Egyptian J. of Phycol. Vol. **7(1)**, 2006

ALGAL FLORA AND PHYSICO-CHEMICAL PROPERTIES OF SEWAGE WATER TREATMENT SYSTEM IN EL-GABLE AL-ASFAR, CAIRO

PART 1- PHYSICO-CHEMICAL PROPERTIES

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Abstract

Samples over 12 months were collected from four tanks and effluent (September 2000-August 2001) along the station. The increase in number of total phytoplankton standing crop, the high concentrations of nutrients and low species diversity are the characteristics of eutrophicated habitats. The total phytoplankton standing crop ranged from 914.6 individuals x 10^4/L at primary sedimentation tank to 6442.3 individuals x 10^4/L at aeration tank. The phytoplankton community was represented by a total of 61 species belonging to 36 genera and 7 classes in the investigated station, namely Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae, Dinophyceae, Xanthophyceae and Cryptophyceae. Approximately all the species of the last four groups and Bacillariophyceae were tolerant species and considered as eutrophic indicators.

Key words: Wastewater treatment – Physico-chemical properties – Algal flora

Introduction

The composition of wastewater depends on its origin and it is strongly dependent on the economic structure within any particular area. One may distinguish between the following kinds of wastewater, which to some extent require different methods of treatment, domestic wastewater, agricultural effluents, industrial effluents, storm water (rainfall), municipal sewage. Domestic sewage is commonly classified as weak, moderate or strong sewage depending mainly on the concentration of organic matter and suspended solids which are in turn dependent on the amount of consumed water (Saleh, 2000). Osada (2000) stated that wastewater treatment is essential to prevent surface and underground water pollution. DO concentration in the aeration tank should be sufficient to sustain all time, desirable microorganisms in the aeration tank. When oxygen becomes low, undesirable microorganisms may predominate and settle ability and the quality of activated sludge may be poor (WPCF, 1990).

Gautnam *et al*. (1993) examined the various changes in physico-chemical characteristics of Alknanda water at Srinagar caused by the disposal of untreated sewage. The author found that the temperature directly affected the various processes going on in an organic environment. He also found that there was an

(ISSN: 1110-8649)

increase in the values of biological oxygen demand, chemical oxygen demand and organic materials, as well as slightly alkaline pH due to sewage disposal.

Mahmoud-Elham (2002) reported that temperature values of raw wastewater are higher than effluent water, its values ranged from 17- 27°C for the influent and from 15- 25°C for the effluent.

Guillaud *et al*. (1992) mentioned that it is necessary to evaluate nutrient loading, physico-chemical parameters and to point out possible nitrogen or phosphorus limitation for primary production in a potentially eutrophication site. Fruend and Romen (1993) conducted an intensive study for one year on parameters governing phytoplankton dominance and succession in wastewater oxidation ponds in relation to their photosynthetic properties under environmental stress. The authors observed that the most successful phytoplankton species was *Chlorella vulgaris* based on its high photosynthetic potential and its relatively modest contribution to suspended solids. Some heavy metals such as Mn, Fe, Cu and Zn are essential micro-nutrients and are needed by algae for various metabolic processes; others such as Hg, Pb, Cd and Ag are not required for growth. Generally all heavy metals are toxic to algae at high concentrations. Mahmoud–Elham (2002) mentioned that the Ras El Bar wastewater treatment plant is characterized by moderate values of BOD and COD as well as a slightly low concentration of heavy metals (Cu, Cd, Zn and Pb) compared with typical domestic wastewater by using a biological treatment .Algae can alter the form of metals occurrence through methylation, chelation, complexation, catalysis or absorption. Thus, phytoplanktons affect the movement of metals up the food chain. Factors which affect algal ability to alter the chemical form of metal are, the bio-available concentration of the metal, the types and numbers of algae present, the time period of the organism's exposed to the metal and the physico-chemical parameters of the environment (Shubert, 1984).

The aim of this work is to study the algal flora and the physico-chemical parameters in the sewage water of El-Gable Al-Asfar station, which is one of the oldest stations that treat wastewater in Egypt.

Materials and Methods

El-Gable Al-Asfar station belongs to the Healthy Water Drain Project, Ministry of Health and Population. The station started in 1911 and is located 25 kilometers north east of Cairo on about 1000 feddans by the last expansions. It is divided into two parts; A and B, part B was founded by the end of 2004 and part A is the one from which we took our samples. The purpose of this station (El-Gable Al-Asfar) is to receive and treat the sewage water coming from Al-Qalag pumping station.

The study was extended from September 2000 to August 2001. Monthly water samples were collected from: primary sedimentation tanks (PST), aeration tank (AT), final clearing tanks (FCT), chloration tanks (ChT) and effluent (E).

For phytoplanktonic analysis plastic bottles with a capacity of 2 L were used. For chemical and physical analysis, samples were collected in plastic containers with a minimum capacity of 4 L.

Physico- chemical parameters

* Temperature: Air/water temperature was measured in situ using a thermometer.
* Hydrogen-ion concentration (pH) was measured in situ by a pH meter.
* Electric conductivity (EC) by conductivity YSI model 33 S.C.T. meter.
* Dissolved oxygen (DOD), Biological oxygen demand (BOD) and Chemical oxygen demand (COD) were estimated according to APHA (1995).
* Total alkalinity and Chlorides were determined according to APHA (1995).
* Sulphate and silicate were determined according to APHA (1985).
* Nitrate and Nitrite were determined according to Snell and Snell (1949).
*Ammonia was determined according to Mostafa (1989).
*Total organic nitrogen was determined according to (Hiller *et al*., 1948).
*Total phosphorus by Gales *et al*. (1966).
*Calcium,Magnesium ,Microelements (Cu, Fe, Mn, Zn, Cd, Ni and Pb), Na^+ and K^+ were determined according to Jackson (1973).

Results and Discussion

The present investigation was carried out from El-Gable Al-Asfar station over one year (September 2000- August 2001) in order to provide proper information on the phytoplankton communities and physico-chemical properties under the influence of pollution at this station.

Physico-chemical properties of sewage depend on the life style of inhabitants. It also shows diurnal and seasonal fluctuation. Its degree of pollution, composition and volume varies from hour to hour, from day to day and from year to year at the same area and may from area to other.

Concerning the seasonal changes of water and air temperatures in the study area, the lowest and highest values of water temperature were 17.5 and 29.2˚C for winter and summer seasons, respectively, while the corresponding values of air temperature were 20.7 and 34.3˚C at the same season. Water temperatures were always lower than air temperatures, relatively low in winter season (15.3-20.8 ºC) and slightly warm in summer season (25.1- 30.9 ºC). These temperature values which were recorded during this investigation appeared suitable for algal growth. It could be revealed that any increase or decrease in standing crop of phytoplankton at all tanks and effluent seemed to be correlated with the fluctuation in water temperature. This is in agreement with the results obtained by the authors (Mahmoud, 1989 and Kobbia *et al*., 1995).

The seasonal changes of Hydrogen ion concentration in the sewage water tanks and effluent were presented in Table (1). The highest pH value of 8.18 was recorded in the effluent water during the autumn season, while the lowest one

7.57 was recorded in the summer season. On the other hand, the distribution pattern of seasonal variation values of pH in the effluent could be arranged in the descending order: autumn > spring > winter > summer. The pH value of 6.6 -8.4 for the water tanks and effluent tends towards the alkaline side .These values appeared suitable for phytoplankton growth and this investigation agree with the investigators (Awad, 1993; Shams El-Din-Nihal, 2000 and Yousry-Karima 2003).

The seasonal changes of EC in the sewage water tanks and effluent were presented in Table (1). The highest EC value of 2.1mmhos/cm was detected in the effluent water during the winter season, while the lowest one of 1.55mmhos/cm was detected in the summer season. On the other hand, the distribution pattern of seasonal variation values of EC in the effluent could be arranged in the descending order: winter >spring > autumn > summer. Such variation in EC may be attributed to high levels of nutrients and high eutrophication levels in turn led to major alterations in community structure of phytoplankton. Such results are in harmony with the findings of Kobbia *et al*. (1995) and El-Attar (2000).

The seasonal changes of dissolved oxygen of the study area were presented in Table (1). The lowest and highest dissolved oxygen values of 4.5 and 9.9 mgO_2/L were detected in the effluent water during autumn and summer seasons, respectively. Generally the minimum DO value of 1.9 mgO_2/L was recorded in the ChT during autumn season and the maximum value of 12.41 mgO_2/L was recorded in the PST during the spring season. These variations may be related to the difference in photosynthesis process as in the findings of Yousry-Karima (2003). In this investigation increasing in DO concentrations during winter may be due to that the solubility of dissolved oxygen in cold water is higher than in warm water (Cole, 1983). Lowest concentrations of DO in summer are mainly due to increasing water temperature and the decomposition of detritus plankton and organic matter, where by oxygen becomes consumed and carbon dioxide is produced (Mitchell and Burns, 1979).

The seasonal changes of BOD of the sewage water in the study area were presented in Table (1). The highest value of BOD in the effluent water was 135.1 mgO_2/L and recorded during the summer season, while the lowest one of 85.1 mgO_2/L was shown in the autumn season. On the other hand, the distribution pattern of seasonal variation values of BOD in the effluent could be arranged in the descending order: summer > spring > winter > autumn.

The seasonal changes of COD in the sewage water in the study area were presented in Table2. The highest COD value of 209.6 mgO_2/L was presented in the effluent water during the Spring season, while the lowest one of 151.8 mgO_2/L was presented in the autumn season. The values of COD in the effluent during the different seasons were 151.8, 201, 209.6 and 183.1mgO_2/L for autumn, winter, spring and summer seasons, respectively. As revealed from the results obtained, the BOD and COD content of tanks and effluent decreased from PST to ChT, these results are in line with that found by Dignac *et al*. (2000) and

Arsitotelis *et al*. (2004) who stated that the concentration of organic matter was decreased by biological treatment. The present results showed that the reduction efficiency of COD reached a maximum value in summer season which agreed with that obtained by Abdullah (1995).

Concerning the seasonal changes of total alkalinity of the study area, the results were presented in Table (1). The lowest and highest values of total alkalinity in the effluent water were 247.7 and 339.7 mg/L for winter and summer seasons, respectively. Generally the minimum total alkalinity value of 143.2 mg/L was recorded in the ChT during autumn season and the maximum value of 361.4 mg/L was recorded in the PST during the summer season. The levels of alkalinity at the sampling station are suitable for high production processes. This view was supported by Mahmoud (1989), who stated that the alkalinity above 50 mg/L indicates productive water.

The seasonal changes of chlorides content of the sewage water in the study area were presented in Table (1). The highest chlorides value of 1.02 mg/L was recorded in the spring season, while the lowest one of 0.53 mg/L was recorded during the autumn season in the effluent water. On the other hand, the distribution pattern of seasonal variation values of chlorides in the effluent could be arranged in the descending order: spring > winter > summer > autumn. The increase of chloride ion concentration during spring may be due to evaporation (Awadallah *et al*., 1991).

The seasonal change values of nitrate of the sewage water in the study area were resented in Table (2). The highest nitrate value of 66.2 µg/L was presented during the summer season, while the lowest one of 31.7 µg/L was shown in the winter season in the effluent water. The values of nitrate in the effluent were 57 and 45.6 µg/L for autumn and spring respectively. Nitrate is the most common and stable nitrogen form. From the results obtained Table (2), the seasonal cycles of nitrate showed that its low values were recorded in winter and spring. This investigation agrees with Becher *et al*. (2000), who found that the rate of uptake by algae decreases with lower water temperature and shorter days so that, its concentration exceeding the demand of algae.

Kobbia *et al*. (1995) pointed out that the decrease in nitrate contents might be due to its utilization by phytoplankton .This phenomenon was found in the present study, where the nitrate contents decreased from PST to ChT (Table 2).

Concerning the seasonal variations of nitrite in the study area, the results were presented in Table 3. The lowest and highest values of nitrite in the effluent water were 7.8 and 59 µg/L for autumn and spring seasons, respectively.

The seasonal changes of ammonia content in the sewage water under investigation were presented in Table (2). The highest NH_4 value of 4083.9 µg/L was recorded in the effluent during the spring season, while the lowest one of 1793.7 µg/L was recorded in the summer season. The distribution pattern of seasonal values of ammonia in the effluent could be arranged in the descending order: spring > winter > autumn > summer. A significant correlation was found between ammonia removal and algal production in the water under study. Hammouda *et al*. (1995) indicated that the utilization of ammonia by algae was an important process.

Table (1): Seasonal variations in Temperature, PH, Electrical Conductivity (EC), Dissolved oxygen (DO), Biological oxygen demand (BOD), Chemical oxygen demand (COD), Total alkalinity and Chlorides of wastewater in the study area

Tanks	**Seasons**	**Parameters**						
		PH	**EC mmhos/cm**	**DO (mgO_2)**	**BOD (mgO_2)**	**COD (mgO_2)**	**Total alkalinity $mgCaCO_3$**	**Chlorides mg/ L**
PST	**Autumn**	7.41	1.27	2.3	92.4	425	283.4	0.63
	Winter	7.46	1.32	6.1	64.5	361.1	246.9	0.89
	Spring	7.63	1.02	12.41	93.24	350.2	321.3	1.34
	Summer	6.96	1.22	10.38	120.9	468.3	361.4	0.81
AT	**Autumn**	7.99	1.54	5.12	165.3	312.0	259.9	0.51
	Winter	7.45	1.57	7.14	114.9	265.6	191.8	0.85
	Spring	7.67	1.55	7.8	187.8	278.5	277.1	1.21
	Summer	7.21	1.35	10.75	216.2	288.3	265.5	0.71
FCT	**Autumn**	7.55	1.60	2.7	103	275.3	169	0.51
	Winter	7.69	1.54	4.4	69.1	195.1	160.1	0.84
	Spring	7.82	1.61	5.59	120	193	214.3	1.06
	Summer	7.31	1.36	6.82	146.4	181.4	200.2	0.65
ChT	**Autumn**	8.0	1.59	1.9	56	172.2	143.2	0.51
	Winter	7.73	2.26	3.7	32.6	163.2	151.0	0.82
	Spring	7.79	1.75	4.1	85.8	128.3	219.3	1.04
	Summer	7.41	1.58	5.4	96.7	115.2	147.6	0.62
Effluent	**Autumn**	8.18	1.57	4.5	85.1	151.8	312.0	0.53
	Winter	7.59	2.1	5.0	73.3	201	247.7	0.80
	Spring	7.77	1.58	7.7	114.3	209.6	307.2	1.02
	Summer	7.57	1.55	9.9	135.1	183.1	339.7	0.62

(PST) Primary Sedimentation Tanks; (AT) Aeration Tanks; (FCT) Final Clearing Tanks; (ChT) Chloration Tanks

The results of nitrogen indicated that nitrate and ammonia ions are the most dominant fraction while nitrite was present in least concentrations at all tanks and effluent.

The seasonal variations of total phosphorus in the different type of tanks and the effluent were presented in Table (2). The lowest and highest values of total phosphorus in the effluent water were 270.3 and 711.3 µg/L for spring and autumn seasons, respectively. The distribution pattern of seasonal values of total phosphorus in the tanks and the effluent could be arranged in the descending order: autumn > summer > winter > spring. The total phosphorus levels in water reached maximum values during autumn (Table 3) this may be related to reduced rates of uptake by algae in the aquatic life. Becher *et al*. (2000) gave similar interpretations. The decrease in phosphorus values from PST to ChT in all seasons is may be due to the flourishing of phytoplankton that consumes phosphate and increased sediment transport according to Heikal *et al*. (1998).

The seasonal changes of silicate in the sewage water treatment system were presented in Table (2). The highest silicate value of 1316.7 µg/L was presented in the effluent water during the spring season, while the lowest one of 351.3 µg/L was shown in the winter season. The values of silicate in four seasons arranged as follow: spring > summer > autumn > winter. Generally, the variations in silicate content are mainly influenced by mixing and stratification processes, physical and chemical characteristics of the environment rather than by diatom consumption (Yousry-Karima, 2003).

The seasonal changes of sulphate content in the system under investigation were presented in Table (2). The highest sulphate value of 35.2 mg/L was recorded in the effluent water during the autumn season, while the lowest one 18.2 mg/L was detected in the spring season. The distribution pattern of seasonal values of sulphate content in the effluent could be arranged in the descending order: autumn > summer > winter > spring. The decreasing of sulfate concentrations from PST to ChT can be attributed to the stratification process and the drop of dissolved O_2 that leads to reduction of sulfate to sulfide by reducing bacteria according to Awadallah *et al*. (1991) explanation. The major factor causing large seasonal and regional changes of sulfate concentration is the degree of sulfate reduction and plankton organisms which cause mineralization of organic cellular content (Elewa, 1991 and Yousry-Karima, 2003).

The seasonal variations of calcium in the tanks and effluent were presented in Table (2). The lowest and highest calcium values of 83 and 134.7 mg/L were recorded in the effluent water for winter and summer seasons, respectively. The distribution pattern of seasonal means values of calcium in the tanks and effluent could be arranged in the descending order: summer > spring > autumn > winter.

The seasonal changes of magnesium content in the sewage water tanks and effluent were presented in Table (2). The highest magnesium value of 57.7 mg/L in the effluent water was recorded during the autumn season, while the lowest one of 47.3 mg/L was detected in the spring season. The distribution pattern of seasonal values of magnesium content in the effluent could be arranged in the descending order: autumn > summer > winter > spring. Osborne *et al*. (1987) reported that, the increase of Ca and Mg concentrations was balanced mainly by an increase in ions. The present results revealed a positive relation between total hardness concentrations and total alkalinity in summer.

The seasonal changes of sodium in the treated sewage water system under investigation were presented in Table (2). The minimum sodium value of 75.9 mg/L was recorded in the ChT during autumn season and the maximum sodium value of 139.8 mg/L was recorded in the PST during summer season. In the present study the high sodium ion concentrations in summer (Table 4) may be attributed to high evaporation rate that leads to increase sodium chloride concentration. This is similar to the findings and explanation of (Sayyah *et al*., 1988 and Elewa, 1991). Generally, the variation in Na^+ concentration during different seasons is affected by many factors e.g. evaporation and consumption by aquatic organisms where sodium is an essential element for living organisms.

The seasonal variations of potassium content in the different type tanks and effluent were presented in Table (2). The lowest potassium value of 8.63 mg/L was recorded in the ChT during autumn season, while the highest value of 38.30 mg/L was recorded in the PST during spring season. Goldman and Horne (1983) stated that potassium is used as a cofactor for a variety of enzymes required for alga growth and photosynthesis , this may be explain the decrease of K^+ and the increase of phytoplankton in the all investigated tanks and effluent (Table 2) .

According to the reuse of treated wastewater for irrigation purposes, the following heavy metals in the treated water (effluent) accumulate in the soil by the course of time and affect plants and people. So it is important to study the seasonal variations of these heavy metals in the effluent water.

In recent years, heavy metals, have received widespread attention because of their release into the environment extended persistence, and toxicity to a wide variety of organisms (Nies, 1999). An interesting characteristic of some metals is that they are nutrients at low concentrations (e.g. Cu, Mo, Fe and Zn) while others as Pb and Cd are not required for growth (Trevors *et al*., 1986).

Seasonal variations of heavy metals content in the sewage water tanks and the effluent under study were represented in Table (3). The minimum zinc value of 0.009 mg/L was detected in the ChT during winter season while the maximum zinc value of 0.073 mg/L was recorded in the PST during summer season. Concerning the changes of zinc content in the effluent water, the highest Zn value of 0.038 mg/L was recorded in the spring season, while the lowest Zn value of 0.017 mg/L was recorded in the winter season. Although Zn is a micronutrient, it is very often found in high concentrations in algal biomass due to accumulation (Vymazal, 1995). It may stimulate algal metabolic activity at higher concentrations. Such results are in harmony with that which Zn decreased from PST to ChT with increased the phytoplankton.

Table (3): Seasonal variations of Zinc (mg/L), Cadmium (mg/L), Lead (mg/L), Iron (Fe) (mg/L), Manganese (mg/L) and Copper (mg/L), in wastewater treatment system.

Tanks	Seasons	Parameters						
		Zinc (mg/L)	Cadmium (mg/L)	Lead (mg/L)	Nickel (mg/L)	Iron (mg/L)	Manganese (mg/L)	Copper (mg./L)
PST	Autumn	0.063	0.010	0.209	0.134	0.970	0.118	0.140
	Winter	0.053	0.008	0.311	0.124	0.913	0.200	0.063
	Spring	0.039	0.013	0.286	0.172	1.890	0.195	0.053
	Summer	0.073	0.012	0.273	0.144	1.447	0.397	0.142
AT	Autumn	0.038	0.005	0.187	0.093	0.733	0.096	0.035
	Winter	0.023	0.006	0.220	0.122	0.899	0.101	0.044
	Spring	0.037	0.005	0.266	0.142	1.111	0.170	0.039
	Summer	0.044	0.008	0.162	0.101	1.315	0.202	0.038
FCT	Autumn	0.019	0.004	0.095	0.075	0.597	0.052	0.032
	Winter	0.011	0.005	0.182	0.095	0.802	0.072	0.041
	Spring	0.018	0.003	0.197	0.125	0.488	0.168	0.035
	Summer	0.027	0.006	0.106	0.088	0.950	0.118	0.036
ChT	Autumn	0.012	0.004	0.083	0.069	0.486	0.043	0.029
	Winter	0.009	0.004	0.101	0.086	0.778	0.060	0.033
	Spring	0.013	0.002	0.079	0.102	0.128	0.124	0.032
	Summer	0.015	0.007	0.088	0.076	0.820	0.056	0.035
Effluent	Autumn	0.025	0.005	0.092	0.081	0.670	0.142	0.037
	Winter	0.017	0.006	0.111	0.089	0.885	0.154	0.039
	Spring	0.038	0.004	0.154	0.112	0.532	0.161	0.035
	Summer	0.024	0.008	0.096	0.090	0.991	0.139	0.046

(PST) Primary Sedimentation Tanks, (AT) Aeration Tanks, (FCT) Final Clearing Tanks
(ChT) Chloration Tanks

The minimum cadmium value of 0.002 mg/L was observed in the ChT during spring and the maximum cadmium value of 0.013 mg/L was observed in the PST during spring season. The minimum lead value of 0.079 mg/L was observed in the ChT during spring season while the maximum lead value of 0.311 mg/L was observed in the PST during winter season. The distribution pattern of lead values of the study area could be arranged in the descending order: PST > AT > FCT > effluent > ChT. The minimum nickel value of 0.069 mg/L was recorded in the ChT during autumn season and the maximum nickel value of

0.172 mg/L was recorded in the PST during spring season. . The distribution pattern of nickel values in the study area could be arranged in the descending order: PST > AT > FCT > effluent > ChT. The lowest iron value of 0.128 mg/L was recorded in the ChT during spring season, while the highest value of 1.89 mg/L was recorded in the PST during spring season. The minimum manganese value of 0.045 mg/L was observed in the ChT during autumn season and the maximum manganese value of 0.397 mg/L was observed in the PST during summer season. The distribution pattern of manganese values in the study area could be arranged in the descending order: PST > effluent > AT > ChT >FCT.

The minimum copper value of 0.029 mg/L was detected in the ChT during autumn season while the maximum copper value of 0.142 mg/L was detected in the PST during summer season. The distribution pattern of copper values in the different tanks could be arranged in the descending order: PST > effluent > AT > FCT >ChT.

Phytoplankton standing crop is a good estimate of the current degree of eutrophication. Reduction in the number of dominant species, species diversity and the increase in cell count of one or two resistant algae are some of the changes observed in the phytoplankton populations of domestic and industrially polluted environments. This fact is stressed by Nicholls *et al*. (1988) and Vilicic (1989), who regarded the occurrence of higher concentration of nutrients, more biomass due to bloom formation by the planktonic algae and low species diversity as the characteristic features of eutrophicated habitats. These findings were in agreement with the present investigation.

The results of phytoplankton standing crop (Table 4) wide variations from 914.6 x 10^4 individuals / L at the PST to 6442.6 x 10^4 individuals / L at the AT indicating a hyper-eutrophic condition , which is confirmed by a major of total phytoplankton standing crop. It is noticed that the phytoplankton standing crop values are high especially in the AT. This may be attributed to the high nutrients value through treated water resulting in a high degree of water eutrophication accompanied with a heavy bloom of phytoplankton. The present results agree with Abdalla *et al*. (1991); Abdalla *et al*. (1995 a and b) and Zaghloul *et al.* (1995).

Table 4: No of genera, No. of species, diversity, richness and evenness of total phytoplankton (individuals x 10^4 /L).

Parameters	Tanks				Effluent
	PST	AT	FCT	ChT	
Total individuals	914.6	6442.5	3571.9	2306.2	3805.0
Total no. of genera	36	36	36	36	36
Total no. of species	42	61	60	52	55
Richness	1.56	2.7	1.9	1.65	2.1
Diversity index	1.5	2.3	2.6	1.2	2.4
Evenness	0.57	1.4	1.7	0.74	1.7

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دراسات على الفلورا الطحلبية و الخواص الفيزيو- كيميائية في نظام معالجة مياه الصرف الصحى (الجبل الأصفر)

1- إحواض الفيزيو- كيميائية

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استهدف هذا البحث دراسة الفلورا الطحلبية لمياه محطة معالجة الصرف الصحي بالجبل الأصفر. لهذا الغرض تم أخذ عينات شهرية من الأحواض الأربعة (حوض الترسيب الأولي ـ حوض التهويه ـ حوض التنقية النهائىـ حوض الكلورة) ومن الدفق لمدة 12 شهرا بدءا من سبتمبر 2000 إلى أغسطس 2001. تم دراسة التغيرات في الهائمات النباتية و علاقتها بالخواص الفيزيوكيميائية لمياه المحطة. وتعد أحواض المعالجة و الدفق من الناحية النمطية مشبعة و قد تميزت باحتوائها على كميات كبيرة من العناصر المغذية و المواد العضوية التي نتج عنها كثافة عالية للهائمات النباتية و التي وصلت كثافتها العظمى 6442.3×10^4خلية/لتر في أحواض التهوية وأقل كثافة914.6×10^4خلية/لتر في أحواض الترسيب. وأوضحت الدراسة ان درجة حرارة المياه كانت أقل من درجة حرارة الهواء بقليل أما بالنسبة للأس الأيدروجينى فيقع في الجانب القلوي في معظم العينات و سجلت أقل قيمة له 6.6 في حوض الترسيب و أعلى قيمة 8.4 في حوض المعالجة النهائية. بالنسبة للتوصيل الكهربي فكان هناك تأرجح في قيمته في الأحواض الأربعة و الدفق. تعتبر مياه المعالجة جيدة التهوية طوال السنة حيث سجلت أعلى قيمة للأكسجين الذائب في حوض الكلورة و أقل قيمة في حوض الترسيب – أما بالنسبة للأكسجين الحيوي فكانت أعلى قيمة له في حوض التهوية و أقل قيمة في حوض الكلورة. بالنسبة للقلوية و الكلوريدات فقد تراوحت قيمهم بين أعلى قيمة في حوض الترسيب و أقل قيمة في حوض الكلورة لكل منهما. سجلت كل من النترات و النيتريت و الأمونيا و النيتروجين الكلى و الفسفور الكلى أعلى قيمة لكل منهم في حوض الترسيب الأولى و أقل قيمة فكانت في حوض الكلورة ماعدا النترات فكانت في حوض الترويق النهائي. بالنسبة للكبريت و السيليكات و الكالسيوم و الماغنسيوم فكانت أعلى قيمة لهم في حوض الترسيب وأقل قيمة في حوض الكلورة ماعدا السيليكات فكانت في حوض التهوية. اما العناصر الأخرى مثل الصوديوم – البوتاسيوم – الزنك – الكالسيوم – الرصاص – النيكل – الحديد – المنجنيز – النحاس فقد أظهرت تغيرات موسمية و أوضحت النتائج أيضا نقصان تدريجي (من هذه العناصر) من حوض الترسيب الأولى حتى حوض الكلورة ثم زيادة مرة أخرى في الدفق لاختلاطه بماء غير معالج مما يؤدي الي تأثير ضار لهذة العناصر علي المحاصيل الزراعية التي تروي بهذه المياه.

أما بالنسبه للهائمات النباتية تعد الزيادة في المحصول القائم و التركيزات العالية في الأملاح المغذية و ضعف التباين في الأنواع من السمات المميزة للأماكن المشبعة بالتلوث. اوضحت النتائج سيادة مجاميع الطحالب الخضراء و العصوية و الخضراء المزرقة موسميا و موقعيا وكان وجود بقية المجموعات بنسب قليلة. احتلت الطحالب الخضراء موقع السيادة الأول و شاركت بنسبة 59.7 % من المحصول القائم للهائمات النباتية بينما احتلت الطحالب العصوية بنسبة 19.3% والطحالب الخضراء المزرقة بنسبة 15.6%. وجد أيضا أن أحواض الترسيب الأولى و الدفق تميزت باحتوائها على كميات كبيرة من العناصر المغذية و المواد العضوية والتي نتج عنها كثافة عالية للهائمات النباتية .