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Wastewater Treatment in Bani-Siouf Governorate Using Membrane Bioreactor in Compare with the Conventional Treatment

Nagla Ahmed Ibrahim Ahmed,[a] Ali M. Abdullah,[b] and Hossam F Nassar,[a]

[a] *Environmental Sciences and Industrial Development Department Faculty of Post Graduate Studies Beni-Suef University*

[b] *HCWW, Cairo*

Abstract

The current learn about aimed to fortify the waste cure in Tazment waste remedy plant, Bani-Siouf Governorate in north of administrative division. The learn about is investigated the efficiency of the Tazment plant and beautify the cure by means of chemical exercise so as to scale again and beautify the elimination of TSS, BOD, COD and moreover investigate the overall performance of a bench-scale submerged membrane bioreactor (MBR). The bench-scale plant used to be positioned inside the waste therapy plant of city of Bani-Siouf and additionally the find out about was once administrated inside the quantity of Dec. 2020 to might. 2021. The physical, chemical and organic traits day by day monitored. The outcomes confirmed the CT effluent water didn`t comply with the Egyptian law due to the fact of the amazing of anatomy, COD, ammonia, TBC, TC and FC, values than the permissible restriction in Egypt. The air pollution index of the dealt with waste inside the plant was once 704 in average, whereas the PI of effluent of MBR used to be 84.07 in average.

Keywords: Membrane bioreactor Wastewater, Enhance the conventional treatment, Tazment WWTP, Bani-Siouf, Egypt.

1. Introduction

Membrane bioreactor (MBR) science should be a mixture of the normal organic sludge method, a sewer water cure technique characterised by using a suspended boom of biomass, with a micro- or ultra-filtration membrane machine [1, 2]. The organic unit is chargeable for the biodegradation of the waste compounds and consequently the membrane module for the bodily separation of the handled water from the combined liquor. The pore diameter of the membranes is inside the fluctuate between 0.01 and 0.1 one in order that particulates and bacterium is unbroken out of permeate and consequently the membrane device replaces the ordinary gravity geological phenomenon unit (clarifier) inside the organic sludge method. Hence, the MBR affords the gain of higher product water nice and low footprint. Because of its benefits, membrane bioreactor science has quality possible in broad tour purposes as properly as municipal and industrial sewer water cure and approach water exercise.

Wastewater reclamation and reprocess are nice equipment for property industrial improvement programmes. More and greater annoying environmental law and commonly elevated intensity, efficiency and range of therapy applied sciences have created the reprocess of water a lot of doable in various industrial processes. Membrane bioreactors (MBRs) technological know-how are a vital a section of advancing such water property as a end result of they inspire water reprocess and open up possibilities for suburbanized treatment. Moreover, membrane bioreactor (MBR) technological know-how is diagnosed as a promising technological know-how to produce water with dependable first-rate for reprocess and is fairly engaging for industrial, e.g. fabric effluent cure [3, 4]. But the overall performance of MBR science relies upon on the acceptable diagram of the plant thinking about one of a kind elements required for superior result [3, 5].

Filtration is described as the separation of two or greater elements from a fluid stream. In traditional usage, it normally refers to the separation of strong or insoluble particles from a liquid stream. Membrane filtration extends this software similarly to consist of the separation of dissolved solids in liquid streams, and therefore membrane procedures in water therapy are oftentimes used to dispose of more than a

*Corresponding author e-mail: tsm.hcww@yahoo.com (Hossam F. Nassar).
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few materials ranging from salts to microorganisms. Membranes tactics can be categorised in various, associated categories, three of which are: their pore size, their molecular weight cut-off; or the stress at which they operated. As the pore dimension receives smaller or the molecular weight cut-off decreases, the stress utilized to the membrane for separation of water from different cloth typically will increase [1, 6].

In the Figure 1, stress pushed membrane methods from micro-filtration to reverse osmosis are special with the respective pore size. The separation concerned in the micro-filtration (MF) can deal with elimination of particulate or suspended fabric ranged in measurement from 0.1 to 10 µm. On the different hand, ultra-filtration (UF) is typically used to get better macro-molecules in the 0.01 to 0.1 µm range. Whereas nano-filtration (NF) can deal with elimination of particulate 0.001 to 0.01 µm. Reverse osmosis (RO) membranes are succesful of setting apart substances much less than 0.001 µm. The operation of RO requires very excessive stress once in a while as excessive as a hundred and fifty bar in order to overcome the osmotic pressure; whereas the hydrodynamic strain required to encompass drift via micro-filtration and ultra-filtration membranes are typically in the area of o.1 to 10 bar [7, 8, 9].

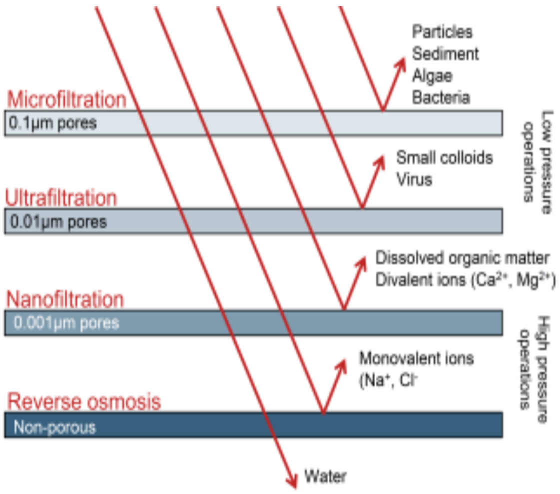

Figure (1): Membrane filtration types

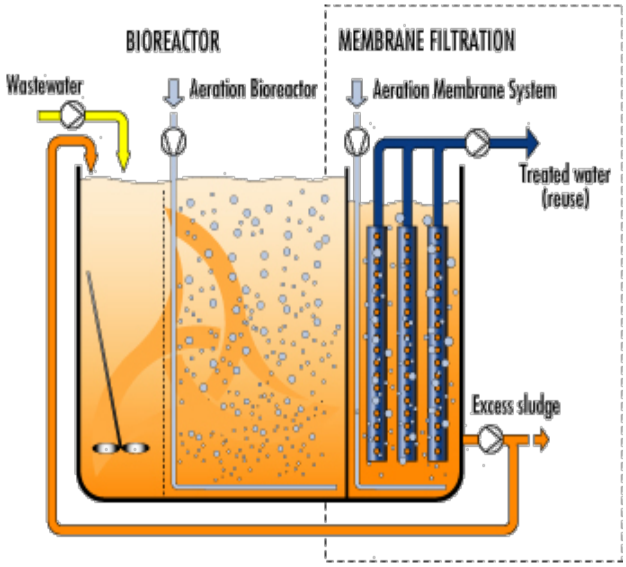

Figure (2): Systematic membrane bioreactor (MBR)

MBR structures have been at first used for municipal wastewater treatment, principally in the vicinity of water reuse and recycling. Compactness, manufacturing of reusable water, and hassle – free operation made the MBR an perfect technique for recycling municipal wastewater in water and area constrained environments. By the middle of the 1990s, the development of far less expensive submerged membranes had actually made MBRs a viable option for high flow, large-scale municipal wastewater applications. Over 1,500 MBRs are presently in operation round the world in Japan, Europe and North America [10, 11, and 12].

This lookup aimed to sketch of a bench-scale MBR to reap most suitable overall performance of this type of science for remedy of Tazment WWTP in Bani-Siouf Governorate in order to gain the excessive satisfactory handled water for irrigation functions in evaluate of the utilized traditional wastewater in the Governorate.

2. Methods

The wastewater samples for analytical determinations had been bought each and every 24 h from the predominant settling tank, organic reactor and permeate (as proven in Fig. 3). The pattern (1 L) from every assayed factor used to be conserved in the laboratory at four 0C till bodily and chemical determinations and analyzed inside four h of sampling. The wastewater samples which amassed for MBR therapy have been accumulated from Aug. 2021 to Apr. 2022. The physical, chemical and organic evaluation and investigations had been decided in accordance APHA, 2017 strategies [17]. The solids in suspension (TSS) were determined by gravimetric methods [17]. The solids in suspension (TSS) have been decided by using gravimetric strategies (17). pH used to be decided by means of pH meter (Janway pH 350) and conductivity used to be decided by way of conductivity meter (Janway 350). The Pollution Index (PI) used to be assessed in accordance the weight noted in Table (4).

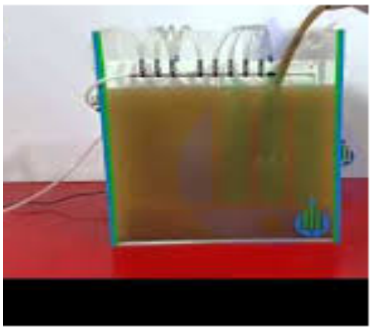

Figure (3): Membrane bioreactor (MBR)

Equipments:

pH meter; WTW portable pH meter ProfiLine pH 3110, Germany. Conductivity& TDS meter; Conductivity meter, bench, Eutech CON 700, EU. DO; Thermo Orion Star A223 Portable RDO/DO Meter, EU. Spectrophotometer; UV-8000A Double Beam UV/VIS Spectrophotometer Ultraviolet Visible Spectrophotometer 190-1100nm Wavelength Range 1nm Bandwidth ±0.3nm Wavelength, EU.

Table (2): Quality control data for measured compounds

No.	Parameters	MDL (µg/l)	LOQ (µg/l)	Accuracy (%)	Precision (RPM)	Bias (±µg/l)
1	Temperature	0.1	0.1	99.8	4.8	0.1
2	pH	0.1	0.1	99.5	4.4	0.05
3	DO	0.1	0.1	99.8	4.6	0.1
4	Conductivity	2.0	2.0	99.7	4.2	1.5
5	TDS	1.0	1.0	99.9	4.5	1.5
6	TSS	0.5	0.5	99.3	4.1	1.0
7	BOD	0.2	0.2	99.1	4.3	0.5
8	COD	0.5	0.5	99.2	4.5	0.5
9	Ammonia	0.02	0.02	99.4	3.8	0.03
10	Phosphate	0.03	0.03	99.1	3.9	0.03
11	TN	0.1	0.1	99.5	4.1	0.1
12	TP	0.1	0.1	99.6	4.3	0.1
13	Total Hardness	0.5	0.5	99.8	4.6	0.5
14	Calcium	0.5	0.5	99.8	4.6	0.5
15	Magnesium	0.5	0.5	99.8	4.6	0.5
16	Sodium	0.5	0.5	99.4	4.4	0.5
17	H_2S	0.02	0.02	99.1	4.3	0.02

***MDL:** Minimum detection limit*, ***LOQ:** Limit of quantitation*

3. Results & Discussion:

The present study aimed to evaluate the efficiency of wastewater treatment in Tazment WWTP in Bany-Siouf Governorate, and try to improve the wastewater treatment and also try to apply the MBR techniques and modify the conventional technique in the plant by using chemical treatment to improve the treatment in Tazment WWTP.

The physical, chemical, microbial and biological analysis for the influent and effluent of the Tazment WWTP were illustrated in Table (1) and Figures (4, 5). The raising percentages of dissolved oxygen (DO) was 1650%, and the removal percentages of TDS, TSS, BOD, COD, ammonia, TN, TP, TBC, TC, and FC were 6.2, 92.2, 89.3, 80.5, 32.8, 31.6, 64.4, 83.3, 85.0, and 68.6 %, respectively, as shown in Table (1) and Figures (4, 5).

The effluent water didn`t comply with Egyptian regulation (18), with the following parameters: DO, BOD, COD, ammonia, hydrogen sulfide, total bacterial count, total coliform, fecal coliform, helminth egg and protozoa, as indicated in Table (1).

The physical, chemical, microbial and biological analysis for the MBR effluent of the were illustrated in Table (2) and Figures (5, 6). The raising percentages of dissolved oxygen (DO) was 2500%, and the removal percentages of TDS, TSS, BOD, COD, ammonia, TN, TP, TBC, TC, and FC were 6.6, 98.3, 98.0, 82.2, 73.1, 91.1, 100.0, 100.0, 100.0, and 100.0 %, respectively, as shown in Table (2) and Figures (6, 7).

The MBR effluent water didn`t comply with Egyptian regulation (18), with ammonia concentration, as indicated in Table (2).

The physical, chemical, microbial and biological analysis for the CT effluent of the were illustrated in Table (3) and Figures (3, 4). The raising percentages of dissolved oxygen (DO) and TDS were 2000, 2.3%, respectively, and the removal percentages of TSS, BOD, COD, ammonia, TN, TP, TBC, TC, and FC were 96.2, 96.1, 92.0, 61.0, 39.4, 75.6, 99.9, 99.9, and 100.0 %, respectively, as shown in Table (3) and Figures (6, 7).

The CT effluent water didn`t comply with Egyptian regulation (18), with BOD, COD, ammonia, TBC, TC and FC, as indicated in Table (3).

The remedy of sewage or waste water is mainly finished first in main clarification tanks, the place the settled solids are removed. The in part handled waste water is then fed to a secondary remedy plant for "biological treatment", the place microorganism degrade and stabilize the natural waste water to bio mass, water and gas. The microorganism that develop on the substrate in the waste water are separated from the water by means of similarly settling of the reacted waste water in the organic tanks, in which carbon substrates are measured as biochemical oxygen demand (BOD) or chemical oxygen demand (COD), leaving a noticeably smooth effluent as the dealt with effluent. The latter will then be discharged into open water or despatched for similarly tertiary cure or for reuse. This organic cure through a ways is the most frequent cure manner for municipal and industrial waste waters. Most organic therapy flowers now use the traditional activated sludge procedure (CAS). CAS has proved beneficial for the therapy of many natural wastes which had been at one time thinking to be poisonous to organic structures or species. This procedure is a remedy method in which waste water and reused organic sludge full of residing microorganisms is blended and aerated. The combination fashioned of waste water and organic sludge is particular as combined liquor. After the combined liquor has been fashioned in the aeration tank of an activated sludge process, extra combined liquor is discharged into settling tanks and the handled supernatant is run off to bear in addition cure earlier than discharge. Some of the settled material, the sludge, is back returned to the head of the aeration machine to re-seed the new sewage or waste water coming into the tank. "Excess sludge" which in the end accumulates past the again sludge is eliminated from the remedy procedure to maintain the ratio of biomass feed to sewage or wastewater, meals to microorganism (F/M) in balance. However, activated sludge technique has a massive foot print due to the want for massive aeration tanks and clarifier tanks**(13, 14)**.

The overall performance of MBR relies upon on unique working parameters such as filtration flux, hydraulic retention time (HRT), stable retention time (SRT), natural loading charge (OLR), etc. Many research have been carried out to take a look at the impact of SRT on MBR performance. For example, Meng et al. (2007) said that the enlarge of SRT from eight to forty d improved membrane overall performance whilst Metzger et al. (2007) pronounced that greater awareness of floc certain exo-polymeric materials (EPS) at decrease SRT of 23 d than greater SRT of forty d. Further, Navaratna et al. (2009) endorsed SRT of >40 d for dependable operation of MBR when treating municipal wastewater. Tian et al. (2011) proven that SRT's bad have an effect on on MBR overall performance used to be prompted by using excessive concentrations of soluble microbial product (SMP) or certain EPS.

In an cardio MBR process, the elimination of natural and vitamins is done thru the bio-degradation of these substances through micro-organisms. In a MBR, two kinds of micro organism are found, heterotrophic and autotrophic, the place the former is extra predominant. Heterotrophs acquire their strength from natural compounds and relying on the medium oxygenation, oxygen (oxic condition) or nitrate (anoxic condition) is used as a terminal electron acceptor. Unlike heterotrophs, autotrophic micro organism attain their power with the aid of oxidizing inorganic compounds and are obligate aerobes, so solely use oxygen as an electron acceptor (Jelena, 2008).

The NH_4-N was once eliminated from wastewater with extra than 98% of efficiency. According to Bjorn et al. (2006), NH4-N is typically eliminated with no dependency on STR. However, NO_3-N in the effluent used to be increased than that in the influent. The cause in the back of the expand in the NO_3-N rather of reduce was once due to inefficient denitrification in the MBR tank. This can be better when aeration is achieved at intermediate fees so that some section in the tank will function as anoxic chamber. The NO_2-N used to be quite rejected and this is due to the reality that NO_2-N is eliminated via changing NH4-N into NO_2-N in an oxic technique in view that air is constantly provided into the MBR chamber. In wastewater treatment, nitrogen is normally eliminated by way of the conversion of NO3-N into N_2 gasoline and this requires an anoxic technique which does now not exist in the MBR chamber. That is why it ought to now not attain a excessive whole nitrogen elimination in our device and an common of solely 33% of rejection was once obtained [13, 14].

Phosphorus in wastewater is generally discovered in phosphate structure and it is generally eliminated with the aid of adsorption on the biomass or with the aid of precipitation [15, 16]. Both precipitation and adsorption require a pH adjustment or the presence of calcium ion. In our wastewater, the calcium attention was once above one hundred forty mg/L. That is the purpose of excessive PO_4-P rejection in our system. COD is a measure of natural count number in the wastewater. For this purpose, its elimination will enhance the exceptional of the effluent water in wastewater therapy processes.

In the current study, an common COD elimination of 98% was once executed with MBR system. In most cases, COD elimination is associated to MLSS concentration. In the find out about carried out through Meng, et al., (2007), COD elimination effectivity has expanded from 71.4% to over 90% when MLSS awareness multiplied from 4.643 g L-1 to 9.658 g L-1. Summary of the effluent homes of pilot MBR effluent was once given in Table 4 previously provided a summary of the effluent properties of the pilot MBR effluent. However, there is little information available about how COD is removed from wastewater.

Table (1): The average values of influent raw wastewater and effluent treated wastewater of *Tazment* WWTP and the treatment efficiency evaluation.

No.	Parameters	Unit	Results (average values)				Removal (%)	Notes (complying with ES)
			Inf.	Inf. Std	Eff.	Eff. Std		
1	Temperature	^{0}C	24.5	66.2	23.8	61.2	-	
2	pH	-	8.1	4.6	7.72	5.1	4.7	
3	DO	mg/l	0.2	11.2	3.5	11.6	-1650.0	Not comply
4	Conductivity	uS/cm	1103	23.6	1034	24.4	6.3	
5	TDS	mg/l	662	22.8	621	23.1	6.2	
6	TSS	mg/l	218	21.2	17	22.6	92.2	
7	BOD	mg/l	366	43.2	39	44.5	89.3	Not comply
8	COD	mg/l	482	44.9	94	43.1	80.5	Not comply
9	Ammonia	mg/l	24.1	31.6	16.2	33.1	32.8	Not comply
10	Phosphate	mg/l	3.1	28.4	1.1	29.4	64.5	
11	TN	mg/l	28.2	22.4	19.3	23.1	31.6	
12	TP	mg/l	4.5	23.1	1.6	22.4	64.4	
13	Total Hardness	mg/l	194	11.8	184	11.1	5.2	
14	Calcium	mg/l	41.6	11.8	39.2	11.3	5.8	
15	Magnesium	mg/l	21.89	11.2	20.92	11.8	4.4	
16	Sodium	mg/l	86.3	13.2	81.2	14.2	5.9	
17	SAR	-	0.006	15.5	0.007	14.8	-6.8	
18	H_2S	mg/l	14.4	17.6	2.5	18.4	82.6	Not comply
19	TBC	CFU/ml	1800000	64.2	300000	61.2	83.3	Not comply
20	TC	CFU/100ml	800000	65.1	120000	59.4	85.0	Not comply
21	FC	CFU/100ml	210000	58.2	66000	55.2	68.6	Not comply
22	Helminth egg	U/l	18	51.4	2	46.5	88.9	Not comply
23	Protozoa	U/l	54	46.8	7	41.8	87.0	Not comply

Table (2): The average values of influent raw wastewater and effluent treated wastewater of *MBR system* and the treatment efficiency evaluation.

No.	Parameters	Unit	Results				Removal (%)	Notes (complying with ES)
			Inf.	Inf. Std	Eff.	Eff. Std		
1	Temperature	^{0}C	24.5	66.2	23.9	61.2	-	
2	pH	-	8.1	4.6	7.69	6.2	5.1	
3	DO	mg/l	0.2	11.2	5.2	4.5	-2500.0	
4	Conductivity	uS/cm	1103	23.6	1044	21.2	5.3	
5	TDS	mg/l	662	22.8	618	22.3	6.6	
6	TSS	mg/l	218	21.2	4	3.2	98.2	
7	BOD	mg/l	366	43.2	6.4	5.5	98.3	
8	COD	mg/l	482	44.9	9.5	3.4	98.0	
9	Ammonia	mg/l	24.1	31.6	4.3	16.2	82.2	Not comply
10	Phosphate	mg/l	3.1	28.4	0.68	14.1	78.1	
11	TN	mg/l	28.2	22.4	7.5	3.1	73.4	
12	TP	mg/l	4.5	23.1	0.4	3.2	91.1	
13	Total Hardness	mg/l	194	11.8	182	12.2	6.2	
14	Calcium	mg/l	41.6	11.8	39.2	11.6	5.8	
15	Magnesium	mg/l	21.89	11.2	20.43	11.1	6.7	
16	Sodium	mg/l	86.3	13.2	78.4	13.2	9.2	
17	SAR	-	0.006	15.5	0.007	15.2	-13.9	
18	H_2S	mg/l	14.4	17.6	0.3	3.2	97.9	
19	TBC	CFU/ml	1800000	64.2	34	1.6	100.0	
20	TC	CFU/100ml	800000	65.1	0	0	100.0	
21	FC	CFU/100ml	210000	58.2	0	0	100.0	
22	Helminth egg	U/l	18	51.4	0	0	100.0	
23	Protozoa	U/l	54	46.8	0	0	100.0	

Table (3): The average values of influent wastewater and effluent of chemical treatment (Ferric chloride "10 mg/l" + Cationic Polymer "2 mg/l") system and evaluation of the treatment efficiency during the period of study.

No.	Parameters	Unit	Results				Removal (%)	Notes (complying with ES)
			Inf.	Inf. Std	Eff.	Eff. Std		
1	Temperature	^0C	24.5	66.2	24.1	63.2	-	
2	pH	-	8.1	4.6	7.22	5.1	10.9	
3	DO	mg/l	0.2	11.2	4.2	13.2	-2000.0	
4	Conductivity	uS/cm	1103	23.6	1128	26.4	-2.3	
5	TDS	mg/l	662	22.8	677	24.1	-2.3	
6	TSS	mg/l	218	21.2	8.2	22.3	96.2	
7	BOD	mg/l	366	43.2	14.2	44.1	96.1	Not comply
8	COD	mg/l	482	44.9	38.4	43.8	92.0	Not comply
9	Ammonia	mg/l	24.1	31.6	9.4	32.2	61.0	Not comply
10	Phosphate	mg/l	3.1	28.4	0.72	29.5	76.8	
11	TN	mg/l	28.2	22.4	17.1	23.1	39.4	
12	TP	mg/l	4.5	23.1	1.1	24.2	75.6	
13	Total Hardness	mg/l	194	11.8	178	12.1	8.2	
14	Calcium	mg/l	41.6	11.8	37.6	12.2	9.6	
15	Magnesium	mg/l	21.89	11.2	20.43	12.1	6.7	
16	Sodium	mg/l	86.3	13.2	82.5	12.6	4.4	
17	SAR	-	0.006	15.5	0.006	14.4	0.4	
18	H_2S	mg/l	14.4	17.6	0.34	14.1	97.6	
19	TBC	CFU/ml	1800000	64.2	1800	66.2	99.9	Not comply
20	TC	CFU/100ml	800000	65.1	820	64.2	99.9	Not comply
21	FC	CFU/100ml	210000	58.2	90	59.5	100.0	Not comply
22	Helminth egg	U/l	18	51.4	0	0	100.0	
23	Protozoa	U/l	54	46.8	0	0	100.0	

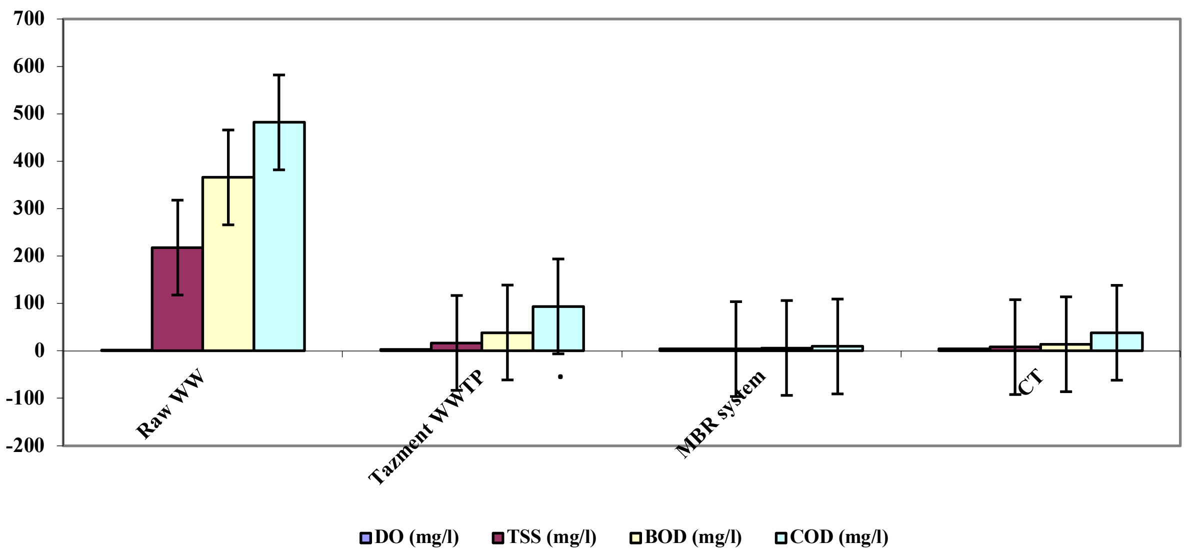

Figure (4): Comparison between conventional treatment of Tazment, MBR and chemical Treatment (CT) and effluent of treated water quality (DO, TSS, BOD and COD)

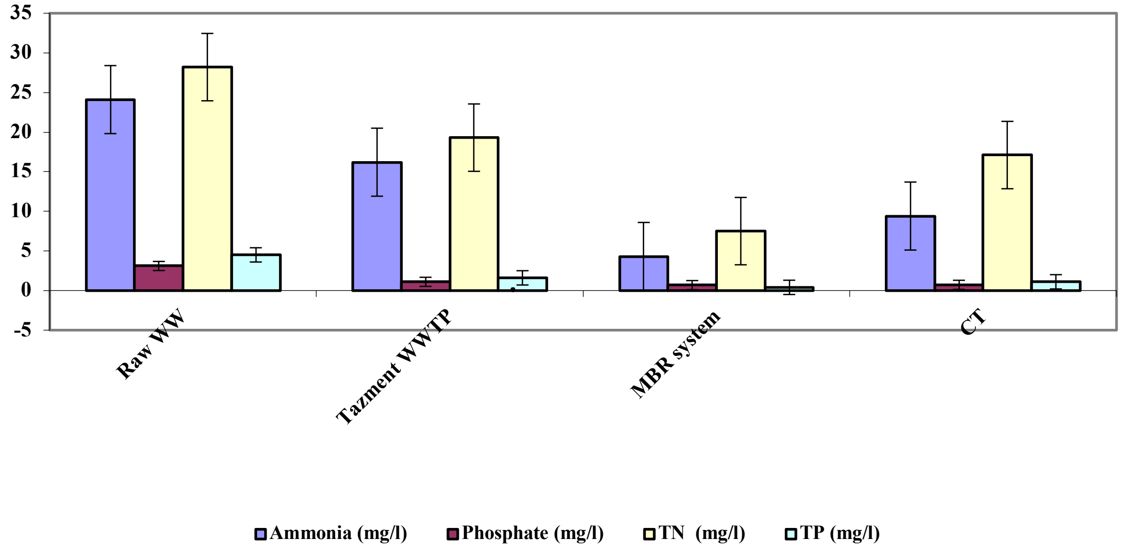

Figure (5): Comparison between conventional treatment of Tazment, MBR and chemical Treatment (CT) and effluent of treated water quality (Ammonia, Phosphate, TN and TP)

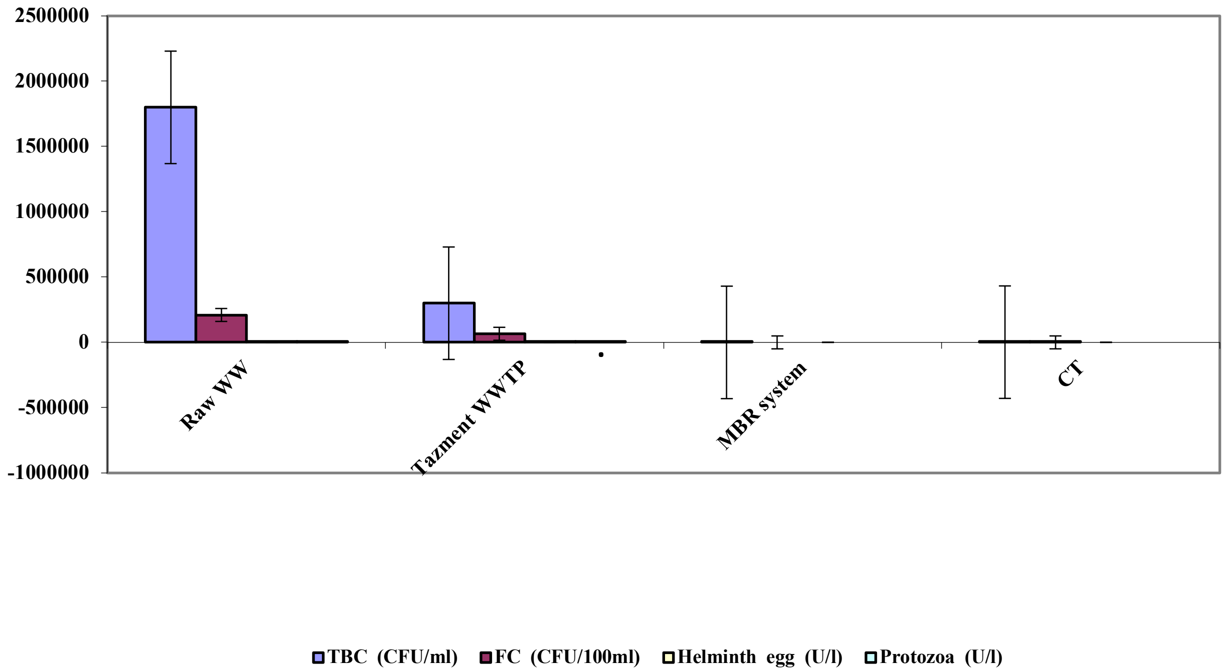

Figure (6): Comparison between conventional treatment of Tazment, MBR and chemical Treatment (CT) and effluent of treated water quality (TBC, FC, Helminth egg and Protozoa)

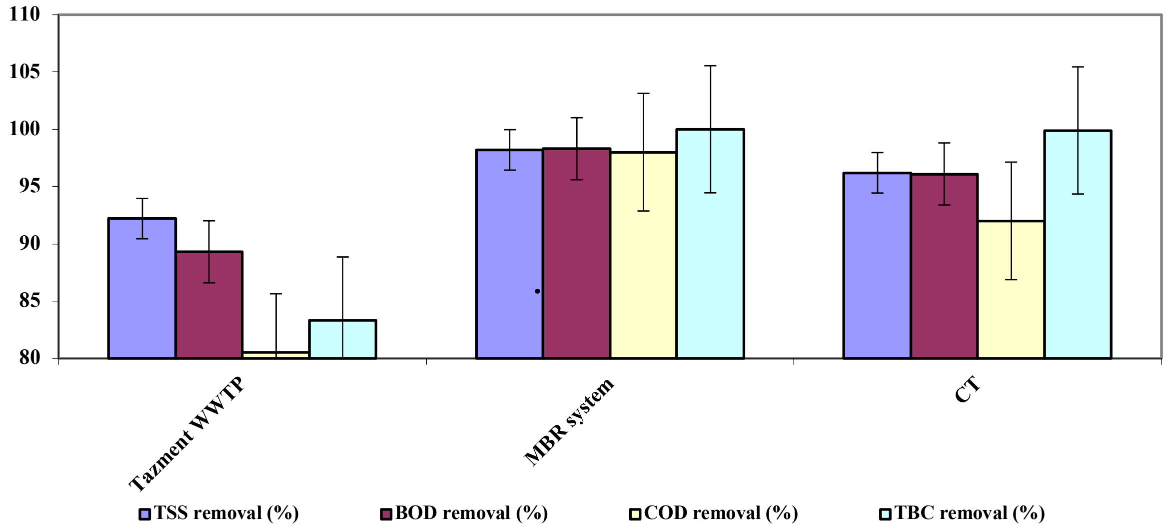

Figure (7): Comparison between efficiency of conventional treatment of Tazment, MBR and chemical Treatment (CT) and effluent of treated water quality (TSS, BOD, COD and TBC)

Pollution index calculation (PI)

The pollution index of raw wastewater of Tazment WWTP and effluent of the plant, treated wastewater chemically and effluent of MBR were calculated based on the Egyptian standard mentioned in Law 48/1982 and amendments No. 92/2013 and the given weighted as shown in Table (4).

The values of PI for the raw wastewater influent of Tazmant WWTP ranged from 699.2 to 708.5, the minimum and maximum values observed during Dec. 2020 and May. 2021, respectively, and the average value was 704.0 and the standard deviation value was 3.4, as shown in Table (5) and Figure (8).

The values of PI for the treated wastewater effluent of Tazmant WWTP ranged from 627.0 to 640.2, the minimum and maximum values observed during Dec. 2020 and May. 2021, respectively, and the average value was 635.0 and the standard deviation value was 5.0, as shown in Table (5) and Figure (8).

The values of PI for the treated wastewater of MBR unit ranged from 76.6 to 90.5, the minimum and maximum values observed during Oct. 2020 and May. 2021, respectively, and the average value was 84.7 and the standard deviation value was 5.4, as shown in Table (5) and Figure (8).

The values of PI for the treated wastewater of chemically technique ranged from 190.6 to 396.0, the minimum and maximum values observed during Nov. 2020 and Oct. 2020, respectively, and the average value was 265.9 and the standard deviation value was 71.7, as shown in Table (5) and Figure (8).

The observation showed that the treated wastewater by MBR unit was less values of PI, then the treated wastewater by chemical technique, while the treated wastewater conventionally in the Tazmant WWTP had the maximum values of PI, that may be gave attention for the hazardous of the discharge of these wastewater to the main streams and using for irrigation purposes while the treated wastewater results from MBR system more safe and low hazardous to the neighbor environment and may be safe for the irrigation purposes than others.

Table (4): Pollution index of influent wastewater and effluent of treated water

No.	Parameters	Unit	Wt	ES
1	TDS	mg/l	0.05	500
2	TSS	mg/l	0.05	10
3	BOD	mg/l	0.1	10
4	COD	mg/l	0.2	10
5	Ammonia	mg/l	0.1	0.5
6	H_2S	mg/l	0.1	0.05
7	TBC	CFU/ml	0.1	5000
8	TC	CFU/100ml	0.1	0.01
9	FC	CFU/100ml	0.1	0.01
10	Helmenth egg	U/l	0.1	0.01

ES: Egyptian Standard; Wt: Weight

Table (5): Pollution index of influent wastewater and effluent of treated water

No.	Month	PI calculation				Notes
		Inf.	Eff. of Tazmant WWTP	TW by MBR	TW chemically (Ferric + poly)	
1	Oct. 2020	700.5	627.0	76.6	396.0	
2	Nov. 2020	705.0	640.2	87.0	190.6	
3	Dec. 2020	699.2	630.3	89.9	206.2	
4	Jan. 2021	702.4	633.5	86.8	216.7	
5	Mar. 2021	705.8	636.2	83.3	256.5	
6	Apr. 2021	706.7	637.5	78.5	289.8	
7	May. 2021	708.5	640.0	90.5	305.8	
Min.		699.2	627.0	76.6	190.6	
Max.		708.5	640.2	90.5	396.0	
Avg.		704.0	635.0	84.7	265.9	
SD		3.4	5.0	5.4	71.7	

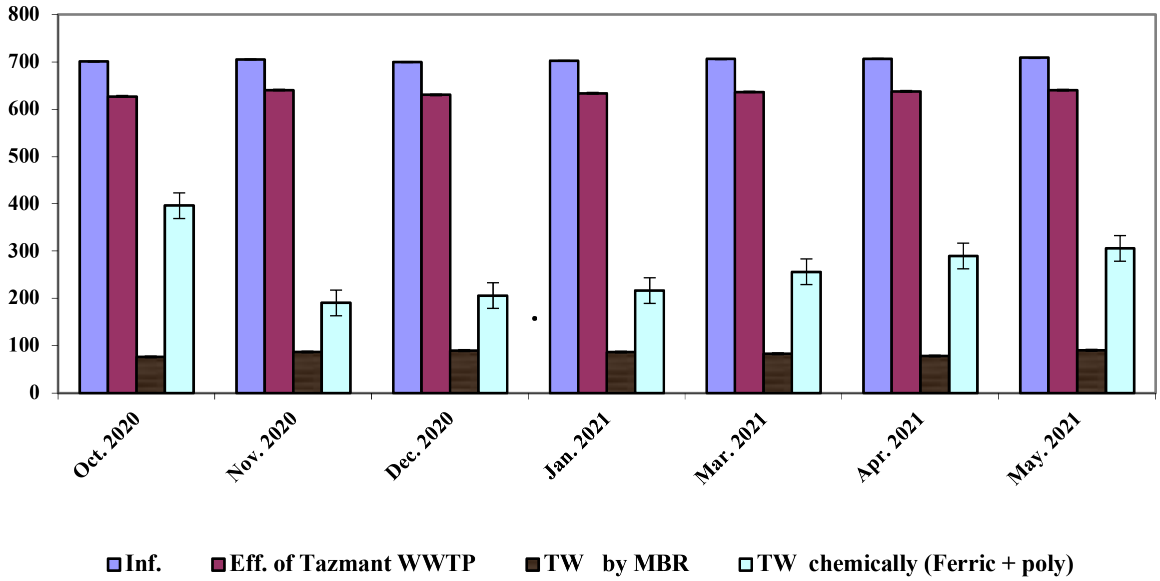

Figure (8): Pollution index of influent wastewater and effluent of treated water

4. Conclusion & Recommendations:

The present study concluded the following:

- The effluent water of Tazment WWTP didn`t comply with Egyptian regulation, with the following parameters: DO, BOD, COD, ammonia, hydrogen sulfide, whole bacterial count, whole coli form, fecal coli form, helminthes egg and protozoa.
- The handled wastewater from the Tazmant WWTP may additionally be due to the fact a many trouble to the neighbor surroundings that may also be motives a bad impact on the predominant circulation that receives the dealt with wastewater.
- The MBR effluent water didn`t comply with Egyptian regulation, with ammonia concentration, that can also be the handled wastewater want greater retention time to do away with the ammonia via bio-nitrification.
- The CT effluent water didn`t comply with Egyptian regulation, with BOD, COD, ammonia, TBC, TC and FC.
- The statement confirmed that the handled wastewater by using MBR unit used to be much less values of PI, then the dealt with wastewater by using chemical technique, whilst the handled wastewater conventionally in the Tazmant WWTP had the most values of PI, that might also be gave interest for the hazardous of the discharge of these wastewater to the important streams and the usage of for irrigation functions whilst the dealt with wastewater consequences from MBR machine extra secure and low hazardous to the neighbor surroundings and may also be protected for the irrigation functions than others.

The present study recommended the following:

- The *Tazmant* WWTP want to rehabilitation to decorate the effectively of wastewater remedy in the plant to be comply with Egyptian regulation.
- Using the MBR approach in the stop of wastewater remedy of the plant might also be make the dealt with wastewater comply with the nearby legislation and can be use the dealt with water for irrigation functions in secure way.
- Finally, in order to attain sustainable operation of the built-in MBR-RO process, it is very essential to choose the most suitable running parameters and tremendous options for the mitigation of membrane fouling in the MBR.
- The chemical cure of wastewater in the find out about confirmed a much less environment friendly than in case of the usage of MBR technique.

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References:

1. Mark A Shannon, "Science and technology for water purification in the coming decades", World Scientific Publishing Co., 2009, pp.337-346.
2. John W.Finley, James N.Seiber, SatinderAhuja, "The Need for Water Reuse", Food Energy and Water, 2015, pp. 431-447.
3. G. Wade Miller, "Integrated Concepts in Water Reuse: Managing Global Water Needs", Desalination, 2006, pp. 67-75.
4. Vinod Tare, "Sewage Treatment in Class I Towns: Recommendations and Guidelines", Report (Code 003-GBP-IIT-EQP-S&R-O2-Ver1**,(** 2010).
5. Bjorn Rusten ate al, "Design and operations of the Kaldnes moving bed biofilm reactors", Aquaculture Engineering, Science, Vol**.**34,2006, pp.322–331.
6. H Shailaja, "Feasibility Report on Sewage Treatment Plant**,"**Unpublished Report.
7. S Chong, T K Sen, A Kayaalp and H M Ang, "The Performance Enhancement of Upflow Anaerobic Sludge Blanket Reactors for Domestic Sludge Treatment – A State of the Art Review", Water Research, Vol. 46, Issue 11, 2012, pp 3434-3470.
8. Jelena Radjenovi et al, "Membrane Bioreactor (MBR) as an advanced Wastewater Treatment Tecnology", Enviormental Chemistry, Vol 5**,** 2008, pp37-110.
9. Vinita Dhupkar, "Optimization of Design & Technology for Sewage Treatment", National Conference on Energy and Environment**,**February, 2014.
10. Cicek, N., Macomber, J., Devel, J., Suidan, M. T., Audic, J. and Genestet, P. (2001). Effect of Solids Retention Time on the Performance and Biological Characteristics of a Membrane Bioreactor. Water Research, 30, 1771–1780.
11. Cui, Y., Peng, C., Peng, Y. and Ye, L. (2009). Effects of salt on microbial populations and treatment performance in purifying saline sewage using the MUCT process. CLEAN–Soil, Air, Water, 37(8), 649-656.
12. Meng, F., Shi, B., Yang, F. and Zhang, H. (2007). Effect of hydraulic retention time on membrane fouling and biomass characteristics in submerged membrane bioreactors. Bioprocess and Biosystems Engineering, 30, 359-367.
13. Meng, F., Yang, F., Shi, B. and Zhang, H. (2008). A comprehensive study on membrane fouling in submerged membrane bioreactors operated under different aeration intensities. Separation and Purification Technology, 59, 91–100.
14. Metzger, U., Le-Clech, P., Stuetz, R.M., Frimmel, F.H., and Chen, V. (2007).Characterization of polymeric fouling in membrane bioreactors and the effectof different filtration modes. Journal of Membrane Science, 301, 180–189.
15. Navaratna, D. and Jegatheesan, V. (2011). Implications of short and long term critical fluxexperiments for laboratory-scale MBR operations. Bioresource Technology, 102,5361–5369.
16. Tian, Y., Chen, L., Zhang, S., & Zhang, S. (2011b). A systematic study of soluble microbial products and their fouling impacts in membrane bioreactors. Chemical Engineering Journal, 168(3), 1093-1102.
17. Standard Methods for the Examination of Water and Wastewater (2017).APHA/AWWA/WEF, Washington, DC, USA.
18. Egyptian Law No. 48/1982, and amendments No. 92/2013, Egypt.