International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

Wastewater Tertiary Treatment Using of Oxidation Ponds

A. M. A. Elhdad[*1], S. M. Hassan[2], M. Kaid[3]

[1]Basic science Department, Madina Higher Institute of Engineering and Technology, Giza, Egypt
[2]Chemical Engineering Department, Borg El Arab Higher Institute Engineering and Technology, Alexandria, Egypt
[3]Chemistry Department, Faculty of Science, Damanhur University, Egypt

*Corresponding Author: e-mail: adelelhdad48[at]gmail.com, Tel: 002- 02- 37530968, 002-01002825005

Abstract: ***The decrease in Egypt's share of the Nile River in lasted years led to an increase in the interest in wastewater treatment in Egypt for re-use in various purposes as compensation for the waters of the Nile. One of these methods was oxidation ponds that followed extended aeration in wastewater treatment plant in Rshid village, El-Behera governorate, Egypt. The results showed that BOD, COD and TSS were reduced in first and third cases after passing through oxidation pond, while they were increased in the second case then decreased after filtration. Also the data showed that the most percentage removal of BOD, COD and TSS was 67.4%, 61.9% and 54.5% respectively and were recorded in second case. The COD/BOD ratio for influent of wastewater under consideration was in the range of 1.6-1.94 indicating that the organic matter in influent wastewater has low biodegradability or its decomposition is low, and also this wastewater not contain volatile fatty acids. The results of the treatment also showed that the wastewater under consideration could be used in many agricultural varieties. The values of COD, BOD, TSS and DO of effluent wastewater for the three cases under consideration are found to be less than the recommended level in wastewater as listed by World Health Organization and within limits according to law 48/82.***

Keywords: Wastewater, Oxidation ponds, Tertiary treatment, COD/BOD, Rashid, Egypt

1. Introduction

Domestic and industrial wastewater includes nearly about 99% liquid waste and only 1% solid waste. These wastes consist mostly of soaps, black water, grey water, toilet paper and detergents. Liquid waste includes from showers, baths, toilet, kitchens and sinks draining into sewers. In many areas, domestic wastewater also includes liquid waste from commercial places [1]. Wastewater is known to be full of microbial and chemical contaminants. The disposal of these wastewater in the environment or its use for agricultural purposes will inevitably lead to pollution of water resources, soil and agricultural products, which will endanger human health. Therefore Wastewater must be treated to remove of the largest quantity of solid materials suspended before liquid waste is discharged into the environment [1], and also to minimize the adverse environmental effects resulting from it and to raise the level of health [2]. Wastewater treatment is divided into three stages of treatment namely physical, chemical and biological treatment. The treatment plant usually include two types of bacteria used to treat sewage or wastewater, they are aerobic and anaerobic bacteria. Treatment of sewage or wastewater is possible by using various processes like oxidation ponds, trickling filter [1]. Oxidation ponds are also called stabilization ponds or lagoons and serve mostly small rural areas, where land is readily available at relatively low cost [3]. It is considered an easy and simple treatment for municipal waste that does not require much equipment, also it solve many of the problems related to the elimination of sludge [4]. Stabilization ponds able to reduce TSS, COD, and BOD with efficiencies reasonably [5]. In developing countries, Wastewater Stabilization Ponds (WSP) or lagoons are most used yet there are about 39 in UK, 1100 in Germany, and 2500 pond systems in France [6]. The treatment system using waste stabilization ponds is a biological treatment system based mainly on environmental conditions such as wind speed, light intensity and temperature, which vary according to the location [3]. This type of biological treatment is characterized by ease of operation, less equipment maintenance, better sludge thickening, and low energy required [3]. The performance and efficiency of stabilization ponds in Polar Regions were studied during four summer seasons and it was found that these ponds were able to reduce BOD5 and TSS with efficiency more than 80% [7]. The study on the assessment of the use of ponds stabilization in wastewater treatment in rural areas showed that the average efficiencies of stabilization ponds in reducing COD, BOD, and SS were 75.1-87.3%, 75.2-94.3%, and 90.2-97.6%, respectively, and noticed this system had features such as suitable performance, low maintenance costs and easy utilization [7]. A study was also conducted on the performance of the stabilization ponds in the treatment of drainage water from agricultural lands and showed that their efficiency in reducing COD, TN, and TP was higher than 57% [4]. The results of studying the combined stabilization ponds including one aerobic pond, one facultative pond, and anaerobic pond that contained sand filters showed large removal of COD, TSS, and BOD [3]. Study was carried out about Performance efficiency of combined stabilization ponds including two facultative ponds, one anaerobic pond, and two ponds containing aquatic plants in treating raw municipal wastewater. The results of the study showed that the highest efficiency in the decrease of COD and TSS were recorded for the pond containing aquatic plants which were removed 78% of COD and 90% of TSS [8]. In facultative ponds the most of the needed oxygen is supplied through the photosynthetic activity of the algae, while small quantity of required oxygen can be obtained through contact between the surface of wastewater and the air [9]. The effects of the organic load on the performance and maintenance of the aerobic conditions in aerobic ponds were studied and the results showed that the stabilization ponds were able to reduce SS and BOD with efficiencies of about 95% and 90% respectively [10]. Maturation ponds can be used to get rid of most pathogens such as viruses, some species of bacteria, and fungi. Maturation ponds are located after a facultative pond, which may be a primary or secondary pond [11]. The pond system can be used alone but usually they are used in combination with each other [12]. Biochemical oxygen demand (BOD) and suspended solid (SS) are relatively higher in the effluent quality from suspended growth systems than that from fixed- film system [13]. BOD can be eliminated through the biological process. It is an aerobic process that occurs in aeration tank, and result in aeration for water by oxygen through creating good conditions for the rapid bacterial growth [1].

2. Experimental

2.1 Studied area

This paper is concerned with study the effluent waste water treatment plant and the effluent of oxidation pond in Rshid village, El-Behera-governorate, Egypt. El-Behera governorate is a costal governorate in Egypt, it is located in northern part of the country in the Nile Delta, and its capital is Damanhur. Western Nile Delta region is located between 29^{o} 30\\ to 31^{0} 00 \ \ E and 30 ^{0} 00 \ \ to 31 ^{0} 00 \ \ N. It occupies the area between Cairo at equator and Alexandria, west of Rosetta branch, and extends westward to the desert area from the west of Wadi el-Natrun up to the eastern edge of the Qattara Depression. Topographic data is available from survey maps of scale 1:100,000 for most of Nile Delta area. The elevation of the area ranges from (0.000) mean sea level in the north to (150.00) above mean sea level in the south. The existing irrigation Networks in the study area consists of six main irrigation canals, namely the Rosetta branch, Rayah Behiri, Rayah Nasery, Nubaria canal, Mahmoudia canal and El Nasr canal. The climate of the study area can be classified as predominantly Mediterranean. The average temperature varies from 14 to 32^{o}C in months of July and August. The location of Western Nile Delta is shown in Figure1.

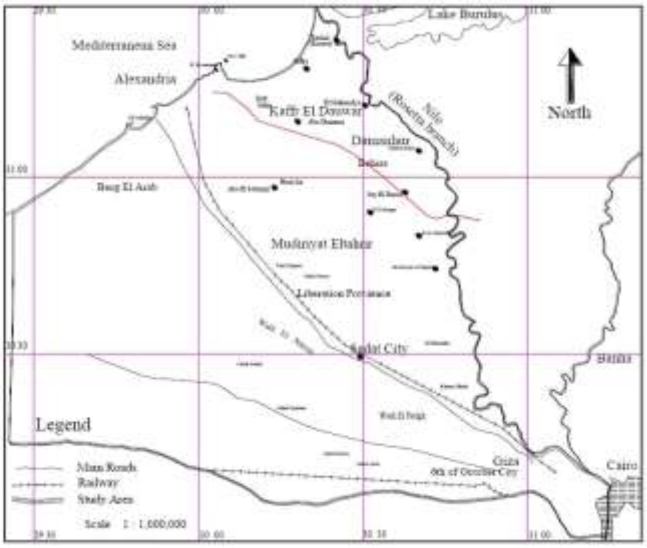


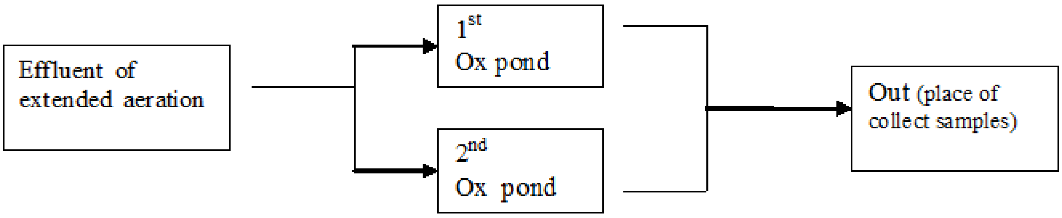
Figure 1: Domain of Western Nile Delta

El-Beheragovernorate enjoys an important strategically place in west of the Rosetta branch of the Nile. It is bounded by Mediterranean (north), by Alexandria Governorate (north western), by Matrouh Governorate (west), by Giza (south Western), by Menoufia (east) and by Kafr Al Sheikh governorate (north eastern); two main Roads runs through El-Beheragovernorate are Cairo-Alexandria desert Road and agricultural Road (Figure 2).

Fig. 2: the geographical location of El-Beheragovernorate

2.2 Description of the wastewater plant under study

Rshid plant of waste water treatment has capacity of 5500 m^{3}/day and operating by activated sludge (extended aeration).Where the effluent of the plant pass through two oxidation ponds, each one has capacity of 2725 m^{3}/day, depth 1.14m, and of retention time 3day (72 hour). The samples were mixed and composed sample from out of two oxidation Ponds as shown in the following shape:



2.3 Collection and analysis of water samples

Water samples were collected using poly ethylene bottles which were washed with tap water at the first and then were rinsed using double deionizes water. The water samples were collected from the effluent waste water treatment plant and the effluent of oxidation pond at Rashid, Beheira governorate, Egypt. The samples were analyzed for total chemical oxygen demand (COD), biochemical oxygen demand (BOD5), total suspended solids (TSS), dissolved oxygen (DO) using the standard methods by the American Public Health Association [14].

3. Results and Dissection

Tables 1, 2, and 3 shows the data of analysis for case I, II and III, respectively. Data were statistically analyzed and the results were recorded in form of minimum, maximum, mean and standard deviation. The percentage removal of BOD, COD, and TSS were computed and also recorded in tables 1, 2, and 3.

Table 1: Variation of COD, BOD, TSS and DO in influent (effluent of the plant) and effluent of oxidation pond for case I.

Date (2017)	Influent of oxidation pond (Effluent of plant) (Concentrations mg L^{-1})				Effluent of oxidation pond (Concentrations mg L^{-1})				Removal percentage %		
	COD	BOD	TSS	DO	COD	BOD	TSS	DO	COD	BOD	TSS
01/05	35	21	25	2.5	23	13	18	11	34.3	35	28
04/05	38	20	28	2.5	18	8	13	12	52.6	55.6	53.6
07/05	37	19	25	2	16	9	15	11	56.8	50.0	40.0
10/05	35	20	23	2	15	7	18	11	57.1	63.2	21.7
13/05	40	20	26	2	19	9	19	11	52.5	55.0	26.9
16/05	42	18	24	1	16	10	17	13	61.9	44.4	29.2
19/05	36	20	26	1.5	18	9	16	12	50.0	52.6	38.5
22/05	38	20	28	1.5	14	8	17	12	63.2	60.0	39.3
25/05	34	21	26	1.6	16	11	16	12	52.9	47.6	38.5
28/05	38	20	25	1.5	13	10	16	10	65.8	47.4	36.0
31/05	32	21	27	1.1	11	9	14	11	65.6	57.1	48.1
Max.	42	21	28	2.5	23	13	19	13			
Min.	32	18	23	1.00	11	7	13	18			
Mean ±SD	36.8 ±2.8	20 ±0.89	25.7±1.6	1.7±0.5	16.3 ±3.2	9.4 ±1.6	16.3 ±1.8	11.3 ±0.7			
Law 48/1982	80 mg L^{-1}	60 mg L^{-1}	50 mg L^{-1}	≥ 4 mg L^{-1}							
WHO	60 mg L^{-1}	30 mg L^{-1}	100 mg L^{-1}	≥4 mg L^{-1}							

WHO=World Health Organization, guideline values

Table 2: Variation of COD, BOD, TSS and DO in influent (effluent of the plant) and effluent of oxidation pond for case II.

Influent of oxidation pond (Effluent of plant) (Concentrations mg L^{-1})					Effluent of oxidation pond. (Concentrations mg L^{-1})				Effluent of oxidation pond (Concentrations mgL^{-1})after filtration			Removal after filtration		
Date (2017)	COD	BOD	TSS	DO	COD	BOD	TSS	DO	COD	BOD	TSS	COD	BOD	TSS
03/06	35	20	22	2.5	48	30	36	11	18	11	14	62.5	63.3	61.1
06/06	35	21	21	2.5	49	32	34	12	20	9	16	59.2	71.9	53
09/06	32	19	20	2	50	36	36	11	21	9	15	58	75	58.3
12/06	36	22	20.5	2	46	36	36	11	20	7	13	56.5	80.5	63.9
15/06	38	23	23	2	48	35	35	11	19	9	15	60.	74.3	57.1
18/06	39	21	23	1	46	30	30	13	17	8	13	63	73.3	56.7
21/06	34	22	24	1.5	47	34	34	12	18	11	14	61.7	50.0	58.8
24/06	38	20	20	1.5	42	34	34	12	16	10	13	61.9	67.6	61.7
27/06	39	24	23	1.6	40	36	36	12	18	12	15	55	66.7	34.8
30/06	36	19	23	1.5	47	35	35	10	15	10	16	68	71.4	54.3
03/07	37	16	21.5	1.1	43	32	32	11	15	9	14	65.1	65.6	56.3

06/07	36	18	25	2.5	48	30	30	11	19	14	13	60.4	53.3	56.7
09/07	34	17	24	2.5	49	28	28	11	18	9	12	63.2	67.8	57.1
12/07	34	20	26	2	51	31	31	11	17	11	16	66.7	64.5	48.4
15/07	37	21	20	2	47	30	30	11	13	12	15	72.3	60	50
18/07	38	20	28	2	43	31	31	11	16	10	15	62.8	67.7	51.6
21/07	32	23	23	1	45	32	32	13	18	10	16	60	68.7	50
24/07	34	21	25	1.5	49	29	29	12	19	9	14	61.2	69	51.7
27/07	36	20	27	1.5	48	30	30	12	17	8	15	64.6	73	50
30/07	37	20	26	1.6	43	31	31	12	19	11	13	55.8	64.5	58
Influent								Effluent before filtration				Effluent after filtration		
Parameter				BOD	COD	TSS	DO	BOD	COD	TSS	DO	BOD	COD	TSS
Max.				24	39	28	2.5	36	51	36	13	14	21	16
Min.				16	32	20	1.0	28	40	28	11	7	13	12
Mean ±SD				20±2	35 ±1.3	24±2	10±1.6	31±2.5	46.5±3	31.4±2.6	12±0.8	18±2	14±1.3	15±1.2

Table 3: Variation of COD, BOD, TSS and DO in influent (effluent of the plant) and effluent of oxidation pond for case III.

Time	Influent of oxidation pond (Effluent of plant) (Concentrations mg L^{-1})				effluent of oxidation pond (Concentrations mg L^{-1})				Removal percentage %		
	COD	BOD	TSS	DO	COD	BOD	TSS	DO	COD	BOD	TSS
3/8/2017	36	19	24	1.5	16	10	12	10	55.56	47.37	50.00
7/8/2017	37	21	23	1.1	17	9	13	10.5	54.05	57.14	43.48
10/08/2017	31	21	25	2.5	20.5	13	12	11	33.87	38.10	52.00
13/08/2017	33	19.5	26	2.5	22	10	10	11.5	33.33	48.72	61.54
17/08/2017	34	18	24	2	21	11	14	11	38.24	38.89	41.67
20/08/2017	31	20	25	2	23	12	12	10.9	25.81	40.00	52.00
23/08/2017	30	21	23	2	16	9	13	11	46.67	57.14	43.48
27/08/2017	29	23	28	1	18	8	16	12.5	37.93	65.22	42.86
30/08/2017	31	22	24	1.5	15	11	10	12	51.61	50.00	58.33

Parameter	Influent				Effluent			
	BOD	COD	TSS	DO	BOD	COD	TSS	DO
Max.	23	37	28	2.5	13	23	16	12.5
Min.	18	29	23	1	8	15	10	10
Mean ±SD	20.5±1.54	32.44±2.7	24.66±1.6	1.78±0.5	10.33±1.58	18.7±2.9	12.44±1.9	11.15±0.8

3.1 Assessment of wastewater for case I before and after oxidation pond

Table 1 showed that: the minimum and maximum values of BOD are 18 and 21mgL^{-1}, with mean of 20 mg $L^{-1}$and standard deviation of 0.89 for the influent, while the minimum and maximum values for the effluent are 7 and 13 mg L^{-1} respectively, with mean of 9.36 mg $L^{-1}$and standard deviation of 1.63. The minimum and maximum COD values are 32 and 42 mg L^{-1}, with mean of 36.8 mg $L^{-1}$and standard deviation of 2.82 for the influent, and 11 and 23 mg L^{-1}, with the mean of 16.27 mg L^{-1} and standard deviation of 3.22 for the effluent. The minimum and maximum TSS values are 23 and 28 mg L^{-1}, with the mean of 25.72 mg L^{-1} and the standard deviation of 1.55 for the influent, and 13 and 19 mg L^{-1}, with the mean of 16.27 mg L^{-1} and the standard deviation of 1.79 for the effluent. Also, for the influent the results showed that the minimum and the maximum values of dissolved oxygen were 1.1, and 2.5 mg L^{-1}, respectively, with mean 1.74 and standard deviation 0.50, while for the effluent, the minimum and the maximum value of dissolved oxygen were 10 and 12.5 mg L^{-1} respectively with mean 11.27 and standard deviation 0.72.

3.2 Assessment of wastewater for case II before and after oxidation pond

In this case, the growth of algae increased significantly. According to table (2), the data showed that: the minimum and maximum BOD values for the raw wastewater (influent) were 16 and 24 mg L^{-1} respectively, with mean of 20.35 mg L^{-1} and standard deviation of 1.86, while for the treated wastewater (effluent) before filtration the minimum and maximum BOD values were increased to 28 and 36 mg L^{-1}, respectively with mean of 32.1 mg $L^{-1}$and standard deviation of 2.53, but after filtration the values were reduced to 7 mg L^{-1} as minimum and 14 mg/l as maximum with mean of 9.95 mg L^{-1} and standard deviation of 1.63. Also the data in table 2 indicated that, the minimum and maximum COD values for the influent were 32 and 39 mg L^{-1}, with mean of 35.85 mg L^{-1} and standard deviation of 2.1, while for the effluent before filtration, the minimum of COD was 42 mg L^{-1} and the maximum was 51 mg L^{-1} with mean 46.45 and standard deviation 2.98, but after filtration, the values of COD were 13 mg L^{-1} as minimum and 21 mg L^{-1} as maximum value, with mean of 17.65 mg $L^{-1}$and standard deviation 0f 1.91. Table (2) also showed that the minimum and maximum values of TSS in case II were 20 and 27 mg L^{-1}, with mean of 23.5 mg L^{-1} and standard deviation of 1.93 for the influent, these values for the effluent before filtration were increased to 28 mg L^{-1} as minimum and 36 mg L^{-1} as maximum with mean 32.5 and standard deviation 2.64. After filtration the minimum and maximum values of TSS for the effluent were reduced to 12 and 16 mg L^{-1} respectively, with the mean of 14.35 mg L^{-1} and standard deviation of 1.25. The minimum and maximum values of DO in case II were 1 and 2.5 mg L^{-1} respectively for the influent with mean of 1.79 and standard deviation of 0.46, while for the effluent the values were 10 mg L^{-1} as minimum and 13 mg L^{-1} as maximum value, with mean 11.5 and standard deviation 0.76. The increasing in BOD, COD, TSS, and DO contents before filtration can be attributed to leaf bud of algae beginning go out with wastewater, so water was filtered using filter (GF/C 0.7mm) to booking the algae and disposing of them, Which helps to decrease values.

3.3 Assessment of wastewater for case III before and after oxidation pond

BOD For the influent ranged between 18 and 23 mg $L^{-1}$with mean value of 20.5 and standard deviation of 1.54. Also COD was ranged between 29 and 37 mg L^{-1} with mean value of 32.44 and standard deviation of 2.7 .While TSS values are ranging from 23 mg L^{-1} to 28 mg L^{-1} with mean of 24.66 and standard 1.6. The dissolved oxygen values are ranging from 1 mg L^{-1} to 2.5 mg L^{-1} with mean 1.78 and standard deviation of 0.54. For the effluent BOD are ranged between 8 mg L^{-1} and 13 mg L^{-1} with mean value 10.33 and standard deviation of 1.58. The lowest value of COD was 15 mg L^{-1} and the highest value was 23 mg L^{-1}, with mean 18.7 and standard deviation of 2.9. The highest value of TSS is 16 mg L^{-1} while the lowest value was recorded 10 mg L^{-1}, with mean 12.44 and standard deviation 1.9.

Figures 3, 4 and 5 illustrate the comparison between concentrations of BOD, COD, and TSS for Case I, II, and III before and after treatment.

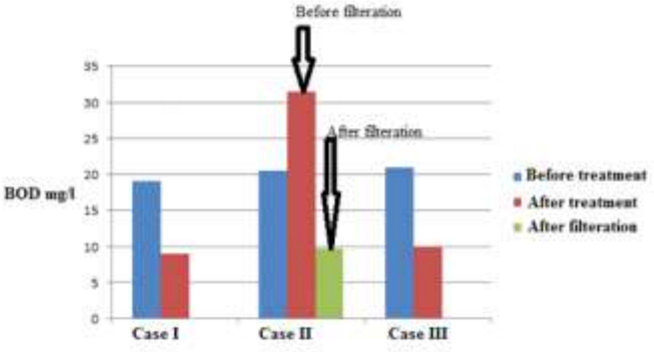


Figure 3: comparison between concentrations of BOD (mgL^{-1})in the wastewater under investigation for the three cases before and after treatment

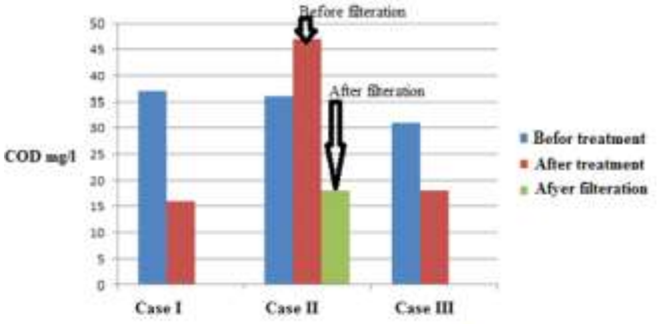


Figure 4: Comparison between concentrations of COD (mgL^{-1})in the wastewater under investigation for the three cases before and after treatment.

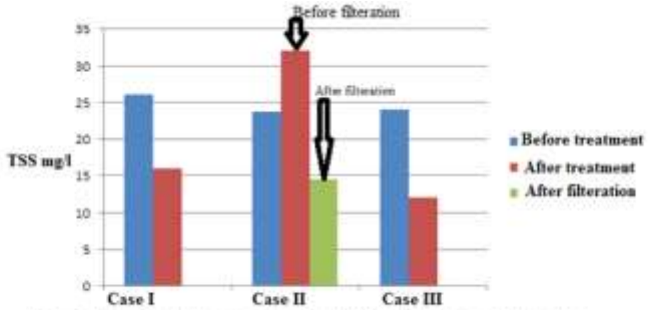


Figure 5 Comparison between concentrations of TSS(mgL^{-1})in the wastewater under investigation for the three cases before and after treatment.

3.4 Assessment of wastewater under investigation according to law 48/1982 [15] and WHO [16]

COD, BOD, TSS, and DO values of Effluent in the three cases for wastewater under investigation are within the limits according to law 48/1982(COD: 80, BOD: 60, TSS 50 mg L^{-1}, and DO $\geq$ 4 mg L^{-1}). Also, the values of COD, BOD, and TSS in the three cases are lower than WHO limits [16] (COD: 60, BOD: 30, and TSS 100m L^{-1}). The reducing of BOD for effluent in the three cases can be attributed to presence of algae at the edges in oxidation ponds, which assisted in degradation of organic matter, hence reducing BOD [17]. The birds at the ponds of Sewage Treatment plant will consume organic matter in the wastewater, thus these birds contribute to aeration of the ponds and reducing of BOD [18]. Chemical oxygen demand is also believed to be reduced in the same way as reducer of BOD [6]. The decrease in the TSS for effluent in the three cases is due to the disposal of large quantities of solid materials such as rags, leaves, sticks, etc. during the passage of raw sewage through the screen and the initial pond, and also is due to decomposition of organic matter, death of microbes and further settlement of solids after the passing of Wastewater through aerobic ponds [6]. TSS concentration in the three cases was lower than the range of domestic wastewater (120-400 mg L^{-1}) [19], and within the acceptable WHO limits (100 mgL^{-1}) [16]. Aerobic microorganisms in oxidation ponds use dissolved oxygen to degrade organic matter into CO_2, water and cell biomass. The naturally oxidation ponds depends on the oxygen produced by phytoplankton during photosynthesis and to a lesser extent, diffusion of oxygen from the air into the surface layers [20].

International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

3.5 Assessment of wastewater for agricultural purposes

According to Egyptian code No. 501/2005 the treated wastewater was classified into three grades depending on the level treatment [21] as shown in the table 4, thus agricultural groups that can be irrigated using treated wastewater [21,22] were identified according to table 4. The results of wastewater treatment showed that the level of treatment makes the wastewater under study classify as grade A, where BOD is less than 20 mg L^{-1} and also TSS is less than 20 mg L^{-1} which indicate that this treated water can be used in cultivating the varieties shown in Table 4 for grade A.

Table 4: BOD and TSS grades of treated wastewater and agricultural groups that can be irrigated [22].

Parameter	Grade A	Grade B	Grade C
<400	<60	<20	BOD (mg L^{-1})
<250	<50	<20	TSS (mg L^{-1})
Agricultural groups	G1-1: Plants and trees grown for greenery at tourist's villages and hotels for examples Grass, Cactus plants, Ornamental palm trees, Climbing plants, Wood trees and Shade trees. G1-2: Plants and trees grown for greener at inside residential areas and the new cities for examples Grass, Cactus plants, Ornamental palm trees, Climbing plants, fencing bushes and trees, fencing bushes and trees, Wood trees and Shade trees.	G2-1: fodder/ feed crops such as sorghum G2-2:trees producing fruit with epicarp on condition that they produced for processing purposes such as lemon, mango, date palm and olive trees G2-3: trees used for green belts around cities and afforestation of high roads such as Casuarina, Camphor, athel tamarix (salt tree), fruit producing trees, Date palm and Oliv trees G2-4: Plant nursery such Plant nursery of wood trees, Omamental plants and fruits trees G2-5: Roses and Cut flowers such as Local rose G2-6: Fiber crops Such as Flax, Jute, hibiscus and Sisal G2-7:Mulberry for the production of silk such as Japanese Mulberry	G3-1: Industrial oil crops such as Jujoba, Castor, oil plants, and Jatrova. G3-2: Wood trees such as Kay, Camphor, and other wood trees

3.6 Comparison between the three cases in removing BOD, COD and TSS

Table 5 and Figure 6 shows the mean values of %removal of BOD, COD, and TSS. The BOD removal in the three cases were 53%, 67.4%, and 49% respectively, which shows the effect of the aeration process in the first and second cases, also the sand filter helped to remove part of the organic components resulting in an increased BOD percentage removal in second case . COD removal in the three cases was 57%, 61.9%, and 42% respectively. Aeration process and sand filter contributed in decreasing of COD concentrations in the effluent wastewater, therefore the results showed that the most percentage removal of COD was recorded in second case. Also the percentage removal of TSS in the three cases was 38, 54.5, and 50 respectively. Sand filter contributes in decreasing the concentrations of TSS in the effluent wastewater which result in increase the percentage removal of TSS. The sand filter in the experimental work contained four layers: sand (0.4-0.5) mm, fine gravel (2.5-6) mm, mid gravel (6-9) mm and coarse gravel (9-13) mm.

Table 5: Mean of %removal and COD/BOD for the three cases.

	Mean of % removal			COD/BOD for the average value	
Case	BOD	COD	TSS	Influent	Effluent
1	53	57	38	1.94	1.77
2	67.4	61.9	54.5	1.7	1.82
3	49	42	50	1.6	1.8

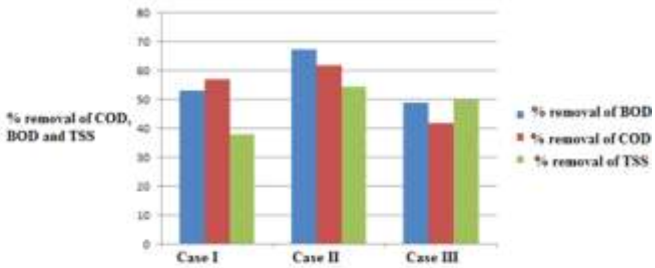


Figure 6: Comparison between % removal of BOD, COD and TSS in the wastewater under investigation for the three cases

3.7 Assessment the biodegradability of organic substances for wastewater under investigation in the three cases

According to Table 5 and Figure 7, the COD/BOD_5 ratio in the study under consideration was in the range of 1.6 - 1.94 for influent; therefore, the organic matters in influent wastewater has low biodegradability, also the higher COD/BOD_5 ratio gives an indication to absence of volatile fatty acids and non-decomposition of organic matter [23].

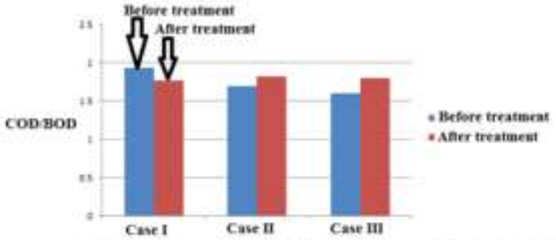


Figure 7: Comparison between COD/BOD in wastewater under investigation for the three cases before and after treatment

The results showed that the mean values of the biodegradability of organic substances BOD_5/COD in the three cases were 0.56, 0.54 and 0.54 respectively which means that decomposition takes place more slowly where degrading microorganisms need to become acclimated to the wastewater [3]. Further, the low BOD/COD ratio of the influent wastewater indicate to presence of inorganic substances which cannot be biologically treated using toxic substances harmful to micro living organisms used in biological treatment of wastewater [24].

4. Conclusion

The multiplicity and diversity of the sources of water pollution makes us pay particular attention to the selection of treatment systems to remove all or most of the contaminants. Consequently, we can reuse this water for various purposes without resorting to Nile water. Using of oxidation ponds as tertiary treatment for wastewater in Rshid village, El-Beheragovernorate, Egypt is one of these systems to remove the appropriate quantity of wastewater pollutants and thus reuse for different purposes. In Egypt and in most parts of the world where sufficient sunlight and temperature are available, oxidation pond system is found to be most suitable for the treatment of domestic sewage and trade waste containing nutrients. Treatment using of oxidation ponds as tertiary treatment for wastewater under consideration is an efficient treatment suitable for reducing the concentration of pollutants as reasonably as possible, and consequently we can reuse this water for important purposes such as planting some types of agricultural crops such as Grass, Cactus plants, Ornamental palm trees, Climbing plants, Wood trees and Shade trees. Also the study on wastewater quality indicated that the values of COD, BOD, TSS and DO of effluent wastewater for the three cases under consideration are found to be less than the recommended level in wastewater as listed by World Health Organization and within limits according to law 48/82, which enhance reuse of water under consideration in some agricultural purposes.

5. Recommendation

It is strongly recommended research required to reuse the treatment wastewater in different purposes without resorting to Nile water and to help in reduce of pollution rate in Egypt.

Acknowledgment

It is important to acknowledge facilities of chemicals, collection of samples personal, field lab measurements, finance support given by El-Beheragovernorate, and Madina Higher Institute of Engineering.

References

[1] Hemath Naveen K.S., Hema Priya.M., Swathi.S.D., Vinothan K.G. Sewage Treatment Methodology- A Review. International Journal of Engineering Trends and Technology (IJETT). 2017, 45(3). March., page 118 -120.

[2] Mara D., Constructed wetlands and waste stabilization ponds for small rural communities in the United Kingdom: a comparison of land area requirements, performance and costs. Environmental Technology. 2006, 27, 753-757.

[3] Al-Hashimi M.A.I, Talee Hussain H., Stabilization Pond for Wastewater Treatment. European Scientific Journal. 2013, 9 (14), 278-294.

[4] Hamed S. B., Tayebeh T., Fazel A., Performance of municipal Waste Stabilization Ponds in Bushehr Wastewater Treatment Plant, Advances in Bioresearch, January. 2017, Vol 8 (1): 106-110.

[5] Ghazy M.M.E.D., El-Senousy W.M., Abdel-Aatty A.M., Kamel M., Performance Evaluation of a Waste Stabilization Pond in a Rural Area in Egypt. American Journal of Environmental Sciences, 2008, .4(4), 316-325.

[6] Chebor J., Ezekiel K. K, Lizzy A. M. Effect of Seasonal Variation on Performance of Conventional Wastewater Treatment System, Journal of Applied & Environmental Microbiology, 2017., Vol. 5, No. 1, 1-7

[7] Song L., Sheng dao S., Lin-hui Z., Zhi-hong S., Treatment of Rural Domestic Sewage by Constructed Wetland/Stabilization Pond Process. China Water & Wastewater. 2008, 24(10), 67-69.

[8] Ouazzani N., Bouhoum K., Mandi L., Bouarab L., Habbari K.H., Rafiq F., Picot B., Bontoux J., Schwartzbrod J. Wastewater treatment by stabilization pond: Marrakesh experiment. Water Science & Technology, 1995, .31, 75-80.

[9] Bastos R.K.X., Calijuri M.L., Bevilacqua P.D., Rios E.N., Dias E.H.O., Capelete B.C., Magalhães T.B. Posttreatment of Up flow anaerobic sludge blanket (UASB) Reactor Effluent in Waste Stabilization Ponds and in Horizontal Flow Constructed Wetlands: A Comparative Study in Pilot Scale in Southeast Brazil. Water Science and Technology (WST). 2010, V 61, NO. 4, 995-1001.

[10] Abis K.L., Mara D. D., Research on waste stabilization ponds in the United Kingdom – initial results from pilot-scale facultative ponds. Water Science and Technology, 2003, 48 (2), 1 7.

[11] Zimmo O.R., van der Steen N.P., Gijzen H.J., Comparison of ammonia volatilization rates in algae and duckweed-based waste stabilization ponds treating domestic wastewater. Water Research, 2003, 37(19), 4587-4594.

ISSN (Online): 2347-3878
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

[12] Pescod M. B., Mara D. D., Design, Operation and Maintenance of Wastewater Stabilization Ponds, in Treatment and Use of Sewage Effluent for Irrigation, Butterworths London, 1988, p 93-115 [Explains the design and operational concepts of WSP from wastewater reuse perspective].
[13] Metcalf and Eddy I., "Wastewater Engineering: Treatment, Disposal, and Reuse, 3rd ed.", 1995. [Comprehensive explanation on the different wastewater treatment technologies].
[14] American Public Health Association (APHA), Standard Methods for the Examination of Water and Waste Water, 22th Ed, APHA, AWWA, WPCF, Washington, D.C., USA. 2012, 1360 PP. ISBN 978 – 087553 – 013-0.
[15] Egyptian Law, (48/1982) for Irrigation and Drainage. The Implementer Regulations for law 48/1982 regarding the protection of the River Nile and water ways from pollution Map Periodical Bull. 3–4 Dec.: 12–35.
[16] World Health Organization (WHO), Fact sheets on environmental sanitation. Epidemic diarrhoeal diseases control. Eng. 1996, 4(1): 43-50. Geneva, World Health Organization. WHO/EOS/96.4.
[17] Wastewater technology fact sheet. 2002 b:facultative lagoons, United States Environmental Protection Agency (USEPA.). [Briefly summarizes few basic facts of facultative ponds for wastewater treatment].
[18] Water treatment Maturation ponds (WTMP). 2012. viewed online 02-02-2012 Http:thewater/treatments.com/wastewater-sewage-treatment/maturation-ponds
[19] Metcalf, Eddy Inc. Wastewater Engineering: Treatment and Reuse. 4th Ed., 2003, McGraw-Hill. New, York.
[20] Shilton, A. (2005). Pond Treatment Technology, London, UK: International Water Association (IWA), 2005. ISBN 9781843390206.
[21] Abuzeid K.., Elrawady M., Cedare (2014),"2030 Strategic Vision For Treated Wastewater Reuse in Egypt ", Water Resources Management Program-CEDARE.
[22] Holding Company for Water Supply and Waste Water, 2011, Governorates sheets.
[23] Abd El-Gawad H. A., Aly A. M., Assessment of Aquatic Environmental for Wastewater Management Quality in the Hospitals: a Case Study. Australian Journal of Basic and Applied Sciences, 2011, 5(7), 474-782.
[24] Leite V., Athayde Junior G., Sousa J. Lopes W., Henrique I., Treatment of domestic wastewater in shallow waste stabilization ponds for agricultural irrigation reuse. Journal of Urban and Environmental Engineering, 2009,3(2),58–62