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# Comparative study on two different waste-water treatment plants in El-Menofeyia Province, Egypt

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## ABSTRACT

This study was carried out at two different waste-water treatment plants in Quessna activated-sludge and Berkt El-Sabee trickling filters during a period extending between Dec. 2015 and Nov. 2016. Bacterial, protozoan and physico-chemical parameters were investigated monthly at these two plants to elucidate their performance efficiencies in treating and enhancing the waste-water. It was obviously that protozoa are represented by three main phyla (*Sarcodina, Mastigophorea* and *Ciliophora*) and the ciliated protozoa prevail the other two phyla. The diversity of the most common protozoan genera was more or less similar where Quessna WWTP has 25 genera (two sarcodines, four flagellates and 19 ciliates), while Berkt El-Sabee plant has 27 ones (three sarcodines, three flagellates and 21ciliated genera). On the other hand, the total protozoan numerical density was higher at Quessna as compared with that of Berkt El-Sabee (30247 organism/L and 25975/L, respectively). The total protozoa , Ciliophora and Mastiogophorea were proved to be significantly influenced to varying levels with Coliform bacteria and certain physico-chemical parameters. From the technological point of view, it was proved that the performing efficiency of the activated-sludge in Quessna WWTP is much better than that of Berkt El-Sabee. Accordingly, it could be possible to recommend the replacing of the trickling filters by the activated sludges to obtain more better wastewater treatment.

**Key words :** Activated sludge, bacteria, performance, protozoa and trickling filters.

## INTRODUCTION

Aquatic ecosystem occupies about 70% of the globe and all the living organisms need water for their survival and growth (Patil *et al*., 2012 ; Reda, 2016). Accordingly, it is very crucial to check up water at regular intervals to avoid water borne diseases (Pauli *et al*., 2001 ; Simpi *et al*., 2011). Wastewater is a mixture of domestic, industrial, agricultural and rainwater. The development of wastewater treatment was driven by the need to recycle, retrieve and reduce the environmental contaminations brought about by the uncontrolled discharge of polluted effluents such as organic matter, nitrogenous, phosphorus compounds and pathogens into rivers and streams (Orrun *et al*., 2014). Biological wastewater treatment includes mainly two methods; trickling filters and the suspended growth reactors using the activated sludge (Curds and Hawk, 1975).

Protozoa are ubiquitous microorganisms, with small size, high reproduction rates, delicate external membranes and close contact with the surrounding environments. Hence protists may react more quickly to environmental change than most of other eukaryotic organisms and thus serve as bioindicators of water quality (Xu *et al*., 2009; Gomiero *et al*., 2013 ; Gong *et al*., 2005).

Protozooplankton is a key element in the food chain and according to Irigoien *et al*. (2005), protozoa can consume up to 100% of daily phytoplankton production. Moreover, they participate in the carbon cycle and are fundamental part of the microbial loop (Azam *et al*., 1983). This term derives from the fact that these organisms are situated in one trophic level, allowing them to transfer energy (carbon and other nutrients) acquired from lower trophic levels, through the ingestion of organisms such as algae and bacteria, moving to higher trophic levels as they are ingested by other organisms (Xu *et al*., 2008; Polat and Koray, 2007 ; Medeiros, 2013). Protozoan grazing affect the abundance of bacteria in different aquatic ecosystems (Fried and Lemmer, 2003; Akpor *et al*., 2007).

The wastewater treatment systems can be characterized as an artificial ecosystem operating under severe conditions in which the key organisms are bacteria and protozoa (Papadimitriou *et al*., 2010). The presence of such bacterial populations allows the development of a microfauna consisting mainly of predator organisms such as protozoa and certain metazoan animals as rotifers, crustacean and insect larvae (Ginoris *et al*., 2007). It is generally accepted that protozoan grazing removes dispersed bacteria resulting in higher transparency (clarification) and lowering suspended organic loads in the output of the treated wastes (Pauli and Pauli, 2014).

Due to the variations in the feeding habits and phenotypic traits, different types of protozoa may have various functions in the wastewater treatment systems and exhibited different relations with environmental conditions (Martin-Cereceda *et al*., 1996 ; Hu *et al*., 2012). It was found that protozoan predation may exert pressure upon bacterial populations as they feed on pathogenic and fecal bacteria, thereby contributing to their removal efficiency at 95% (Bitton; 2002 ; Tyagi *et al*.,2008).

## MATERIALS AND METHODS

This study was carried out at two different wastewater treatment plants (WWTP); the activated sludges at Quessna and the trickling filters at Berkt El-Sabee. As the examined plants have different technology and various influent wastewater characters, different treatment efficiency was obtained. Monthly samples from these two plants were collected during the studying time. Water samples for Coliform bacteria were collected in 500 ml sterilized glass bottles containing 1 ml of 3% freshly prepared sodium thiosulphate in order to neutralize the residual chlorine and their numerical densities were detected by using the Most Probable Number (APHA, 1995). Another water sample was picked up using one liter glass bottle for both physico-chemical and zooplankton analysis. The collected water samples were transported as quickly as possible to our laboratories to be examined within six hours for the various bacterial populations and throughout 24 hours for rest of the parameters. Microscopical examination and identification of zooplankton with particular reference to protozoa was performed according to Patterson and Hedley (1996).

## RESULTS

### The Physico-chemical values at Quessna and Berkt El-Sabee WWTPs:

At Quessna water plant, the seasonal values of water temperature fluctuated from 17.8 °C in Winter to 28.9 °C in Summer. $P^H$ changed from 7.2 to 7.5 and from 7.2-7.7 in raw and treated water, respectively. The electrical conductivity in raw water stage varied between a minimum of 1181.7 µmhos/cm to a maximum of 1486.7 µmhos/cm, while in treated water stage ranged between 1077.7 and 1132.7 µmhos/cm. The COD content in raw water stage ranged between the minimum value of 122.3 mg/L and the maximum of 456.3 mg/L, while in treated water stage ranged between 47.7 and 112 mg/L. Simultaneously, BOD level in raw water ranged between a minimum of 73.4 mg/L and a maximum of 273.8 mg/L, while in treated water its value oscillated between 17.2 and 67.2 mg/L. The TSS content in raw water varied from 96.3 mg/L minimally to 168.8 mg/L maximally, while in treated water it moved from 37.7 to 66.7 mg/L. The total nitrogen concentration in raw water achieved a minimum value of 33.7 mg/L and a maximum of 39.3 mg/L, while in treated water its content ranged between 9.5 and 17 mg/L. Alternatively, the total phosphate level in raw water changed between a minimum value of 5.8 mg/L and a maximum of 8.8 mg/L, while in treated water its concentration ranged from 4.5 to 7.5 mg/L (Fig. 1). On the other hand, the seasonal values of the Physico-chemical parameters at Berkt El Sabee WWTP could be summarized as follows; water temperature fluctuated from 17.8 °C in Winter to 28.9 °C in Summer. $P^H$ changed from 7.1 to 7.6 and 7.4 – 8.0 in raw and treated water respectively. The minimum electrical conductivity value of 1210.3 µmhos/cm belonging to raw water moved to its maximum value of 1540.3 µmhos/cm, while in treated water it ranged between 1253 and 1355.7 µmhos/cm. The COD value in raw water ranged between 174 mg/L minimally and 373 mg/L maximally, while in treated water it ranged between 138 to 268 mg/L. The BOD content in raw water varied between a minimum of 176.9 mg/L and a maximum of 223.9 mg/L, while in treated water it oscillated between 71.1 and 160.8 mg/L. The TSS content of raw water varied between 145 mg/L and 148 mg/L, while in treated water its content ranged between 58.3 and 142.3 mg/L. The Total Nitrogen level belonging to raw water changed between the minimum value of 43.4 mg/L and the maximum value of 53.4 mg/L, while in treated water its level moved from 42.6 to 51.8 mg/L. On the other hand, total Phosphate concentration in raw water achieved a minimum of 7.1 mg/L and a maximum of 9.4 mg/L, while in treated water its value ranged between 6.0 and 8.4 mg/L (Fig. 2 ).

**Protozoan communities at Quessna and Berkt El-Sabee WWTPs:**

Water samples of the different locations belonging to these plants exhibited the presence of two major types of plankton. The most abundant group belongs to Kingdom Protista followed by some rotifers. Kingdom Protista was illustrated by three main protozoan phyla; *Sarcodina, Mastigophora* and *Ciliophora.* The latter prevails the other two phyla during different months of the present study at Quessna and Berkt El-Sabee wastewater treatment plants. Sarcodines are represented by two genera at the former plant and by three ones at the latter, mastigophores are illustrated by four and three genera at these two water plants respectively, while Ciliates are exhibited by 19 and 21 genera at the former and the latter plants respectively. These ciliates include three types; crawling, swimming and sessile organisms as could be seen in Table (1). Total cumulative numerical protozoan density at Quessna and Berkt El-Sabee WWTPs are 30247 $x10^3$/L and 25975 $x10^3$ organisms/L, respectively. The maximal numerical density of total protozoa, during the present investigation exhibited 10194 and 7575 $x10^3$ organisms/L during Summer at Quessna and Berkt El Sabee respectively. The maximal numerical densities of the ciliated protozoan organisms were observed during Summer as well at Quessna stages; raw sewage, mixed liquor and treated water (3680, 4127 and 393 $x10^3$ organisms/L respectively). Simultaneously, the maximal densities of ciliophoran organisms were detected during Summer also at Berkt El Sabee stages; raw sewage, trickling filter and treated water (3963, 1498 and 1111 $x10^3$ organisms/L, respectively).

**The numerical densities of Bacteria at Quessna and Berkt El Sabee WWTPs:**

The highest numbers for total coliform belonging to raw sewage were observed on July and August $1.2\times 10^{10}$ and $1.1\times 10^{10}$ /100ml respectively, While the lowest numbers were detected on September ($4.6\times10^6$/100ml). Regarding Fecal coliform and *E. coli*, it was found that bacterial numbers were $2.3 \times 10^9$ and $2.1 \times 10^8$ /100ml on November respectively. On the other hand, treated water samples proved that total coliform varied from $2\times 10^3$ to $5\times 10^9$ on September and July respectively, While those of Fecal coliform were obtained on March and November ($4 \times 10^3$ and $1 \times 10^9$/ 100 ml, respectively). Finally, *E.*

*coli* was obtained on April and August (1.1 × $10^3$ and 1.5 × $10^7$ /100 ml, respectively). On the contrary, in raw sewage water samples at Berkt El-Sabee WWTP, the highest numbers for total coliform achieved 11× $10^{10}$, 11× $10^{10}$ and 10× $10^{10}$ /100ml during January, June and July respectively, While the lowest number was illustrated on March ( 9×$10^4$ /100ml). Fecal coliform and *E. coli* were observed maximally on January 1.5 × $10^{10}$ and 0.93 × $10^{10}$ /100ml, respectively. In treated water samples, total coliform ranged between 4 × $10^3$ and 3.7 × $10^8$ /100ml on January and April respectively, While those of Fecal coliform were observed on March and October (1 × $10^2$ and 1.1 × $10^8$ /100 ml, respectively). Finally, for *E. coli*, minimal and maximal densities were illustrated on March and June (1 × $10^2$ and 3.7 × $10^8$ /100 ml, respectively).

It appears that the highest protozoan densities were obtained on May (4080 $10^3$/L) at Berkt El-Sabee, while those of Quessna water plant achieved their maximal numerical densities (3790 $10^3$/L) on July. The removal efficiency percentages of protozoa in the trickling filter at Berkt El-Sabee are higher than those at Quessna activated sludge from October to May, while the opposite behaviour was obtained during a period extending from June to September at the latter water plant. The highest removal percentages were obtained on July at Quessna (95.8%) and on February at the other treatment plant (94.5%) as could be seen in Table (2). Table (3) illustrated the major technological parameters (BOD, COD, TSS, Total nitrogen and Total phosphates) controlling the performance and the efficiency of the wastewater treatment plants. A comparison between the previously mentioned parameters at these two wastewater treatment plants could be observed in Figures 3 and 4. It was proved that efficiency of Quessna WWTP is better than that of Berkt El-Sabee.

## DISCUSSION

Wastewater treatment is performed by two different methods; the first comprises the activation of the sludge where incorporated oxygen permits bacterial multiplication leading to oxidation of the polluted material, while the second involves trickling the used water over a deep bed of small pebbles. The rocky medium is colonized by bacteria which perform finally the breakdown of the pollutants.

Temperature is a vital parameter in the biological wastewater treatment processes. Sudden changes in temperature will affect the microbial activity which might influence processes like flocculation due to changed surface properties of the microbial cells (Manassra, 2006). Water temperature of the present study was nearly the same at all three collection points in both plants ( ranged between 17.8 and 30.5 $^oC$) . However, Turbidity was higher during Summer than the other seasons which is parallel to data of Aull (2005) and it was positively correlated with BOD ($r = 0.706$, $P< 0.05$) and COD ($r = 0.728$, $P< 0.01$). The present $p^H$ values (7.1 - 8.1) is lower on Summer as compared with those of other seasons like those of Birhanu (2007). The present data are concomitant with those of Elewa and Authman (1991) and Abd El-Satar (1994) during Winter. Present values have significant correlations with TDS of raw water at both plants ($r = 0.633$, $P < 0.05$) and only of treated water at Quessna ($r = 0.643$, $P <0.05$) which agree with Patil et al, (2012) and Galal *et al*. (2014). Simultaneously, conductivity proved a significant correlation with temperature in raw water of both plants ($r= -0.794$, $p<0.01$) exactly as that of NHDES (2008).

TDS and TSS are very important parameters influenced 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 change in TDS could damage the aquatic life (Gaikwad; 2003 and Samrat et al., 2012). TDS achieved the maximal value in raw and treated water on Autumn and Summer respectively at Quessna WWTP, while at Berket El Sabee the maximal values obtained during Spring and

Autumn at raw and treated water respectively. This agree with ELewa and Authman (1991). On the other hand, TSS of treated water at Quessna and Berket el Sabee were significantly correlated with oil and grease ($r=0.846$, $p<0.05$) ($r = 0.980, P<0.01$) respectively which is parallel to those of (EPA, 1975) . 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 ($r= 0.897$, $p<0.01$) and treated water ($r=0.0924$, $p<0.05$) ($r=0.969$, $p<0.01$) of Quessna and Beket el Sabee WWTPs indicates that the general balance of the composition of domestic and industrial sewage in the influent remained steady. It was found also that total phosphate were influenced by turbidity and TSS (Jones *et al.*, 2011). This is parallel with the present data where there is a significant correlation between total phosphate and turbidity ($r = 0.649$ , $p<0.05$). Also, the present study showed a significant correlation between total phosphate and total nitrogen ($r=-0.707$, $p<0.01$). It was proved that heavy metals levels are lower than the permissible limits apart from Cyanide which recorded 0.2 and 0.05 mg /L in raw water of Quessna and Berket el Sabee WWTPs on Autumn respectively. This could be interpreted as a result of the various industrial activities in the surrounding location.

The present maximal numerical density of total protozoa exhibited 10194 and 7575 organism $x10^3$/L during Summer at Quessna and Berkt El Sabee respectively. However, the maximal numerical densities of ciliates were obtained during Summer at Quessna stages; raw sewage, mixed liquor and treated water (3680, 4127 and 393 organism $x10^3$/L respectively) and Berkt El-Sabee stages; raw sewage, trickling filter and treated water (3963, 1498 and 1111 organisms x $10^3$/L respectively). Protozoa associated with sewage treatment 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 Phytomastigophorea where 67 species of ciliates were detected in activated sludges, where those of percolating filters achieved 53 ciliophoran species only. Also, Curds (1975) proved the presence of a succession of species through the depth. It is worthy to mention that the abundance of protozoa in the present study are in the same order; Ciliates (19 and 21 genera), phytomastigophoreans (4 and 3) followed by Sarcodines (2 and 3) at Quessna and Berkt El-Sabee WWTPs respectively.

It was proved that there is a correlation between the composition of the protozoan community in a wastewater treatment plant and the quality of the produced effluent (Curds and Cockburn; 1970 $_{a\,\&b}$). They found also that the effluent of high quality is characterized by low BOD values, low suspended solids, a wide variety and high numerical densities of ciliated protozoan organisms. After a few days of wastewater treatment BOD declined from 53-70 mg/L to 7-24mg/L and the suspended solids dropped from 86-118 mg/L to 26-34 mg/L. The improved BOD and TSS could be referred to a decline in the viable bacterial numbers from 106 -160 $10^6$/ml to 1-9 $10^6$/ml (Curds *et al*., 1968). On the other hand, data of the present study indicated that the BOD of the effluent treated water varied between 17.2 minimally and 67.2 mg/l maximally, those of TSS decreased to 37.7 and 66.7 mg/l, those of total nitrogen oscillates between 9.5 and 17.0 mg/l, while those of total phosphates ranged from 4.5 to 7.5 mg/l.

Protozoan populations of the two plants of the present study show poor diversity which might be attributed mainly to the added primary chlorine at the beginning of water treatment where diversity of various organisms in water treatment plants depending on the influent composition as well as the operational parameters of the wastewater treatment unit (Papadimitriou *et al.*, 2004). In the present study, Protozoa persisted all over the year and hence they contributed the highest percentage of the total numerical density of the examined zooplankton recorded in water samples. The highest occurrence frequencies of the dominant protozoan genera are *Vorticella* , *Cyclidium* and *Arcella* at Quessna plant, while those at Berket El Sabee are *Vorticella, Aspidisca, Arcella* and *Dinoflagellate*.

In the present study, total and fecal coliform beside *E. coli* were detected in raw wastewater samples from both sewage treatment plants. Since wastewater from homes, hospitals and commercial buildings were collected in sewers and flow to sewage treatment plants, high fecal bacterial counts were expected in the raw sewage (Samie et al., 2009; Hendricks and Pool, 2012). Concerning the final effluent the maximal densities of total and fecal coliform with *E.coli* at Quessna WWTP were $5x10^9$, $1x10^9$ and $1.5 \times 10^7$ respectively and the minimum were $2x10^3$, $4x10^3$and $1.1x10^3$. In Berket El Sabee treated water samples the maximum level of total, fecal coliform and *E.coli* were $3.7x10^8$, $1.1x10^8$ and $3.7 \times 10^7$/l respectively and the minimum were $4x10^3$, $1x10^2$and $1x10^2$/l. The final numerical densities of coliforms could reach very high values, which could be harmful for the public health if these waters will be discharged at the environment in inadequate sites. So it is recommended Prior treatment, wastewater that is passed to a trickling filter must be pretreated firstly to remove solid and greasy materials, so as to prevent them from covering the thin layer of microorganisms present and to prevent the solid and greasy materials from killing them (Akpor *et al*., 2014).

Finally, it is necessary to mention that analyzing the major technological parameters proved that the efficiency of the wastewater treatment plant at Quessna is much better than that of Berkt El-Sabee plant and consequently, the latter plants should be replaced by the former type of treatment.

**Table (1)-: Protozoan Genera and their prevalence at Quessna AND Berkt El-Sabee Wastewater Treatment Plants.**

| Protozoan phyla | Protozoan genera at Quessna WWTP | Protozoan genera at Berkt El-Sabee WWTP |
|---|---|---|
| ***Sarcodina*** | *Amoeba (C)* *Arcella (C)* | *Arcella (C)* *Amoeba (C)*<br>*Cryptodiffligia (R)* |
| ***Mastigophora*** | *Hetronema (F)* *Euglena(C)*<br>*Peranema (F)* *Dinoflagellate (R)* | *Anthophysa (F)* *Dinoflagellate (C)*<br>*Peranema (R)* |
| ***Ciliophora*** | | |
| ***Crawling*** | *Aspidisca (C)* *Spirostomum (R)*<br>*Oxytricha (F)* *Phialina (R)*<br>*Euplotes (C)* | *Aspidisca (C)* *Rhabdostyle*<br>*Oxytricha (C)* *Euplotes (R)*<br>*Tachysoma (R)* *Phialina (R)*<br>*Discophyra (R)* |
| ***Swimming*** | *Cyclidium (C)* *Strombidium (R)*<br>*Litonotus (F)* *Prorodon (F)*<br>*Coleps (R)* *Chilodonella (C)*<br>*Spathidium (R)* *Paramecium (C)*<br>*Metpus (R)* *Colpidium (C)* | *Strombilidium (R)* *Paramecium (C)*<br>*Metpus (F)* *Cinetochilum (R)*<br>*Prorodon (R)* *Chilodonella (F)*<br>*Litonotus (F)* *Cyclidium (C)*<br>*Monodinium (R)* *Holotricha (R)*<br>*Colpidium (F)* |
| ***Sessile*** | *Epistylis (R)* *Vorticella (C)*<br>*Thuricola (R)* *Vaginicola (R)* | *Epistylis (R)* *Podophyra (C)*<br>*Vorticella (C)* |

C = Common genera
F = Frequent genera
R = Rare genera

**Table (2): Monthly efflue**

**nt and influent total protozoa beside their remaining percentages at Berkt El-Sabee and Quessna WWTPs in El-Menofeyia Province, Egypt.**

| Month | Total influ. Proz. | Total effl. Proz. | Total infl. Proz. | Total effl. Proz. |
|---|---|---|---|---|
| Dec 2015 | 1789 | 134 (7.4%) | 1790 | 592 (33.1%) |
| Jan 2016 | 2528 | 255 (10.1%) | 2280 | 285 (12.5%) |
| Feb | 2229 | 123 (5.5%) | 2876 | 486 (16.9%) |
| Mar | 1345 | 265 (19.7%) | 3336 | 591 (17.7%) |
| April | 1716 | 201 (11.7%) | 2126 | 408 (19.2%) |
| May | 4080 | 280 (6.9%) | 3355 | 750 (22.4%) |
| June | 2220 | 355 (16.0%) | 3062 | 305 (10.0%) |
| July | 2415 | 570 (23.6%) | 3790 | 160 (4.2%) |
| Aug | 2940 | 405 (13.8%) | 3342 | 285 (8.5%) |
| Sept | 2220 | 1170 (52.7%) | 1635 | 690 (42.2%) |
| Oct | 1367 | 104 (7.6%) | 1291 | 366 (28.4%) |
| Nov | 1126 | 126 (11.2%) | 1364 | 455 (33.4%) |

**Table (3) : Technological parameters and wastewater characteristics at the two examined wastewater treatment plants**

| | | Berkt El-Sabee | | | Quessna | | |
|---|---|---|---|---|---|---|---|
| **Season** | **Parameters** | **Influent** | **Effluent** | **Efficiency** | **Influent** | **Effluent** | **Efficiency** |
| **Winter** | **COD mg/l** | 122.33 | 56.00 | 54.22 % | 362.3 | 187.7 | 48.21 % |
| | **BOD mg/l** | 73.40 | 28.60 | 61.04 % | 217.4 | 112.6 | 48.21% |
| | **TSS mg/l** | 96.33 | 37.67 | 60.90 % | 145.7 | 58.3 | 59.95 |
| | **Total-N mg/l** | 38.17 | 13.20 | 65.41 % | 53.2 | 42.6 | 19.86 |
| | **Total-P mg/l** | 7.62 | 7.46 | 2.10 % | 9.4 | 8.2 | 12.77 |
| **Spring** | **COD mg/l** | 456.33 | 67.67 | 85.17% | 311.7 | 138.0 | 55.72% |
| | **BOD mg/l** | 273.80 | 40.60 | 85.17 | 187.0 | 82.8 | 55.72% |
| | **TSS mg/l** | 106.33 | 45.33 | 57.37 | 148.0 | 78.0 | 47.30% |
| | **Total-N mg/l** | 39.27 | 10.77 | 72.58 | 53.4 | 51.8 | 3.00% |
| | **Total-P mg/l** | 7.61 | 4.93 | 35.25 | 8.1 | 6.9 | 15.76% |
| **Summer** | **COD mg/l** | 269.00 | 112.00 | 58.36 | 373.0 | 268.0 | 28.15% |
| | **BOD mg/l** | 161.40 | 67.20 | 58.36 | 223.9 | 160.8 | 28.17% |
| | **TSS mg/l** | 136.00 | 53.33 | 60.78 | 146.7 | 95.3 | 35.00% |
| | **Total-N mg/l** | 33.73 | 9.50 | 71.84% | 48.2 | 44.9 | 6.92% |
| | **Total-P mg/l** | 8.79 | 5.98 | 32.03 | 7.1 | 6.0 | 15.27% |
| **Autumn** | **COD mg/l** | 158.00 | 47.67 | 69.83 | 174.0 | 145.0 | 16.67% |
| | **BOD mg/l** | 171.67 | 17.20 | 89.98 | 176.9 | 71.1 | 59.82% |
| | **TSS mg/l** | 168.00 | 66.67 | 60.32 | 145.0 | 142.3 | 1.48% |
| | **Total-N mg/l** | 30.60 | 17.03 | 44.34 | 43.4 | 43.1 | 0.70% |
| | **Total-P mg/l** | 5.78 | 4.51 | 21.91 | 8.7 | 8.4 | 2.66% |

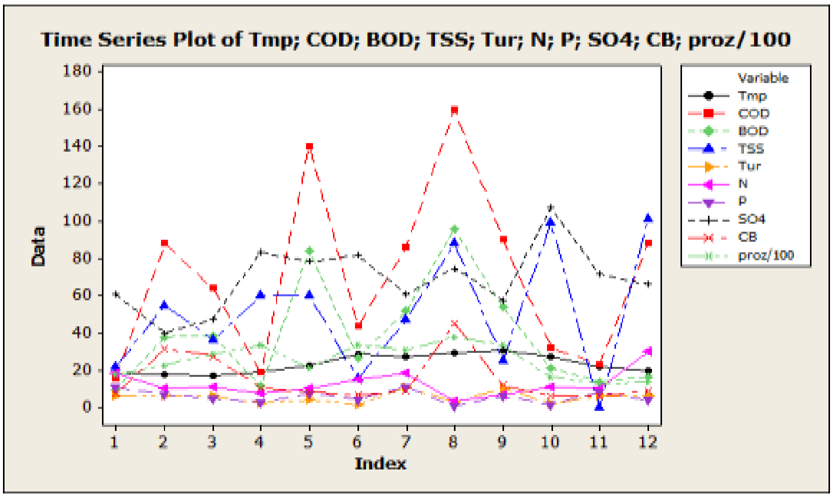


**Fig. (1). Main biotic and abiotic parameters at Quessna WWTP in El-Menofeyia Province, Egypt.**

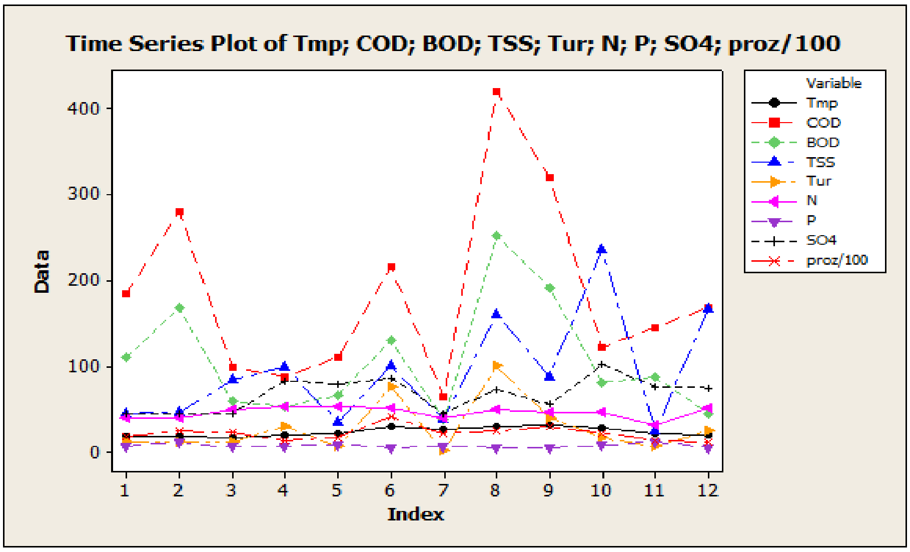


**Fig. (2). Main biotic and abiotic parameters at Berkt El-Sabee WWTP in El-Menofeyia Province, Egypt.**

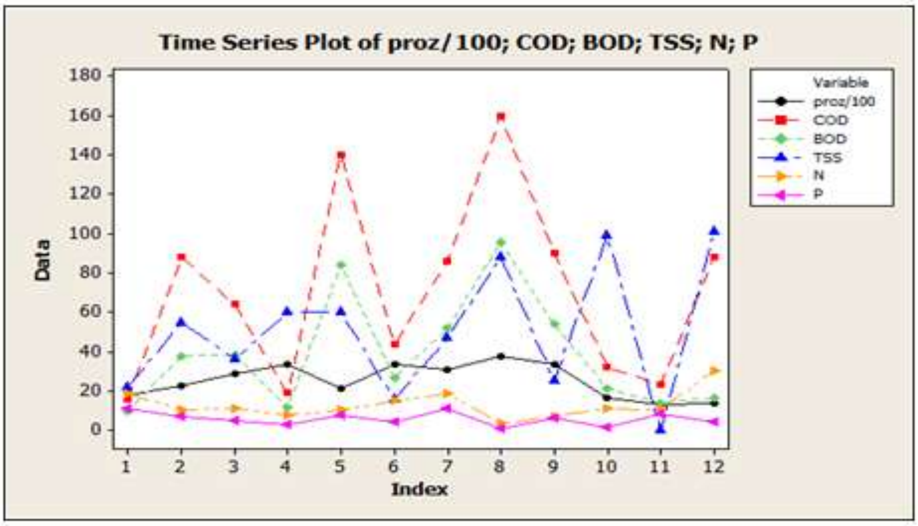


**Fig. (3). Technological parameters at Quessna WWTP in El-Menofeyia Province, Egypt.**

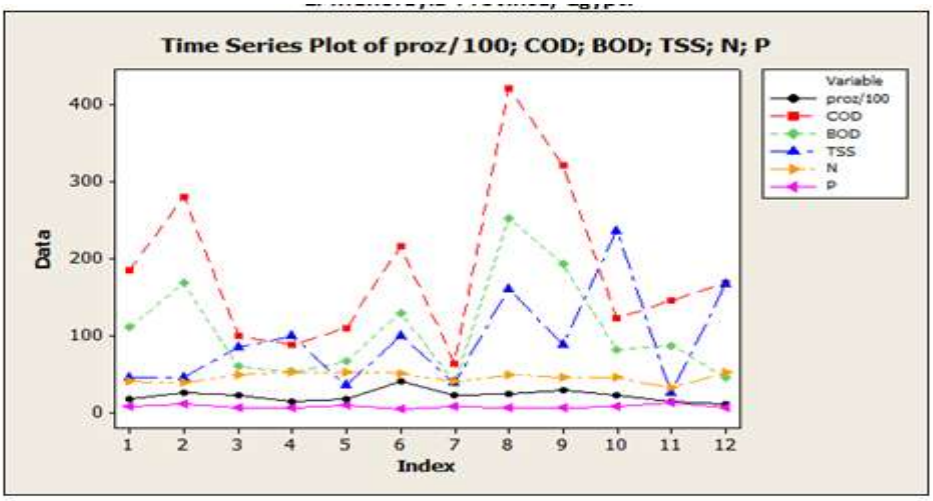


**Fig. Fig. (4). Technological parameters at Berkt El-Sabee WWTP in El-Menofeyia Province, Egypt.**

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# Comparative study on two different waste-water treatment plants in El-Menofeyia Province, Egypt

## دراسات مقارنة على محطتين مختلفتين لمعالجة مياه الصرف في محافظة المنوفية بمصر

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**المستخلص**

أجريت هذه الدراسة فى الفترة بين ديسمبر 2015 و نوفمبر 2016 بمحطتين لمعالجة مياه الصرف (قويسنا للحمأة النشطة وبركـة السبع للمرشحات الزلطية) بمحافظة المنوفية بمصر. ولقد درست فيهما التواجد والكثافة العددية لبعض الكائنات الحية كالاوليات وحيدة الخلية وبعض العوامل الفيزيقية والكيميائية شهرياً خلال العام ، وذلك لتحديد الكفاءة لكل من هاتين المحطتين المختلفتين لمعالجة مياه الصرف غير النظيفة. ولقد أظهرت نتائج هذا البحث أن محطة قويسنا للحمأة النشطة هى الأكثر كفاءة فى معالجة ذلك النوع من المياه عن مثيلتها ببركة السبع باستخدام المرشحات الزلطية. ولئلك يمكن التوصية بإحلال المرشحات الزلطية بمحطات الحمأة النشطة للحصول على جودة أعلى لمياه الصرف المعالجة.