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Ecological studies on some planktonic organisms at Mahallet Ziad Wastewater treatment plant in El Gharbia Province, Egypt

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ABSTRACT

This study was carried out at Mahallet Ziad wastewater treatment plant in El-Gharbia Province during a period extending between Feb. 2018 and Jan. 2019. Major planktonic groups and certain physico-chemical parameters were investigated monthly at this water plant to elucidate its performance efficiency in treating and enhancing the wastewater. It was apparently that protozoa and rotifers represent the major groups in that wastewater treatment plant. Protozoa are represented by three major phyla (*Sarcodina, Mastigophorea* and *Ciliophora*) where the ciliated protozoans prevail the other two phyla. The numerical densities of sessile peritrich ciliates were less abundant than other ciliated protozoan types (crawling and swimming ciliates). It was proved that the maximal and minimal numerical densities of total protozoans of the present investigation exhibited 6956 and 1716x 10^2/L during March and December, respectively. Simultaneously, the uppermost numerical values of sarcodines, flagellates and ciliates were 565, 2211 and 5631^2/L during May, February and April, while the lowest ones were 30, 87 and 1716x 10^2/L on September, July and December, respectively. Different types of protozoan were proved to be significantly influenced to varying levels with certain physico-chemical parameters.

From the technological point of view, it was proved that the performing efficiency of the activated sludge of the present study is more or lessparallel to those of other wastewater treatment plants in different provinces of Egypt which gives an indication that there is a critical strategic need for the government to have more treated water to be used in agricultural and industrial activities.

Keywords: Plankton, Protozoa, Rotifers, Wastewater treatment.

INTRODUCTION

Water is the most important factor in the universe due to its distinctive chemical and physical properties. It occupies about 75% of the globe and as a result of the increased human activities; it became highly polluted with different harmful contaminants (Patil *et al*., 2012; Reda, 2016). Egypt is considered as one of the most water-stressed countries. The limited amounts of rainfall make the country dependent mainly on water from the Nile. It is the donor of life to Egypt and represents the principal freshwater resource for the country. It constitutes over 98 % of the freshwater resources (Mohamed *et al*., 2017). It supports the country with water needs for food, drinking water, irrigation, urban, industrial and environmental uses (Mohamed *et al*., 1998; Anwar, 2003; Gohar and Ward, 2010; Osman and Kloas, 2010).

Surface water plays a critical role in the transmission of water-related infections due to the illegal sewage removal and urbanization especially in the developing countries (Khan, 1999 and Oakley *et al*., 2000). The availability of good water quality is an indispensable feature for preventing diseases and improving quality of life (Patil *et al*., 2012).

One of the most common forms of pollution control is the wastewater treatment. Sewers collect the wastewater mainly from homes, and many industries to be delivered to plants for treatment. Most treatment plants were designed to scrub sewage for discharging into streams or other receiving water bodies, or for reuse. Sewage treatment generally involves three stages, called primary, secondary and tertiary treatment (Tortora *et al*., 2010; Wilbey, 2012). The first one consists of temporarily holding the sewage in a basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to the secondary treatment where dissolved and suspended biological matters were removed. The secondary treatment may require a separation process to remove the micro-organisms from the treated water prior to the tertiary treatment in which the total nitrates and phosphates were particularly eliminated. Treated water is sometimes disinfected chemically or physically before discharging into a stream, river, bay, lagoon or wetland.

Wastewater regulations require the monitoring of numerous physical, chemical and biological parameters. These include total suspended solids (TSS), chemical oxygen demand (COD) and 5-day biochemical oxygen demand (BOD5), phosphorus, nitrogen and microbiological parameters to investigate both water quality and ecological variations of the water body (WHO, 1996).

Biologically, Protozoa have proven to be excellent tool for assessing the occurrence of pollution during wastewater treatment, along with its role in the control of pollution itself, through grazing of dispersed bacteria and maintenance of a healthy trophic web in those artificial ecosystems (Nicolau *et al*., 2001).

The aim of the present work is to measure certain biological, physical and chemical parameters in order to detect the performance efficiency of Mahallet Ziad wastewater treatment plant.

MATERIALS AND METHODS

This study was carried out at various stages of Mahallet - Ziad Wastewater Treatment plant (Fig. 1) in El-Gharbia province with hydraulic loading rate of 15000 m^3/day. Water samples for microbiological examination were collected using 500 ml glass bottles thrice monthly during a period extending between February 2018 and January 2019 and examined within six hours of collection. In the laboratory, water content of each bottle was mixed well by inverting the bottle several times smoothly and then three replicates each of 10 ml were taken at the different stages. Each replicate was centrifuged at 3000 rpm for seven minutes and then concentrated to three ml by decanting quickly most of the supernatant. The residual part was transferred to a cavity slide to be examined using an Optical Microscope (Optica BM 100B, Italy) provided with high resolution digital camera to identify and count the major planktonic organisms particularly Protozoa using the key of Patterson and Hedley (1996). Simultaneously, other samples were picked up in one-liter glass bottles for measuring certain physico-chemical parameters in the central laboratories of the water and wastewater company. Different statistical analyses of the obtained data were carried out using Minitab Statistical package.

Ecological studies on some planktonic organisms at Mahallet Ziad Wastewater treatment plant in El Gharbia Province, Egypt

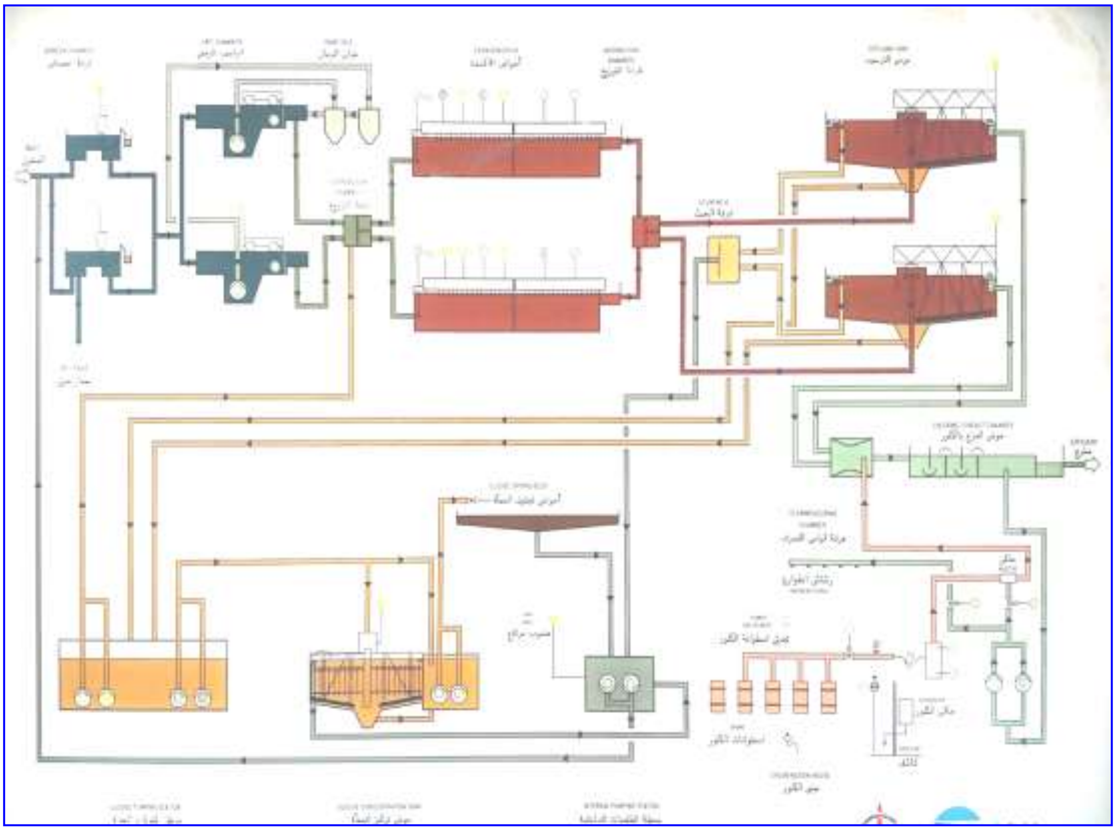

Fig. 1. Diagram of Mahallet Ziad WW TP Source : Holding Co. For Water & Wastewater (HCWW)

RESULTS

Water samples of the different locations belonging to Mahallet Ziad Wastewater Treatment Plant exhibited the presence of two major types of zooplankton. The most abundant group belongs to protozoan organisms followed by some rotifers. Protistes were represented by three main protozoan phyla; *Sarcodina, Mastigophora* and *Ciliophora.* Ciliates were the most dominant during different months of the present study. Table (I_a) showed that the maximal numerical density of total protozoan organisms belonging to the present investigation exhibited 6956x 10^2/L during March. On the other hand, the uppermost densities of sarcodines, flagellates and ciliates were 565, 2211 and 5631x 10^2/L, respectively during May, February and April, while their lowest values were 30, 87 and 1716x 10^2/L, respectively on September, July and December. It was proved that swimming ciliates were higher in their numbers than those of the sessile ones. Rotifers achieved their maximum numerical densities (223x 10^2 /L) on April and minimal one (47x 10^2/L) during May (Table Ia). The seasonal numerical densities of both protozoan organisms and rotifers are illustrated in Table (I_b). It appears that their maximal corresponding values (5213 x10^2/l and 179 x 10^2/L) can be detected during spring and summer, respectively. The uppermost densities of sarcodines, swimming ciliates and stalked ones achieved 288, 2851 and 1275x 10^2/L, respectively. On the other hand, the highest number of flagellates (892x 10^2/L) was obtained during winter.

It was obvious from Tables (II_a and II_b) that p^H values at the different stages of the investigated treatment plant varied between 7.13 and 7.9 monthly and between an average of 7.19 and 7.79 seasonally which mean a slightly alkaline medium. The average water temperature varied between 18.21 and 18.29^{o}C on winter, 22.52 and 22.94^{o}C on spring, 27.49

and 27.88°C during summer and between 25.79 and 26.07°C on autumn at the various waste-water treatment stages. Moreover, the monthly and seasonally total alkalinity, total dissolved solids (TDS), conductivity, chemical oxygen demand (COD), biochemical oxygen demand (BOD), total nitrates, total phosphates beside oil and grease decreased gradually from influent to effluent water passing through the activated tank, while those of total suspended solids (TSS) showed a similar trend in both influent and effluent water only as the activated tank contains more suspended particles mostly in the form of various organisms mainly protozoans and rotifers. It is worthy to mention that the average values of chlorides are more or less similar to each other in the various stages of the wastewater treatment processes with very few occasions. On the contrary, the seasonal dissolved oxygen average values achieved 0.11 and 4.58 mg/l as minimum and maximum levels during the treatment process. It appears that the former value was permanently recorded in the raw water samples, while the maximal one was obtained in the treated water. It is necessary to mention that dissolved oxygen in the activated tank was not less than 1.7 mg/L during the whole studying period. At the same time, ferric salts could not be detected mostly in all water samples of the treatment stages apart from very few exceptions in samples of effluent water.

The average values of the seasonal residual chlorine belonging to the effluent (treated) water varied minimally between 0.32 and 0.5 mg/l on spring and winter, while those of maximal ones changed from 0.42 to 0.55 mg/l during spring and autumn, respectively.

Table (III) illustrated the major technological parameters (BOD, COD, TSS, Total nitrogen and Total phosphates) controlling the performance efficiencies belonging to the present wastewater treatment plant. It was proved that chemical oxygen demand; COD, biochemical oxygen demand; BOD, total suspended solids; TSS, nitrates and phosphates decreased obviously through various stages of the treatment process. The percentage removal of these parameters during the investigation period achieved 88.9 – 93.2, 70.6 – 93.9, 85.2 – 94.5, 65.6 – 81.3 and 73.2 – 88.1%, respectively.

The previously mentioned data indicated that wastewater treatment process during the present study reduced pollution significantly and therefore treated water can be delivered into certain water bodies in order to be used in different human activities as agriculture and industry. The relationship between BOD and COD showed that they behave parallel to each other as could be seen in Figure (2).

The regression analysis for different biotic and abiotic parameters belonging to the present study was carried out and the results were shown in Table (IV). The numbers of total ciliates, sarcodines and rotifers were significantly affected with certain physico-chemical parameters as shown by a multiple regression equation.

Table (I_a). Average monthly numerical densities of the major planktonic organisms (x 10^2/L) at the activated tank in Mahallet Ziad Waste-water Treatment plant, El-Gharbia Province, Egypt.

Month	T.Sarcod.	T. Flagel.	Swim. Ciliates	Sessile Cil.	T. Protoz.	Rotifera
January	87	207	975	961	2230	127
February	142	2211	2908	1447	6707	103
March	148	1311	3715	1782	6956	213
April	151	188	3842	1789	5971	223
May	565	898	996	254	2713	47
June	181	417	1861	1338	3797	177
July	67	87	2265	520	2939	143
August	94	208	1929	1162	3392	217
September	30	133	1846	864	2873	107
October	143	350	1965	283	2741	150
November	95	356	2862	2017	5330	167
December	71	258	1249	467	2044	143

Table (I_b) Average seasonal numerical densities of the major planktonic organisms (x 10^2/L) at the activated tank in Mahallet Ziad Waste-water Treatment plant, El-Gharbia Province, Egypt.

Seasons	T.Sarcod.	T. Flagel.	Swim. Ciliates	Sessile Cils.	T. Protoz.	Rotifera
winter	100	892	1710	958	3660	124
spring	288	799	2851	1275	5213	161
summer	114	237	2018	1007	3376	179
autumn	89	280	2224	1055	3648	141

Table (II_a) Monthly physico-chemical parameters of Mahallet Ziad Waste-Water Treatment plant, El-gharbia province, Egypt.

month		Ph	Temp	TDS	Cond	Do	COD	BOD5	TSS	FRC	Sulfides	Chlorides	T. alkalinity	T.N	T.P	O&G
January	Inf	7.30	17.27	1163.33	2319.33	0.15	505.67	363.33	153.33	0.00	6.70	218.33	511.67	49.63	2.40	48.67
	A.tank	7.47	17.07	930.67	1824.33	2.03	370.67	276.67	4026.67	0.00	0.77	220.00	220.00	18.00	0.47	31.67
	Eff	7.33	16.90	915.33	1760.67	4.77	56.00	27.33	11.33	0.53	0.43	221.67	206.67	12.73	0.40	7.67
February	Inf	7.70	18.23	836.00	1659.33	0.09	647.67	406.67	248.00	0.00	6.63	228.33	516.67	44.87	2.23	42.67
	A.tank	7.67	18.70	738.33	1470.67	1.87	456.67	310.00	3550.00	0.00	0.30	223.33	228.33	15.90	0.47	27.33
	Eff	7.50	18.67	728.67	1430.00	4.57	44.00	24.67	16.00	0.50	0.13	223.33	218.33	12.47	0.40	8.67
March	Inf	7.90	19.40	1019.67	2018.67	0.16	589.00	383.33	188.67	0.00	4.17	220.00	595.00	46.63	2.17	49.33
	A.tank	7.53	19.93	770.33	1538.00	1.77	299.33	190.00	3660.00	0.00	0.67	215.00	283.33	21.37	0.63	36.67
	Eff	7.53	19.73	766.00	1533.67	4.50	55.33	28.00	16.67	0.32	0.37	210.00	268.33	12.67	0.53	4.33
April	Inf	7.83	23.07	924.67	1851.33	0.08	555.67	356.67	232.00	0.00	3.80	198.33	473.33	45.57	2.50	28.00
	A.tank	7.70	23.60	687.00	1398.67	1.73	335.33	196.67	4030.00	0.00	0.67	196.67	225.00	19.50	0.83	30.33
	Eff	7.57	23.60	678.00	1359.00	4.60	46.67	27.67	12.67	0.40	0.53	200.00	201.67	12.43	0.67	6.00
May	Inf	7.63	25.10	841.33	1683.00	0.15	597.67	360.00	250.00	0.00	4.80	221.67	465.00	44.17	2.57	27.33
	A.tank	7.90	25.37	681.33	1336.67	1.90	401.33	250.00	3093.33	0.00	0.73	211.67	298.33	22.40	0.80	28.67
	Eff	7.70	25.50	676.67	1292.00	4.50	66.00	40.33	35.33	0.42	0.47	206.67	283.33	11.73	0.63	3.00
June	Inf	7.23	26.20	910.00	1722.00	0.13	496.00	356.67	164.00	0.00	6.27	201.67	488.33	36.40	2.77	38.33
	A.tank	7.40	26.20	765.33	1447.00	1.93	310.67	233.33	4046.67	0.00	0.57	193.33	215.00	8.20	0.77	26.33
	Eff	7.53	26.27	755.33	1427.67	4.60	54.00	32.00	17.33	0.48	0.40	195.00	193.33	6.90	0.67	2.67
July	Inf	7.13	28.03	704.33	1347.33	0.10	489.00	300.00	228.67	0.00	7.80	188.33	478.33	36.80	3.30	33.67
	A.tank	7.40	28.37	611.67	1171.67	1.93	357.00	226.67	3640.00	0.00	0.83	190.00	193.33	8.47	0.73	21.00
	Eff	7.60	28.63	607.33	1159.33	4.67	40.67	26.00	16.67	0.47	0.70	193.33	183.33	7.43	0.67	4.33
August	Inf	7.20	28.23	715.33	1432.67	0.10	528.67	353.33	168.00	0.00	7.77	185.00	480.00	34.37	2.23	39.67
	A.tank	7.43	28.47	617.00	1231.33	1.93	357.00	246.67	4166.67	0.00	0.63	185.00	191.67	7.10	0.57	24.33
	Eff	7.50	28.73	612.33	1219.00	4.40	40.67	24.67	10.67	0.52	0.37	190.00	186.67	6.20	0.37	5.67
September	Inf	7.60	27.30	753.67	1507.00	0.12	493.33	340.00	125.33	0.00	7.23	182.67	480.00	35.33	1.90	38.33
	A.tank	7.70	27.53	665.00	1328.33	1.73	335.33	238.67	3786.67	0.00	0.43	185.00	215.00	12.07	0.33	26.33
	Eff	7.70	27.77	650.33	1301.67	4.37	48.00	27.33	16.00	0.55	0.30	185.00	188.33	11.73	0.27	5.67
October	Inf	7.67	26.00	830.00	1662.00	0.14	583.33	366.67	148.67	0.00	7.73	185.00	480.00	35.67	1.93	50.00
	A.tank	7.83	26.27	653.00	1307.33	1.70	416.67	290.00	3736.67	0.00	0.23	186.67	225.00	12.57	0.30	35.67
	Eff	7.70	26.13	647.67	1296.67	4.67	56.67	108.00	22.00	0.48	0.10	191.67	218.33	12.27	0.23	6.67
November	Inf	7.53	24.07	937.33	1874.33	0.08	473.33	303.33	130.00	0.00	7.60	203.33	483.33	36.67	1.63	52.00
	A.tank	7.80	24.23	780.33	1539.67	1.70	323.33	230.00	3770.00	0.00	0.43	205.00	230.00	9.10	0.40	38.00
	Eff	7.67	24.30	774.33	1512.67	4.47	46.00	24.00	14.67	0.40	0.20	208.33	215.00	8.93	0.23	9.33
December	Inf	7.77	19.13	1031.00	2060.67	0.11	463.33	300.00	148.00	0.00	6.33	228.33	496.67	48.43	1.93	37.00
	A.tank	7.93	19.23	898.67	1775.33	1.77	330.00	226.67	3916.67	0.00	0.73	230.00	230.00	16.97	0.43	29.33
	Eff	7.77	19.30	892.00	1734.00	4.40	44.67	20.33	12.67	0.54	0.47	230.00	211.67	12.50	0.37	5.67

Table (II_b). Seasonal physico-chemical parameters of Mahallet Ziad Waste-Water Treatment plant, El-gharbia province, Egypt.

Season		Ph	Temp	TDS	Cond	Do	COD	BOD5	TSS	Chloride	T.N	T.P	O&G
Winter	Inf	7.59	18.21	1010.11	2013.11	0.12	538.89	356.67	183.11	225.00	47.64	2.19	42.78
	A.tank	7.69	18.33	855.89	1690.11	1.89	385.78	271.11	3831.11	224.44	16.96	0.46	29.44
	Eff	7.53	18.29	845.33	1641.56	4.58	48.22	24.11	13.33	225.00	12.57	0.39	7.33
Spring	Inf	7.79	22.52	928.56	1851.00	0.13	580.78	366.67	223.56	213.33	45.46	2.41	34.89
	A.tank	7.71	22.97	712.89	1424.44	1.80	345.33	212.22	3594.44	207.78	21.09	0.76	31.89
	Eff	7.60	22.94	706.89	1394.89	4.53	56.00	32.00	21.56	205.56	12.28	0.61	4.44
Summer	Inf	7.19	27.49	776.56	1500.67	0.11	504.56	336.67	186.89	191.67	35.86	2.77	37.22
	A.tank	7.41	27.68	664.67	1283.33	1.93	341.56	235.56	3951.11	189.44	7.92	0.69	23.89
	Eff	7.54	27.88	658.33	1268.67	4.56	45.11	27.56	14.89	192.78	6.84	0.57	4.22
Autumn	Inf	7.60	25.79	840.33	1681.11	0.11	516.67	336.67	134.67	190.33	35.89	1.82	46.78
	A.tank	7.78	26.01	699.44	1391.78	1.71	358.44	252.89	3764.44	192.22	11.24	0.34	33.33
	Eff	7.69	26.07	690.78	1370.33	4.50	50.22	53.11	17.56	195.00	10.98	0.24	7.22

Table (III) . Performance efficiency percentages of the major technological parameters at Mahallet Ziad Waste-Water Treatment plant, El-Gharbia Province, Egypt.

Month	COD	BOD	TSS	T.N	T.P
Jan.	88.93%	92.48%	92.61%	74.35%	83.33%
Feb.	93.21%	93.93%	93.55%	72.21%	82.06%
Mar.	90.61%	92.70%	91.65%	72.83%	75.58%
Apr.	91.6%	92.24%	94.54%	72.72%	73.2%
May	88.96%	88.8%	85.87%	73.44%	75.49%
June.	89.11%	91.03%	89.43%	81.04%	75.81%
July	91.68%	91.33%	92.71%	79.81%	79.70%
Aug.	92.31%	93.02%	93.65%	81.25%	83.41%
Sept.	90.27%	91.96%	87.23%	66.80%	85.79%
Oct.	90.29%	70.55%	85.2%	65.6%	88.08%
Nov.	90.28%	92.09%	88.72%	75.65%	85.89%
Dec.	90.36%	93.22%	91.44%	74.19%	80.83%

T.N = total nitrates T.P = total phosphates

Table (IV) Summary of the significant statistical relationships between biotic and abiotic parameters at Mahallet Ziad WWTP, Gharbia Province, Egypt.

Parameters	Df	F (Variance)	P
Total ciliates Vs p^H, temp, O_2, N, P	5, 11	4.50	0.047
Total ciliates Vs p^H,temp,O_2	3,11	4.51	0.039
Total ciliates Vs p^H,temp,O_2,cond.	4,7	4.14	0.050
Sarcodines Vs p^H, temp, O_2,N,P	5,11	4.57	0.046
Sarcodines Vs TSS, N	2,11	5.3	0.030
Sarcodines Vs COD, TSS	2,11	4.42	0.046
Sarcodines Vs BOD,TSS	2,11	4.5	0.044
Sarcodines Vs Alk, N, P	3,11	6.05	0.019
Sarcodines Vs p^H, temp, cond, Cl, Alk, N,P	8,11	185.60	0.001
Rotifers Vs COD, BOD, TSS	3,11	7.98	0.009
Rotifers Vs COD,BOD,TSS, N	4,11	5.49	0.025
Rotifers Vs BOD,TSS, N	3,11	6.14	0.018
Rotifers Vs TSS, N	2,11	4.81	0.038
Rotifers Vs Tot. ciliates	1,11	7.20	0.023
BOD Vs COD	1,11	31.26	0.000

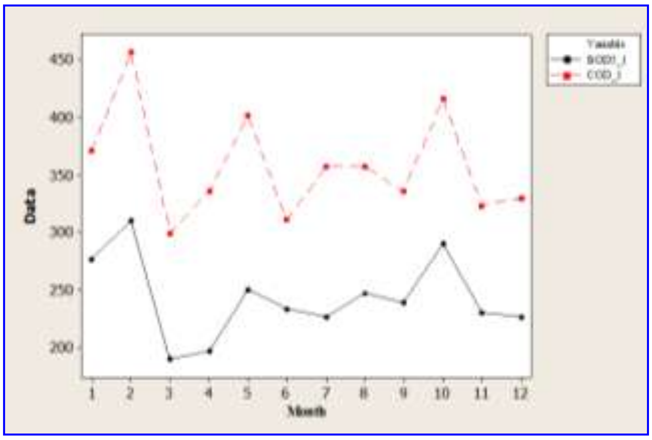

Fig. 2. Time series analysis plot of both BOD_5 and COD at Mahallet Ziad WWTP.

Discussion

Rapid increase in the population and high consumption of water led to need for improving and increasing the existing wastewater treatment plants in different provinces in Egypt. Sewage treatment is the process of removing contaminants from wastewater and household sewage, domestic, commercial and institutional. There are 2 basic stages within the treatment of wastes, primary and secondary. In the primary stage, solids are allowed to settle and removed from wastewater. The secondary stage uses biological processes to purify sewage and the principal technique used in the secondary treatment is the activated sludge process (EPA, 1998).

It is worthy to mention that the average values of the dissolved oxygen inside the active tank (activated sludge) were above 1.7 mg/l permanently which keep the aerobic situation of that stage to ensure the continuation of the biological treatment for producing high water quality. It is known that protozoan organisms especially ciliates are of great importance in achieving good effluent quality (Curds, 1973). Accordingly, an obvious relationship between the abundance of rotifers and protozoan organisms beside certain environmental parameters and the plant operating conditions is strongly confirmed in the present study.

It is necessary to mention that the areal graph and/or the time series analysis of the present study illustrated that both BOD and COD parallel to each other where the ratio between the average values of both of them ranged between 58.8% during April and 74.9% on June. Simultaneously, the relationship between BOD and COD of the wastewater in the present study is highly significant ($P<0.001$) and could be expressed by the following regression equation : **COD (**mg/l**) = 78.0 + 1.15 BOD** (mg/l)

Accordingly, this relationship could serve as a model for predicting BOD values which are available in few hours. TDS and TSS are very important parameters influencing water quality where the former indicates all dissolved substances in water, while the latter is discharged due to the various industrial, agricultural and domestic human activities (Authman, 1998). Any sudden or exaggerated change in TDS could damage the aquatic life (Gaikwad; 2003 and Samrat *et al.*, 2012). TDS in the present investigation achieved the maximal value in raw and treated water (1010.11 and 854.33 mg/l) on Winter, while the minimal values (776.56 and 658.33 mg/l) were obtained during Summer. This is comparable with ELewa and Authman (1991). On the other hand, BOD and COD are the most common parameters used to recognize the composition of wastewater (Russell, 2006; Abdalla and Hammam, 2014). The consistent positive relationship between the BOD and COD values throughout the study in both raw and treated water of Mahallet Ziad WWTPs indicates that the general balance of the composition of domestic and industrial sewage in the influent remained steady.

Protozoa associated with sewage treatment process have been considered by different workers as mentioned by Laybourn (1984), but the most comprehensive study of protozoa and their role in sewage treatment processes has been carried out by Curds and Cockburn (1970 a) who proved that ciliates were the dominant group, followed by Rhizopoda and Phyto-mastigophorea. Simultaneously, Galal *et al.* (2018) illustrated that ciliated protozoan organisms dominate flagellates, while sarcodines proved to be the least abundant protozoan type.

It is worthy to mention that the numerical densities of various types of rotifers ranged from $47x10^2$ to $223x10^2$/l indicating a good sludge quality which is parallel to the data obtained by Ghazy *et al.* (2010). It was proved that there is a relation between the composition of the protozoan community in a wastewater treatment plant and the quality of the produced effluent (Curds and Cockburn; 1970 $_{a\ \&b}$ and Galal; 2013). They found also that the effluent of high quality is characterized by low BOD values, a wide variety and high numerical densities of ciliated organisms. The improved BOD and TSS could be referred to a decline in the viable bacterial numbers (Curds *et al*., 1968). These data are concomitant with those of the present study in reducing pollution significantly and therefore, effluent water can be delivered into certain water bodies to be used in particular human activity as agriculture and industry.

Applying the regression analysis for different biotic and abiotic parameters of the present study, it was proved that there were no significant simple regression relationships between any single parameter and the others which could be attributed to the presence of a chemostat pattern controlling the whole wastewater treatment process which is more or less parallel to the data obtained by Galal (1989). Accordingly, multiple regression analysis had to be used to examine the various combinations between the previously mentioned parameters. It was concluded from the statistical point of view that total ciliates, sarcodines and rotifers had significant relationships with different abiotic factors. On the other hand, it was proved that flagellates, swimming ciliates and sessile ones had no statistically significant relationships.

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دراسات بيئية على بعض الكائنات الهائمة فى محطة محلة زياد لمعالجة مياه الصرف بمحافظة الغربية – مصر

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المستخلص

أجريت هذه الدراسة فى محطة محلة زياد لمعلجة مياه الصرف بمحافظة الغربية وذلك فى الفترة من فبراير 2018 وحتى يناير 2019، وذلك لدراسة الهائمات الرئيسية وبعض العوامل الفيزيقية والكيميائية ودورها فى التأثير على الكفاءة الادائية لمعالجة مياه الصرف فى تلك المحطة. ولقد أوضحت النتائج أن الأوليات والعجليات تمثلان المجموعتين الرئيسيتين من تلك الهائمات بالمحطة وأن الأوليات هى الأكثر شيوعاَ من غيرها وهى تتكون من ثلاث طوائف هى اللحميات والسوطيات والهدبيات مرتبة تصاعدياَ من حيث الكثافة العددية الاانها تظهر تبايناَ عددياَ بداخل كل مجموعة فى الشهور والفصول المختلفة. ولقد أثبتت هذه الدراسة ان الانواع المختلفة من تلك الكائنات الاولية تتاثر معنوياَ و بدرجات متفاوتة عملياَ و إحصائياَ ببعض العوامل الفيزيقية والكيميائية بما يؤثر ايجاباَ على كفاءة عملية معالجة مياه الصرف حيث يسمح فى نهاية المعالجة باستعمال هذه المياه فى بعض الأغراض الزراعية والصناعية.