Studies on water quality changes in River Nile and electric power plants treatment water at different localities in River Nile.

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Abstract:

The aim of this study was to determine the seasonal variations in physicochemical and bacteriological parameters between inlet River Nile water and filtration water of Shoubra El-Khiema (SH) and Damietta (D) electric power plants. Total organic carbon (TOC) ranged between the highest values of 29.55-18 and the lowest values of 28.95-21 mg/l at (SH) and (D) River Nile water respectively. In filtration water, TOC ranged between 27.5-20- and 21.79 - 16 mg/l at (SH) and (D) filtration water respectively. Mean of electric conductivity values exceeded permissible limit 417 mg/l at (D) River Nile but it still within limits of filtration water at two plants. Sulphate mean values ranged between 39.5,43 and 19.7,26 mg/l at (SH) and (D) River Nile water respectively and it increased in filtration water to 77, 56 and 34, 41mg/l at (SH) and (D) respectively, than permissible limits at two plants. The bacteriological analyses recorded the highest values of TC, FC, FS and *Pseudomonas* sp. during summer at inlet River Nile of two plants, but decreased in filtration water at two plants.

Key words: Physicochemical, bacteriological parameters, River Nile, Filtration water.

1-INTRODUCTION

River Nile constitutes over 90% of fresh water resources of Egypt. It is the main source of drinking water besides its use for agriculture, industry, recreation, fish production and in the electricity generation. During recent decades a considerable increase in pollution has taken in the rate of disposal of agricultural and domestic sewage into River Nile and its branches **(Nehad and Shawky, 2013)** which affects its physicochemical and microbiological quality **(Chemmattu *et al.,*2014)**. In fact, the electricity production in a thermal power plant is based on a set of energies transformations using water as support of energy **(Lakhoua1, 2013)**. The operation of the energetic boilers depends to a great extent on the quality of the water used for producing the steam **(Nicolae, 2012)**. This water must have a noble quality to guarantee the installation security and to improve production groups' performances. It is therefore necessary to apply a rigorous

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treatment of the raw water and a stern control of its quality **(Lakhoua1, 2013)** by processes such as filtration, softening and demineralization **(Thamer and Usama, 2010)**. The degree of treatment depends on the nature of the river water **(Singh *et al*., 2010)**. Bacteria have been recently categorized as aquatic plankton after recognizing that they play an important role in secondary production via bacterial primary production. For energy and material cycling, bacteria have been emphasized much because of their abundance and per unit higher surface-volume ratio **(Li *et al*., 2004)**.

The aim of this study was to determine the seasonal variations in physicochemical and bacteriological parameters between inlet River Nile water and filtration water of Shoubra El-Khiema (SH) and Damietta (D) electric power plants and compared to electric power plants permissible limits.

2-Materials and methods:

2.1. Study area and sampling sites:

Two electric power plants were studied, Shoubra-El-Khiema its site on El- Kaliubiya governorate and Damietta which presented on Damietta governorate.

Table (1): Description of the study electric power plants**:**

Plants	Shoubra El-Khiema power plant	Damietta power plant
Power	1200 M W.	1230 M W.
Intake water	River Nile, the main stream.	Damietta branch.

2.2. Water sampling:

Eight inlet River Nile waters during (autumn 2010 to winter 2012) and four filtration water during (autumn 2011 to winter 2012) samples from each electric power plant Shoubra El-Khiema (**SH**) & Damietta (**D**) Fig. (1) were collected seasonally according to the standard methods for the examination of water and wastewater **(APHA, 2005)**.

Fig. (1): Distribution of Shoubra El-Khiema power plant and Damietta electric power plant on River Nile (google earth).

2.3. Physicochemical analysis:

Air and water temperature, pH, total Alkalinity (M), partial alkalinity (P), total hardness, calcium hardness and magnesium hardness, were determined according to American Society for Testing and Materials **(ASTM 2009)**. Total dissolved solids (TDS) and total suspended solids (TSS) were determined gravimetrically **(APHA, 2005)**. Electrical conductivity (EC), turbidity**(ASTM 2009)**, dissolved oxygen (DO) was determined by Azide Modification of Winkler Method, biochemical oxygen demand (BOD), chemical-oxygen demand (COD) was determined according to closed reflux colorimetric method**(APHA, 2005)**, chlorides (mg/l) of water was determined according to Mohr's method, **(ASTM 2009)**.Total-Organic Carbon (mg/l as Carbon) was determined as non-purgeable organic carbon (NPOC) by using Multi N/CUVHS instrument. Dissolved Silicon was determined according to colorimetric molybdate blue method, iron and ammonia were determined by using thermo scientific spectrophotometer **(ASTM, 2009)**. Sodium and potasium, sulphate, nitrite, nitrat, phosphate were determined by using ion chromatography, Heavy metals were measured by Atomic Adsorption **(ASTM, 2009)**.

2.4. Bacteriological analysis:

The heterotrophic plate count (HPC) at 22ºC and 37ºC were determined by using pour plate method. Total coliforms (TC), feacal coliforms (FC), feacal streptococci (FS), and *Pseudomonas* sp. were estimated by MPN method according to **(APHA**, **2005)**.

2.5. Statistical Analysis:

All River Nile values from physicochemical analyses and bacteriological are presented as mean ± SD. Computer assisted data analysis were performed for determination of the correlation coefficients between the biological parameters and the physicochemical parameters through statistical program under excel windows according to **Challejee (1995)**.

3-RESULTS AND DISCUSION:

Results of physicochemical characteristics of River Nile water showed in Table (1). Water temperature was always lower than the corresponding air temperature. Air and water temperatures were positively correlated during studied seasons (r=1) (data not present). This indicated that the water temperature is affected thermal water pollution, this agree with **Safaa *et al.* (2012).**

The pH of River Nile water in all sites (Table 1) is within the South African Recommended Standard Limits (6.5-8.4**) (Shawky and Saleh, 2007)**. Results of physicochemical characteristics of Filtration water was showed in Table (2). A lower pH values of filtration water influence of the added dose of aluminum sulphate than the pH values of River Nile water at the two investigated sites due to production of hydrogen ions,

H_3O^+, during the hydrolysis of the aluminium sulphate ,this results agree with **Badr El-Din (2012)**. PH was less than permission limits of filtration water at **D** electric power plant.

In table (1) the maximum total alkalinity (M) mean values of 145-150 mg/l were recorded during winter at **SH** and **D** River Nile respectively this can be attributed to the lower air and water temperature during cool season that affect the carbonate reactions **(Abdo, 2005)**. Alkalinity exhibited negative correlation with water temperature (r = -0.57) and high positive correlations with TDS and electric conductivity (r=0.86 &0.86 respectively). Lower total alkalinity in filtration water than of River Nile water at the two investigated sites were due to add dose of aluminum sulphate which hydrolysed producing hydrogen ions that react with the alkalinity of the water leading to decrease the pH of the water **(Ahmed, 2009)**.

The high Ca^{2+} concentration in River Nile Table (1) during autumn at **D** may be due to the re-dissolution of organisms and suspended solids containing Ca^{2+} in the presence of dissolved CO_2 **(Awdallah *et al.,* 1991)**. Total Hardness in River Nile revealed negative correlation with temperature (r=-0.79) and positive correlation with TDS (r=0.70). Calcium and Magnesium hardness (data not present) of filtration water were the same as that of Nile water at the two investigated sites which may be due to the absence of the precipitation or adsorption through the treatment processes.

An increase of TDS values of 271.5 -319 mg/l during winter at **SH** and **D** inlet River Nile water respectively Table (1), that may be related to lowering of water level in the River Nile during drought period which leads to concentrate the dissolved mineral in the water **(Elsayed, 2009)**.At Damietta TDS increased permissible limits. In parallel to these findings, TDS and EC turbidity values revealed positively strong correlation to each other (r = +0.97) as illustrated in **(Mohamed and Mostafa, 2009)** reported the same correlations. The increasing in total dissolved solids in filtration water (Table 2) than River Nile water due to additional of chemical treatment except in winter and spring seasons at **D** filtration water. Correlation coefficient showed complete correlation between TDS and EC (r=1) at two plants.

The maximum TSS values during summer at two plants inlet River Nile water respectively because of flood period that carry silts from Ethiopian land during summer seasons Table (1). Total suspended solids values are positively correlated with TOC and silica (r =0.77&0.71, respectively). A decrease in total suspended solids of filtration water (Table 2) were observed than River Nile water at the two electric power plants due to using of aluminium sulfate which form $2Al(OH)^3$ bonded to suspended particles, making them more likely to settle out in a coagulation process **(El Karamany, 2010)**. Correlation coefficient showed negative correlation between TSS and TOC (r=-0.90) at two plants filtration water.

The turbidity in the inlet River Nile water of **SH** was higher than that of the inlet River Nile water of **D** power plant in autumn and summer (Table 1). This may be due to the

industrial discharges in **SH** region Increasing values from up-stream to down-stream along the branch may be attributed to drains discharge **(Safaa *et al.,* 2012)**. Turbidity values were positively correlated with TC, FC, FS , *Pseudomonas* sp. (r=0.5), and with TOC (r=0.33). A decreasing of turbidity (Table 2) were observed after treatment of Nile water at the two investigated sites with aluminum sulfate, in addition, the particles are partly removed in the rapid sand filter, this results agree with **Pontius (1990)**.

The high mean values of electric conductivity 428-495 μ mho/cm (Table 1) at **SH** and **D** River Nile during winter respectively may be attributed to the intrusion of the drain's effluents into the lowered level water in the branch causing elevation of dissolved and suspended particles which increase the ability to convey electrical current **(Ahmed, 2012)**. Conductivity values were positively correlated with TOC, Cl^- and SO_4^{-2} (r=0.80,0.66   &0.79, respectively),this results agree with **Mohamed and Mostafa (2009)**. The seasonal average value of the electric conductivity of **D** was higher than the corresponding stations standard limits of River Nile but in **SH** the electric conductivity was within the limits. An increase in electrical conductivity of filtration water (Table 2) due to additional of chemical treatment. But in winter and spring seasons at **D** filtration water the electrical conductivity decrease which may be related to the dose used.

Table (1) showed that the dissolved oxygen mean values recorded the maximum values of 8.8 -9.6 mg/l at **SH** and **D** inlet River Nile water respectively during winter may be due to the high solubility of oxygen at low water temperature **(Saad *et al.* 2011)**. Dissolved oxygen values were negatively correlated with water temperature (r= -0.48), similar results were obtained by **Shehata and Badr (2010)** and were negatively correlated with TC,FC,FS, *Pseudomonas* sp. (r= -0.2). Decreasing in dissolving oxygen values after treatment (Table 2) at both electric power plants were due to removing a density of phytoplankton after water treatment process. But DO increased at autumn after treaetment may be fouling of sand filter with phytoplankton.

The maximum BOD values were 3.3-5 mg/l (Table 1) was recorded at **SH** and **D** River Nile during autumn and winter respectively, this agree with **Mohamed *et al.* (2011)**, where concentrations were larger during low flow condition. This confirmed by statistical analysis (r =-0.16,-0.21,-0.26 &-0.25 of TC,FC,FS and *Pseudomonas* sp. respectively) and between BOD. A decreased of BOD of filtration water (Table 2) than that of River Nile water at two plants may be due to the decreasing counts of microorganisms after treatment water process and adding of chlorine as disinfectants.

The high values of COD during spring at **D** inlet River Nile water (Table 1) could be attributed to the increase in water temperature which accelerates the oxidation of organic matter and decrease in oxygen content **(Abdo, 2010)**. But the increased in autumn at **SH** may be due to increased of chemical wastes in drought period. Chemical oxygen demand

gave a negative correlation with TOC (r=-0.49) and positive correlations with sulfate, nitrate and ammonia (r= 0.60, 0.71 &0.70 respectively). The COD at **SH** of filtration water ranged from 1 to 4.8 mg/l during summer and spring respectively, while at **D** filtration water it ranged between 2-4.8 mg/l during autumn or summer and winter respectively (Table 2). The reduction in COD in filtration water may be due to chemical coagulation and membrane filtration methods **(Nor and Wan, 2010)**.

The high value of TOC in River Nile during summer (Table 1) may be mainly related to flood water originating from Ethiopin highland which is known by its high turbidity due to silt carried (carbon source) that decomposed during high flow downstream special during hot summer. Statistically, the total organic carbon in Nile water was positively correlated with temperature (r =70). The introduction of excess of organic matter may result in a depletion of oxygen from an aquatic system mainly during warm stagnant condition **(Maria *et al.,* 2000)**. Increasing of TOC during autumn (Table 2) at **SH** might be due to fouling of filtration medium. The chemical disinfection reaction with organic matter can also lead to an increase in organic carbon **(Roeder *et al.*, 2010)**.

As given in Table (1) the chloride mean values recorded the highest values ranged from 45.5 to 54.5 mg/l during winter at **SH** and **D** inlet River Nile water respectively which were registered in cold seasons especially during the drought period, these results agreed with **Metawea (2009)**. Chloride was negatively correlated with temperate (r=-0.90) and was positively correlated with conductivity and sulphate (r =0.8&0.9 respectively). The increasing in chloride values after treatment (Table 2) was due to addition of disinfection in chlorination process.

Data in Table (1) showed the River Nile maximum sulphate content were 39.5 - 43 mg/l measured at **SH** and **D** inlet River Nile water respectively during winter which were registered in cold seasons especially during the drought period **(Metawea, 2009)**. Sulphate are positive correlated with total alkalinity, TSS, conductivity (r=0.79) and sodium (r=0.81) and were negatively correlated with silica (r =-0.89). Table (2) showed filtration water sulphat values which varied between the maximum values of 77-56 during autumn and winter at **SH** and **D** filtration water respectively and the minimum values of 34- 41mg/l during summer at **SH** and **D** filtration water respectively. The maximum values were exceeded the stations permissible limits. The increasing of sulphate in filtration water than in raw water was a result of addition of chemical treatment (aluminum sulphate) this agree with **Badr (2012)**.

The highest sodium mean values Table (1) were 92.5 -106.5 mg/l recorded during autumn and winter at **SH** and **D** inlet River Nile water respectively which exceeded the permissible limits. Major cations (Ca^{2+}, Mg^{2+}, K^+, and Na^+) are naturally very variable in environmental water due to local geological climate, geographical conditions and waste

water discharge **(Badr *et al .,* 2006)**. Table (2) showed that, the sodium concentration at **SH** filtration water ranged from 50 to 94.5 mg/l during summer and autumn respectively, while at **D** filtration water it ranged between 65-100 mg/l in spring and winter respectively. The average values were exceeded **D** permissible limits. Sodium concentration in filtration water did not change than that in River Nile water.

Potassium values Table (2) in filtration water were approximately did not change than that in River Nile water.

The high Fe mean values in River Nile (Table 1) during spring at **SH** may be attributed to low values of DO which promote reduction in the above equilibrium. So, Iron occurs as Fe^{2+} and wasn't precipitated as $Fe(OH)^3$. The iron values Table (2) were found to be below permissible limits of **D** filtration water. Iron values in filtration water were less than in River Nile water which might be because the filtration process removed most of iron and after chlorination practically all of iron was oxidized **(Keith *et al.,* 2000).**

The present data Table (1) showed high concentration of dissolved silica in River Nile occurred during the flood seasons in summer at **SH** River Nile water. The increase in silicon during the flood season was due to production of large Si reserves by rock weathering whose dissolution by the rain, temperature and turbulence of the river in flood **(Hall *et al.,* 1977)**. Silica was positively correlated with TSS and TOC (r= 0.71& 0.65, respectively). Silica values of filtration water Table (2) were less than in River Nile water due to coagulation, precipitation and filtration processes in treatment water.

Nitrite in River Nile Table (3) was positively correlation with ammonia (r=90). Nitrate mean values in River Nile Table (1) were in the permissible limits of **SH** power plant but exceeding permissible limits of **D** power plant. Increases of NO_3^- and decreases in NH_4^+ have been identified as an increase towards north (Nile downstream) in which oxidation of ammonia (NH_3) to nitrate (NO_3) and nitrite (NO_2) by aerobic bacteria in a process called nitrification **(Safaa *et al.,* 2012)**. Phosphorus was positively correlated with COD (r=0.71). As showed in Table (2) nitrite, nitrate and phosphate were not detected in most seasons at two plants filtration water. Nitrite, nitrate and phosphate in filtration water were nearly the same or less than River Nile water.

From Table (1) it was found that ammonia was recorded a low concentration during all seasons at River Nile. Ammonia was positively correlated with HPC at 22°C and HPC at 37°C (r= 0.90). Ammonia values in filtration water Table (2) were, nearly, the same or demolished than in River Nile water that might be due to the effect of chlorination with ammonia,this agree with **Badr (2012)**.

As showed in Table (1), trace element in **SH** River Nile of Mn ranged from <0.001 to 0.0008 and Zn fluctuated between <0.001 and 0.00043 mg/l. Some of heavy metals (Zn, Ni,

and Mn) were enriched during the treatment process (Table 2). This could be attributed to the adsorption of these metals by the organic matter retained in these filters during low discharge rates. Under such conditions, some of the former precipitated Fe-oxihydroxides may be dissolved and release their adsorbed heavy metal load into the water **(Geriesh *et al.*, 2004)**.

As showed in Table (3), the highest bacterial counts (HPC) in River Nile were recorded for both groups (at 22°C and 37°C) during spring for both power plants. This might be due to the high temperature prevailing during this season and discharged wastewater during this season. Damietta inlet River Nile water bacterial counts at both incubation temperatures (22ºC and 37ºC) almost higher than that at **SH**. This may reflects the nature of heterotrophic bacteria and the density of fecal pollution **(Wafaa, 2006)**. As showed in Table (4), a decrease in HPC counts at both 22°C , 37°C , TC, FC, FS and *Pseudomonas* sp*.* of filtration water than River Nile water. Although some variation in HPC levels is normal and can occur seasonally, these increases can indicate a change in raw water quality, problems with water treatment, or problems in the distribution system or plumbing and should be investigated **(Federal, 2012)**.

The bacterial values in River Nile (Table 3) detected in warmer seasons. They reached their maximum values during summer when TC, FC, FS and *Pseudomonas* sp. recorded 143.5×10^3–15.5×10^3, 22×10^3–8×10^3, 3.6×10^3–0.66×10^3, 0.2×10^3–7.6×10^3 MPN/100 ml at **SH** and **D** respectively, These results may be due to increase of water temperature and discharge of waste water during these seasons **(Sabae and Rabeh, 2007)**. Statistical analysis indicated highly positive significant correlation (r =+0.9) between different bacteriological parameters (HPC, TC, FC and FS) at River Nile. The same results were concluded by **(Safaa *et al.,* 2012)** and negative correlation with DO (r=-0.2).

Richard (2004) reported that, the presence of coliforms in water distribution systems associated with biofilm growth problems, inadequate treatment, cross-connections or failure to maintain an adequate disinfectant residual.As observed in Table (4), *Faecal Streptococci* presented in filtration water during autumn at **SH** and presented during all seasons except during winter at **D** in contrasted with faecal coliform not presented at those seasons at two plants. Faecal streptococci are rarely multiply in polluted water **(Amira *et al.,* 2012)**. The presence of *Pseudomonas* sp*.* during autumn and winter at **SH** (Table 4) might be due to fouling filtration medium with high concentration of organic matter which lead to low rats of flow leading to multiply of *Pseudomonas* sp*.* during distribution given suitable conditions **(Hunter, 1997)**.

4-CONCLUSIONS:

Water quality along the studied areas in **SH** and **D** inlet Nile River influenced by wastewater discharge from regarding both physicochemical and bacteriological characteristics. After treatment, TC,FC, FS and *Pseudomonas* sp. was decreased but still existing also increased of sulphate in filtration water than River Nile water. The presence of any impurities in the filtration water affects on the performance of anion exchange resin and water quality produced which leading to deposits layers and forms corrosion on boiler and turbines in the electric power plants, so it affects on the electricity production.

5-RECOMMEDATIONS:

Monitoring of Nile River water regularly and constantly should be followed up in order to record any alteration in quality and the detrimental impacts on the aquatic ecosystem and for water treatment effectiveness. Adequate records of coagulation dose chlorine additions and measurements as well as indicator bacteria monitoring should be kept.

Table (1) The variation of physicochemical parameters of inlet River Nile water of Shoubra El- Khiema and Damietta electric power plants at different seasons (Autumn 2010- Winter 2012):

Seasons	Autumn		Winter		Spring		Summer		Stations Limits	
Plants	Shoubra El-khiema	Damietta	Shoubra El-Khiema	Damietta	Shoubra El-khiema	Damietta	Shoubra El-khiema	Damietta	Shoubra El-khiema	Dam
Parameters	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD		
Temperature C° **air**	25±0	19.5±2.5	23±0	25±0	31.5±6.5	30±5	35±3	36±2	-	-
water	23±0	17.5±2.5	19±0	24±0	29±7	29±5	33.5±2.5	34±2	14-29	14-3
	8.3±0	7.71±0.19	8.21±0.01	7.86±0.49	7.84±0.32	7.89±0.11	7.75±0.15	8.05±0.65	7.4-8.3	7.4-8
Total Alkalinity mg/Las CaCO$_3$ **M**	1.25±1.25	0±0	0±0	0±0	0±0	0±0	0±0	0±0	-	-
Partial alkalinity **P**	135±10	145±0	145±0	150±5	133.8±3.8	137.5±7.5	120±5	132.5±7.5	<175	112
Hardness mg/L as CaCO$_3$ **Total H**	114±14	143.5±11.5	128.5±3.5	137.5±2.5	112.5±2.5	121±1	105±0	112.5±7.5	84-140	65-
Ca H.	62±7	88±6	72±5	83.5±6.5	65±5	75±0	66±0	70±5	<95	44-9
Mg H.	52±7	55.5±5.5	56.5±1.5	54±4	47.5±2.5	46±1	39±0	42.5±2.5	<75	21-7
Total dissolved solid mg/L	264±36	275.8±10	271.5±31.5	319.5±22.5	238.5±11.5	248.8±17.75	219.5±18.5	266.35±22.65	125-300	135-2
Total suspended solid mg/L	6.2±1.8	5.8±0.2	6.65±0.35	6.8±0.2	6.25±1.25	5.85±0.15	16±4	7.65±0.35	<30	1- 4
Turbidity NTU	3.05±1.95	2.95±1.55	3.25±0.05	3.25±0.25	3.1±0.4	3.1±0.5	4.8±1.7	2.65±0.45	<11	4.4-
µs/cm	395±45	424±16	428±20	495±35	367.5±17.5	390±20	364±2	403±28	190-450	190- 4
mg/l	8.3 ± 1.3	7.7 ± 1.7	8.8 ± 0.2	9.6 ± 4	7.01 ± 1.41	8.4 ± 1	7.65 ±0.25	7.4 ± 0.6	>5*	>5
D mg/l	3.3 ± 0.9	1.51 ±0.19	3 ± 0.4	5 ± 3.8	2.71 ±0.91	4.27 ±0.53	2.6 ± 0.4	1.45 ± 0.05	<6-10*	<6-1
D mg/l	9.75 ±2.75	8 ± 0	6.75 ±1.75	6.65 ±1.65	5.65 ±0.65	8.2 ± 3.2	5.63 ±0.63	5.15±0.85	<10-15*	<10-1
Total organic carbon mg/l as C	18±3	21.5±0.5	25±1	24±1	24.03±0.98	27.85±1.85	29.55±1.55	28.95±4.05	-	-
mg/l	40±5	50.5±4.5	45.5±3.5	54.5±5.5	25.6±2.6	30.5±0.5	22±4	32.9±0.9	<43	40-8
$^{-2}$ mg/l	35.3±4.7	39±4	39.5±1.5	43±1	25.8±4.8	26.4±4.6	19.7±0.3	26±5	12.5-41.6	14-4
mg/l	92.5±2.5	84.5±14.5	91.5±2.5	106.5±6.5	69±2	70.5±5.5	52±2	75.95±2.05	32.5-70.2	32-7
mg/l	6.5±0.5	6±0	6±0	7±0	7.5±2.5	6.5±1.5	5.75±0.25	6.6±0.4	-	-
mg/l	0.04±0.02	0.03±0.01	0.04±0.02	0.04±0.02	0.13±0.06	0.06±0.01	0.04±0.00	0.04±0.01	0.085-0.5	0.08 0.5

a mg/l	0.22±0.19	2.05±0.75	0.34±0.09	0.54±0.36	2.6±0.3	2.51±0.19	4.8±2.1	2.1±0.9	<18	0.6-
$^-$ mg/l as NO_2^-	ND	ND	ND	ND	ND	0.06±0.05	ND	ND	0.06-0.4	-
$^-$ mg/l as NO_3^-	0.32±0.28	ND	0.18±0.17	2.16±2.15	ND	0.61±0.60	ND	ND	-	0.06-
$^{-3}$ mg/l as PO_4^{-3}	0.04±0.03	ND	ND	ND	ND	ND	ND	ND	-	-
$^+$ mg/l as NH_3^+	ND	0.25±0.25	ND	ND	0.51±0.5	0.06±0.05	ND	ND	-	-
mg/l	ND	ND	0.0008±0.0003	ND	ND	ND	ND	ND	-	-
mg/l	ND	ND	0.0043±0.00017	ND	ND	ND	ND	ND	-	-

SD,Standard deviation,-,No guideline available, Cond., conductivity, P, partial alkalinity , M , total alkalinity, Ca H., calcium hardness, MgH., Magnesium hardness.ND, not detected ,The trace element values of As , Cr, Cu, Ni ,Cd, Pb, Co and Hg were not detected at both electric power plants,*, according to law 48/1982.

Table (2) The variation of physicochemical parameters of Filtration water of Shoubra El- Khiema and Damietta electric power plants at different seasons (Autumn 2011- Winter 2012):

Seasons	Autumn		Winter		Spring		Summer		Stations Limits	
Plants / ameters	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Dami
	7.6	7.43	7.59	6.84	7.6	7.6	7.45	6.8	7.4-8.3	7.4-8
al Alkalinity mg/Las $CaCO_3$ **M**	0	0	0	0	0	0	0	0	-	-
tial alkalinity **P**	95	135	105	125	115	120	105	120	<150	112-
rdness mg/L as $CaCO_3$ **Total H**	120	132	132	135	115	122	105	120	84-140	<17
Ca H.	75	82	77	77	65	75	66	75	<95	44-9
Mg H.	45	50	55	58	50	47	39	45	<75	21-7
al dissolved solid mg/L	267	283	275	298	250	245	243	283	125-300	135 29
al suspended solid mg/L	1.2	3	2.7	2.3	3.6	2.5	2.6	1	-	4-7
bidity NTU	0.4	1	0.9	1.2	1.2	1.1	0.7	0.8	<1	0.5

µs/cm	425	446	436	474	394	379	380	446	190 417	190-
mg/l	5.5	8.4	3.8	8.6	5.66	7	6.4	6.7	-	-
D mg/l	0.7	0.9	2.2	4	1.87	1.86	0.7	0.15	-	-
D mg/l	1.5	2	3	4.8	4.8	4.14	1	2	-	-
al organic carbon mg/l as C	27.5	16	20	18.6	20.46	19.78	21.28	21.79	-	-
mg/l	45	55	55	55	33	31	26	36.6	<50	40-8
$^{-2}$ mg/l	77	45	76.5	56	40	42	34	41	<50	14.4
$^-$ mg/l	94.5	99	89	100	71.7	65	50	73.9	-	32-7
mg/l	8	6	6	7	5.6	5	5.5	7	-	-
$^+$ mg/l	ND	0.04	0.04	0.02	0.04	0.04	0.03	0.03	-	0.085
ca mg/l	0.03	2.58	0.19	0.39	1.9	2.2	6.6	2.9	<13	0.9-
$_2^-$ mg/l as No_2^-	ND	ND	ND	ND	ND	ND	ND	ND	-	-
$_3^-$ mg/l as No_3^-	0.003	ND	ND	ND	ND	ND	ND	ND	-	0.06-
$_4^{-3}$ mg/l as PO_4^{-3}	0.003	ND	ND	ND	ND	ND	ND	ND	-	-
$_3^+$ mg/l as NH_3^+	ND	ND	ND	ND	0.2	ND	ND	ND	-	-
mg/l	ND	ND	0.023	ND	ND	ND	ND	ND	-	-
mg/l	ND	ND	0.0226	ND	ND	ND	ND	ND	-	-
mg/l	ND	ND	0.0106	ND	ND	ND	ND	ND	-	-

-, No guideline available, Cond., conductivity, P , partial alkalinity , M , total alkalinity, Ca H., calcium hardness, MgH., Magnesium hardness.

ND, not detected ,The trace element values of As , Cr, Cu, Cd, Co and Hg were not detected at both electric power plants.

Table (3)The variation of bacteriological parameters of Inlet River Nile water at Shoubra El- Khiema and Damietta electric power plants at different seasons (Autumn 2010-Winter 2012):

Seasons	Autumn		Winter		Spring		Summer	
Plants	Shoubra El- Khiema	Damietta	Shoubra El- Khiema	Damietta	Shoubra El- Khiema	Damietta	Shoubra El- Khiema	Damietta
Parameters	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
HPC at 22°C (CFU/ml ×10³)	0.7±0.157	5.3±2.108	1.7±1.417	2.5±1.530	2.4±1.595	20.3±1.961	1.4±0.185	3.0±1.836
HPC at 37°C (CFU/ml×10³)	0.46±0.160	2.1±0.133	1.2±0.917	1.36±0.570	3.5±0.490	87±78.250	2±0.760	5.1±4.426
TC (MPN/100ml×10³)	16±8.050	3±1.300	4.3±3.630	8.1±1.100	58±34.000*	15.1±10.961	143.5± 136.500*	15.5±0.850
FC (MPN/100ml×10³)	2.6±2.315	0.13±0.037	1.3±1.085	0.3±0.130	0.34±0.339	1.1±1.089	22±21.499	8±7.999
FS (MPN/100ml×10³)	0.165±0.164	0.096±0.083	0.065±0.045	0.23±0.153	0.245±0.244	0.087±0.082	3.6±3.365	0.66±0.640
Pseudomonas sp. (MPN/100ml×10³)	0.085±0.084	0.001± 0.0006	0.145±0.025	0.012± 0.00785	0.119±0.051	0.132±0.083	0.2±0.030	7.6±7.599

SD, Standard deviation×10³, -, No guideline available,*Increased the limits of <25000 according to law 48/1982.

 Egyptian Law for protection of the River Nile and water ways from pollution.

Table (4) The variation of physicochemical parameters of Filtration water of Shoubra

El- Khiema and Damietta electric power plants at different seasons (Autumn 2011-Winter 2012):

Seasons	Autumn		Winter		Spring		Summer	
Parameters \ Plants	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Damietta	Shoubra El-Khiema	Damietta
HPC at 22°C (CFU/ml)	18	90	117	0	32	620	3	400
HPC at 37°C (FU/ml)	0	10	5	5	2	460	1	3000
TC (MPN/100ml)	12	>23	16.1	1.1	3.6	3.6	5.1	>23
FC (MPN/100ml)	<1.1	<1.1	<1.1	1.1	<1.1	<1.1	<1.1	<1.1
FS (MPN/100ml)	2.2	12	<1.1	<1.1	<1.1	1.1	<1.1	1.1
Pseudomonas sp. (MPN/100ml)	2.2	<1.1	3.6	<1.1	<1.1	6.9	<1.1	<1.1

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الملخص العربي

دراسة على التغيير النوعى فى خواص مياه النيل والمياه المعالجة لمحطات توليد الكهرباء بمكانين مختلفين على نهر النيل.

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يهتم البحث بدراسة التغيير الموسمي للخواص الفيزيائية والكيميائية والبكتريولوجية بين مياه النيل الداخلة والمياه المرشحة لمحطتي توليد الكهرباء شبرا الخيمة (SH)، ودمياط (D). تراوحت قيم الكربون العضوي الكلي (TOC) بين أعلى قيمة وهي 29,55 — 18، وأقل قيمة وهي 28,95 — 21 ملجرام/ لتر في (SH)، و(D) لمياه النيل على الترتيب. في المياه المرشحة تراوحت قيم الـ (TOC) بين 27,50 — 20، و21,79 - 16 ملجرام/ لتر في (SH)، و(D) على الترتيب. بلغ متوسط قيم التوصيل الكهربي أعلى من القيمة المسموح بها لمياه النيل في محطة (D) وهي 417 ملجرام/ لتر، ولكنها لازالت في القيم المسموح بها للمياه المرشحة للمحطتين. تراوحت قيم متوسط الكبريتات لمياه النيل بين 39,50 ,43، و7,19 — 26 ملجرام/ لتر في (SH)، و(D) على الترتيب، ولكنها زادت في المياه المرشحة لتصل إلى 77 — 56، و34 — 41 ملجرام/ لتر في (SH)، و(D) على الترتيب، وهي زادت عن القيم المسموح بها للمياه المرشحة للمحطتين. التحليل البكتريولوجي سجل أعلى قيمة لـ .TC, FC, FS, *Pseudomonas* sp خلال الصيف لمياه النيل الداخلة للمحطتين، وقد انخفضت في المياه المرشحة للمحطتين.