD, TSS and TP but the NH3 and TKN not reach the law limits. So, the effluent is not allowed to be used in irrigation process.

The primary settling basin had a great affect into the values of physiochemical parameters as discussed before in trial 1 treatment.

Moving bed biofilm reactor unit had also a great removal performance into the physiochemical parameters. The aeration process applied for continues 12 hours for one day (i.e.,\ applied for two stages of aeration) with adding the sugarcane (bagasse) additives. An incredible effect has been noticed that the physiochemical parameters decreased greatly until the final aeration stage for the first day ended. But the values of COD, BOD, NH3, TKN and TP not reached the required target. The percent removal of COD and BOD is same percentage achieved by (Kettunen & Rintala, 1995) and higher than reported by (Horan et al., 1997) despite of the lower strength of raw leachate used in that research. The COD and BOD values enhancement can be explained as a result of the increasing the microorganism's activity in organics decomposing process due to the air supplying by aeration system in the M.B.B.R unit.

The removal percentage achieved in the NH3 and TKN values are little bit lower than reported by (Loukidou & Zouboulis, 2001) but a little bit the same removal percentage in trial 3. The removal caused by nitrification-denitrification process. The nitrification process done through the

Nitrosomas, Nitrospopira and Nitrospira. Any one of these microbes can convert the ammonia(NH_3) to the nitrite (NO_2^-). Then the Nitrobacter microbes convert the nitrite (NO_2^-) to nitrate (NO_3^-) which leads to lowering the concentration of ammonia (NH_3). The denitrification process converts the nitrate (NO_3^-) to nitrogen gas which allowed to be released into the atmosphere. The denitrification process done through the heterotrophic bacteria. This process causes a decrease in TKN concentration. (Teamaquafix.com, 2015)

The TP decreased due to the process of anaerobic- aerobic action. The anaerobic had been achieved inside the primary settling tank. The aerobic condition achieved inside the M.B.B.R reactor. This tricky condition responsible for generating a such microorganisms that have the ability of storing phosphorus inside the microorganism cell as polyphosphate which lead to concentration TP depletion. (Hydroflux Industrial Pty Ltd, 2018). The removal percentage of TP is more than reported by (Xue et al., 2015)

The TSS value increased inside the M.B.B.R unit due to the carrier's existence and also the treatment process which make the carriers treat the leachate by decomposing organics and convert it to in organic solids moving inside the reactors. (J. Xiong et al., 2018)

A significant reduction in the physiochemical parameters happens due to the sugarcane additive addition. This happened because the sugarcane considered as adsorbent for COD, BOD and TP due to it is one of raw material of activated carbon manufacturing. So, the values of these physiochemical parameters decrease. (Baçaoui et al., 2001; Khalili et al., 2000; Sahu et al., 2010). The achieved removal percentage is at the same range reported by (Pan et al., 2011; W. Xiong & Peng, 2008).

Also, the powder form of the additive makes the active specific area is very large which leads to a higher rate of action and also the short interparticle diffusion distance. The addition inside the M.B.B.R reactor with continues aeration and mixing process makes the additive is more efficient due to the higher utilization of the adsorbents surfaces and ensuring the mass transfer. (Lakdawala et al., 2012)

After the final settling tank, the samples show a huge TSS concentration enhancement due to the suitable settling retention time. The all formed settable inorganic solids in M.B.B.R allowed to settle in this period. The little enhancement happens in the other physiochemical parameters due to the activation of anaerobic bacteria.(Renou et al., 2008)

The filtration process through the brick scraps enhances the physiochemical parameters generally due to retaining the residual unsettled solids and also through formation of biofilm sticked to the bricks surface. This biofilm can treat the leachate when filtration process happens. This concept was similar to trickling filter treatment idea. The filtration process also enhances the color of the filtered effluent but the enhancement in the physiochemical parameters is minor due to the absence of circulation of the effluent to enhance the generated biofilm.(Daud et al., 2009). The average removal percentage achieved through the filtration process is much higher in average removal reported by (Abood et al., 2014).

3-2-5 Trial 5 results:

Table 6 shows the samples physiochemical parameters achieved after treatment by using 12-hours aeration cycle with palm leaf additives (Trial 5). This trial application took three continual days. The results of each day cleared in the table 6. The average results cleared in last section in table 6.

Table 6 : physiochemical parameters of trial 5 treatment samples

Trial No.	Samples Name	Parameters						
		COD	BOD	P.H	TSS	NH3	TKN	TP
Trial 5	Raw 1-Day 1 - (12) hr. cycle-with Manufactured additive(B)	12400	4510	6.5	7600	1380	3720	30
	After P.S.T-Day 1 - (12) hr. cycle-with Manufactured additive(B)-R.T=4hr	10200	3750	6.6	3450	1420	3790	26
	After aeration 12hr cycle-with Manufactured additive(B)-Day 1- stage 1	6500	2420	6.5	3540	850	2300	23
	After aeration 12hr cycle-with Manufactured additive(B)-Day 1- stage 2	4200	1350	6.6	3610	470	1380	19
	After F.S.T-Day 1 - (12) hr. cycle-with Manufactured additive(B)-R.T=4hr	1350	710	6.7	1200	380	720	14
	After filtration-Day 1 - (12) hr. cycle-with Manufactured additive(B)	380	145	6.7	160	65	170	13
	% removal	96.94	96.78	----	97.89	95.29	95.43	56.67
	Raw 1-Day 2 - (12) hr. cycle-with Manufactured additive(B)	12520	4630	6.5	7410	1460	3860	29
	After P.S.T-Day 2 - (12) hr. cycle-with Manufactured additive(B)-R.T=4hr	10630	3870	6.5	3300	1510	3920	25.5
	After aeration 12hr cycle-with Manufactured additive(B)-Day 2- stage 1	7600	2500	6.5	3450	920	2380	21.5
	After aeration 12hr cycle-with Manufactured additive(B)-Day 2- stage 2	4800	1410	6.7	3530	510	1450	17
	After F.S.T-Day 2 - (12) hr. cycle-with Manufactured additive(B)-R.T=4hr	1650	780	6.5	1350	350	760	13.5
	After filtration-Day 2 - (12) hr. cycle-with Manufactured additive(B)	410	170	6.5	135	75	185	12
	% removal	96.73	96.33	----	98.18	94.86	95.21	58.62
	Raw 1-Day 3 - (12) hr. cycle-with Manufactured additive(B)	12650	4740	6.6	7350	1510	3920	28
	After P.S.T-Day 3 - (12) hr. cycle-with Manufactured additive(B)-R.T=4hr	10720	3910	6.6	3350	1590	4010	23.5
	After aeration 12hr cycle-with Manufactured additive(B)-Day 3- stage 1	7900	2620	6.6	3460	960	2530	21

	After aeration 12hr cycle-with Manufactured additive(B)-Day 3- stage 2	5000	1490	6.7	3520	570	1540	15.5
	After F.S.T-Day 3 - (12) hr. cycle-with Manufactured additive(B)-R.T=4hr	1890	830	6.7	1300	360	810	13
	After filtration-Day 3 - (12) hr. cycle-with Manufactured additive(B)	440	190	6.6	120	90	210	11
	% removal	96.52	95.99	----	98.37	94.04	94.64	60.71
	Avg-Raw-(12) hr. cycle-with Manufactured additive(B)	12523	4627	6.5	7453	1450	3833	29
	Avg-After P.S.T-(12) hr. cycle-with Manufactured additive(B)-R.T=4hr	10517	3843	6.6	3367	1507	3907	25
	Avg-After aeration 12hr cycle-with Manufactured additive(B)-stage 1	7333	2513	6.5	3483	910	2403	22
	Avg-After aeration 12hr cycle-with Manufactured additive(B)-stage 2	4667	1417	6.7	3553	517	1457	17
	Avg-After F.S.T-(12) hr. cycle-with Manufactured additive(B)-R.T=4hr	1630	773	6.6	1283	363	763	14
	Avg-After filtration-(12) hr. cycle-with Manufactured additive(B)	410	168	6.6	138	77	188	12
	% removal	96.73	96.37	----	98.15	94.73	95.09	58.67
Law 48 for 1982		100	60	6-9	60	40	10	10

Treatment trial 5 approach had been less successful than trial 4. Thus, the values of physiochemical parameters decreased severely. This is because applying an aeration period of 12-hour per stage and also using palm leaf additives which added at the start point of reaction inside the M.B.B.R reactor. The values of physiochemical parameters not reach the allowable environmental law limits of law 48 for year 1982. So, the effluent is not allowed to be used in irrigation process.

The primary settling basin had a great affect into the values of physiochemical parameters as discussed before in trial 1 treatment.

Moving bed biofilm reactor unit had also a great removal performance into the physiochemical parameters. The aeration process applied for continues 12 hours for one day (i.e.,\ applied for two stages of aeration) with adding the palm leaf additives. A significant effect has been noticed that the physiochemical parameters decreased greatly until the final aeration stage for the first day ended. But the values of COD, BOD, NH3, TKN and TP not reached the required target. The percent removal of COD and BOD is lower than removal percentage achieved by (Kettunen & Rintala, 1995) and higher than reported by (Horan et al., 1997) despite of the lower strength of raw leachate used in that research. The COD and BOD values enhancement can be explained as a result of the increasing the microorganism’s activity in organics decomposing process due to the air supplying by aeration system in the M.B.B.R unit.

The removal percentage achieved in the NH3 and TKN values are lower than reported by (Loukidou & Zouboulis, 2001). The removal caused by nitrification-denitrification process. The nitrification process done through the Nitrosomas, Nitrospopira and Nitrospira. Any one of these microbes can convert the ammonia(NH3) to the nitrite (NO2-). Then the Nitrobacter microbes convert the nitrite (NO2-) to nitrate (NO3-) which leads to lowering the concentration of ammonia (NH3). The denitrification process converts the nitrate (NO3-) to nitrogen gas which allowed to be released into the atmosphere. The denitrification process done through the heterotrophic bacteria. This process causes a decrease in TKN concentration. (Teamaquafix.com, 2015)

The TP decreased due to the process of anaerobic- aerobic action. The anaerobic had been achieved inside the primary settling tank. The aerobic condition achieved inside the M.B.B.R reactor. This tricky condition responsible for generating a such microorganisms that have the ability of storing phosphorus inside the microorganism cell as polyphosphate which lead to depletion of TP concentration. (Hydroflux Industrial Pty Ltd, 2018). The removal percentage of TP is more than reported by (Xue et al., 2015)

The TSS value increased inside the M.B.B.R unit due to the carrier's existence and also the treatment process which make the carriers treat the leachate by decomposing organics and convert it to inorganic solids moving inside the reactors. (J. Xiong et al., 2018)

Reasonable reduction in the physiochemical parameters happens due to the palm leaf additive addition. It is considered as a bio-sorbent material. Also, the palm leaf is one of the raw materials that can be reprocessed to produce the activated carbon. This due to the interarticular pores of the palm leaf can be classified into three types Macro pores, meso pores and micro pore. The first and second category are responsible of the mass transfer. The third type is responsible of the size of the internal surface which reflects on the adsorbance volumetric ability. (Shafiq et al., 2018)

This interarticular structure govern the behavior of the material in adsorption of organic materials on its outer surface. (Chaouki et al., 2021; Knapik & Stopa, 2018). Adsorption is caused by oppositely charged ionic interactions such as dipole–dipole, dipole- induced dipole, and induced dipole-induced dipole, hydrogen bond formation, chemical bond formation, and ion exchange process. (Ahmad et al., 2012). Surface functional groups play an important part in the elimination of cationic and anionic adsorbates. (El-Hendawy, 2009)

The palm leaf additive has very wide and significant applications such as Removal of heavy metals, removal organic pollutants, Removal of dyes, Removal of phenolic pollutants, Removal of pesticides and Removal of miscellaneous pollutants like Sulfur containing compounds, nitrogenous compounds and phosphates compounds. (Aksu & Yener, 2001; Al-Ghouti et al., 2010; Danish et al., 2010; Robinson et al., 2001).

After the final settling tank, the samples show a huge TSS concentration enhancement due to the suitable settling retention time. The all formed settable inorganic solids in M.B.B.R allowed to settle in this period. The little enhancement happens in the other physiochemical parameters due to the activation of anaerobic bacteria. (Renou et al., 2008)

The filtration process through the brick scraps enhances the physiochemical parameters generally due to retaining the residual unsettled solids and also through formation of biofilm sticked to the bricks surface. This biofilm can treat the leachate when filtration process happens. This concept was similar to trickling filter treatment idea. The filtration process also enhances the color of the filtered effluent but the enhancement in the physiochemical parameters is minor due to the absence of circulation of the effluent to enhance the generated biofilm. (Daud et al., 2009). The average removal percentage achieved through the filtration process is much higher in average removal reported by (Abood et al., 2014)

3-2-6 Trial 6 results:

Table 7 shows the samples physiochemical parameters achieved after treatment by using 12-hours aeration cycle with manufactured additive “C” (Trial 6). This trial application took three continual days. The results of each day cleared in the table 7. The average results cleared in last section in table 7.

Table 7 : physiochemical parameters of trial 6 treatment samples

Trial No.	Samples Name	Parameters						
		COD	BOD	P.H	TSS	NH3	TKN	TP
Trial 6	Raw 1-Day 1 - (12) hr. cycle-with Manufactured additive(C)	12600	4250	6.6	7000	1220	3550	28
	After P.S.T-Day 1 - (12) hr. cycle-with Manufactured additive(C)-R.T=4hr	11000	3640	6.7	3200	1310	3680	22.5
	After aeration 12hr cycle-with Manufactured additive(C)-Day 1- stage 1	5600	2100	6.6	3410	720	1300	16.5
	After aeration 12hr cycle-with Manufactured additive(C)-Day 1- stage 2	2150	1000	6.5	3540	430	820	11
	After F.S.T-Day 1 - (12) hr. cycle-with Manufactured additive(C)-R.T=4hr	300	140	6.5	350	160	36	8
	After filtration-Day 1 - (12) hr. cycle-with Manufactured additive(C)	85	55	6.5	50	32	7	6
	% removal	99.33	98.71	----	99.29	97.38	99.8	78.57
	Raw 1-Day 2 - (12) hr. cycle-with Manufactured additive(C)	12850	4550	6.5	6790	1310	3720	28
	After P.S.T-Day 2 - (12) hr. cycle-with Manufactured additive(C)-R.T=4hr	11120	3650	6.7	3300	1480	3910	22
	After aeration 12hr cycle-with Manufactured additive(C)-Day 2- stage 1	5750	2240	6.6	3580	800	1960	17.5
	After aeration 12hr cycle-with Manufactured additive(C)-Day 2- stage 2	2380	1100	6.6	3720	430	980	13

	After F.S.T-Day 2 - (12) hr. cycle-with Manufactured additive(C)-R.T=4hr	410	260	6.7	210	180	290	10
	After filtration-Day 2 - (12) hr. cycle-with Manufactured additive(C)	90	50	6.6	45	35	8	7
	% removal	99.3	98.9	----	99.34	97.33	99.78	75
	Raw 1-Day 3 - (12) hr. cycle-with Manufactured additive(C)	13100	4690	6.5	6650	1370	3790	29
	After P.S.T-Day 3 - (12) hr. cycle-with Manufactured additive(C)-R.T=4hr	11460	3870	6.6	3240	1520	4110	24
	After aeration 12hr cycle-with Manufactured additive(C)-Day 3- stage 1	5870	2350	6.6	3380	780	2270	20.5
	After aeration 12hr cycle-with Manufactured additive(C)-Day 3- stage 2	2490	1230	6.7	3510	450	1030	14
	After F.S.T-Day 3 - (12) hr. cycle-with Manufactured additive(C)-R.T=4hr	470	290	6.6	250	220	320	10.5
	After filtration-Day 3 - (12) hr. cycle-with Manufactured additive(C)	93	57	6.6	42	37	8	7
	% removal	99.29	98.78	----	99.37	97.3	99.79	75.86
	Avg-Raw-(12) hr. cycle-with Manufactured additive(C)	12850	4497	6.5	6813	1300	3687	28
	Avg-After P.S.T-(12) hr. cycle-with Manufactured additive(C)-R.T=4hr	11193	3720	6.7	3247	1437	3900	23
	Avg-After aeration 12hr cycle-with Manufactured additive(C)-stage 1	5740	2230	6.6	3457	767	1843	18
	Avg-After aeration 12hr cycle-with Manufactured additive(C)-stage 2	2340	1110	6.6	3590	437	943	13
	Avg-After F.S.T-(12) hr. cycle-with Manufactured additive(C)-R.T=4hr	393	230	6.6	270	187	215	10
	Avg-After filtration-(12) hr. cycle-with Manufactured additive(C)	89	54	6.6	46	35	8	7
	% removal	99.31	98.8	----	99.33	97.33	99.79	76.48
Law 48 for 1982		100	60	6-9	60	40	10	10

Treatment applied into trial 6 approach had been very successful than trial 5 and trial 4. Thus, the values of physiochemical parameters decreased severely but the removal percentages not exceed the trial 3 results. This is because applying an aeration period of 12-hour per stage and also using the newly generated manufactured additive “C” additives which added at the start point of reaction inside the M.B.B.R reactor. The values of physiochemical parameters reach the allowable environmental law limits of law 48 for year 1982 and the effluent is allowed to be used in irrigation process.

The primary settling basin had a great affect into the values of physiochemical parameters as discussed before in trial 1 treatment.

Moving bed biofilm reactor unit had also a great removal performance into the physiochemical parameters. The aeration process applied for continues 12 hours for one day (i.e.,\ applied for two stages of aeration) with adding the manufactured additive “C”. The fascinating effect have been noticed that the physiochemical parameters decreased greatly until the final aeration stage for the first day ended. But the values of COD, BOD, NH3, TKN and TP not reached the required target. The percent removal of COD and BOD is same as reported at (Kettunen & Rintala, 1995) and higher than reported by (Horan et al., 1997) despite of the lower strength of raw leachate used in both research’s. The COD and BOD values enhancement can be explained as a result of the increasing the microorganism’s activity in organics decomposing process due to the air supplying by aeration system in the M.B.B.R unit.

The removal percentage achieved in the NH3 and TKN values are lower than reported by (Loukidou & Zouboulis, 2001) . The removal caused by nitrification-denitrification process. The nitrification process done through the Nitrosomas, Nitrospopira and Nitrospira. Any one of these microbes can convert the ammonia(NH3) to the nitrite (NO2-). Then the Nitrobacter microbes convert the nitrite (NO2-) to nitrate (NO3-) which leads to lowering the concentration of ammonia (NH3). The denitrification process converts the nitrate (NO3-) to nitrogen gas which allowed to be released into the atmosphere. The denitrification process done through the heterotrophic bacteria. This process causes a decrease in TKN concentration. (Teamaquafix.com, 2015)

The TP decreased due to the process of anaerobic- aerobic action. The anaerobic had been achieved inside the primary settling tank. The aerobic condition achieved inside the M.B.B.R reactor. This tricky condition responsible for generating a such microorganisms that have the ability of storing phosphorus inside the microorganism cell as polyphosphate which lead to concentration TP depletion.(Hydroflux Industrial Pty Ltd, 2018). The removal percentage of TP is more than reported by (Xue et al., 2015)

The TSS value increased inside the M.B.B.R unit due to the carrier’s existence and also the treatment process which make the carriers treat the leachate by decomposing organics and convert it to in organic solids moving inside the reactors. (J. Xiong et al., 2018)

The great reduction in the physiochemical parameters achieved by adding the manufactured additive “C”. This happened because of the dual action of both base components of additive “C”. The sugarcane additive {Additive “A”} and palm leaf {Additive “B”} each one of them achieve a good result but not acceptable results according to the environmental laws. So, the mixture idea can achieve a higher removal performance as declared in table 7. The higher specific surface area for the sugarcane additive (Baçaoui et al., 2001; Khalili et al., 2000; Sahu et al., 2010) beside the interarticular structure of the palm leaf ensure that the great absorbance action and also the excellent mass transfer which ensured by the existence of micro pores and meso pores (El-Hendawy, 2009; Shafiq et al., 2018) . Also, the both additives considered as based raw material for activated carbon manufacturing. The both additives can remove the organic pollutants and enhance the physiochemical parameters. Besides, they can remove the heavy metals contamination. (Ahmad et al., 2012; Al-Muhtaseb, 2010; Alhamed & Bamufleh, 2009; Bamufleh, 2009; El-Naas et al., 2010; Lakdawala et al., 2012; Lee et al., 1997; Mor et al., 2019; Riahi et al., 2009; Satyawali & Balakrishnan, 2008)

Also, the palm leaf additive behaves like a coagulant during the treatment like attraction between anions and cations in the treatment process. Where adsorption is caused by oppositely charged ionic interactions such as dipole–dipole, dipole- induced dipole, and induced dipole-induced dipole, hydrogen bond formation, chemical bond formation, and ion exchange process. (Ahmad et al., 2012)

After the final settling tank, the samples show a huge TSS concentration enhancement due to the suitable settling retention time. The all formed settable inorganic solids in M.B.B.R allowed to settle in this period. The little enhancement happens in the other physiochemical parameters due to the activation of anaerobic bacteria. (Renou et al., 2008)

The filtration process through the brick scraps enhances the physiochemical parameters generally due to retaining the residual unsettled solids and also through formation of biofilm sticked to the bricks surface. This biofilm can treat the leachate when filtration process happens. This concept was similar to trickling filter treatment idea. The filtration process also enhances the color of the filtered effluent but the enhancement in the physiochemical parameters is minor due to the absence of circulation of the effluent to enhance the generated biofilm. (Daud et al., 2009). The average removal percentage achieved through the filtration process is much higher in average removal reported by (Abood et al., 2014).

4- Conclusions:

From the presented experimental work and presented results shown in the previous section, it is concluded that:

- ❖ Increasing the retention time inside the settling tank shows enhancement in TSS concentration and a little enhancement in other physiochemical parameters exhibit NH3 and TKN.
- ❖ The application of 8-hour aeration cycle without additive achieve average removal efficiency after three days of running equal to 81.45%.
- ❖ The application of 12-hour aeration cycle without additive achieve average removal efficiency after three days of running equal to 86.62%.
- ❖ Increasing aeration time inside the reactor achieve a higher rate of action reflects into a higher removal efficiency.
- ❖ After both treatment trials of 8-hour and 12-hour without additives the treated effluent not fulfils the required environmental laws limits for reusing in irrigation process.
- ❖ The application of 12-hour aeration cycle with INNPT additive achieve average removal efficiency after three days of running equal to 95.32%.
- ❖ A significant removal achieved by using INNPT additive. Also, the all-tested parameter during the research fulfils the target environmental law limits for reusing the treated effluent in irrigation process.
- ❖ Agricultural waste used in manufacturing a treatment additive for leachate treatment. Sugarcane and Palme leaf used in manufacturing the both additives “A” and “B”.

- ❖ Both manufactured additives “A” and “B” subjected for jar test for optimum dose finding process. The optimum dose of additive “A” found to be 8 mg/L and the optimum dose of additive “B” found to be 24 mg/L.
- ❖ A new additive invented by mixing both additives “A” and “B” with the optimum dose required for leachate treatment obtained from the jar test. The new additive “C” undergoes into jar test also for optimal dose determination. The optimal dose found to be 14 mg/L.
- ❖ The application of 12-hour aeration cycle with sugarcane additive {additive “A”} achieve average removal efficiency after three days of running equal to 92.14%. But the treated effluent not undergoes the environmental law limits for irrigation usage. Some of physiochemical parameters such as COD, BOD, TSS and TP fulfil the environmental law limits.
- ❖ The application of 12-hour aeration cycle with palm leaf additive {additive “B”} achieve average removal efficiency after three days of running equal to 89.96%. But the treated effluent not undergoes the environmental law limits for irrigation usage.
- ❖ The application of 12-hour aeration cycle with mixture additive {additive “C”} achieve average removal efficiency after three days of running equal to 95.17%. The treated effluent undergoes the environmental law limits for irrigation usage. All physiochemical parameters.
- ❖ The brick scraps filter used in all treatment processes had a great effect in retaining the resulting solids from the action of treatment and skipped from the final settling tank. Also, polishing effect had been done through the filtration process.

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