BASIC EQUIPMENT FOR WASTEWATER TREATMENT PROCESS: CASE STUDY (MIXED WASTEWATER)

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ABSTRACT

In a continually emergent globe, where many activities are high consumers of natural resources, including water, it has become absolutely necessary to apply methods of wastewater treatment. Wastewater treatment aims to advance water quality for many purposes and safe aquatic environment and control different harmful environmental factors. The study presented simple equipment system (pH control system) that used in the mechanical stage of a wastewater treatment and status of wastewater treatment process in case study (mixed drainage and industrial wastewater along Rahway drain). The main relation status of physicochemical parameter controlling wastewater treatment plant as operating factors that are electric conductivity (EC), pH and total dissolved salts (TDS) selected as optimum conditions for treatment control.
Keywords: wastewater, mechanical water treatment, treatment plant

INTRODUCTION

Water bodies such as lakes, rivers and streams are the most essential reservoirs for freshwater that important part of life [Dudgeon *et al*, 2006]. In the current state of economic and social development is becoming more difficult to achieve the satisfaction of water needs for household, industrial,

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energy and agricultural use. Water pollution is mostly due to industrial development, growth of urban population that discharges organic, inorganic, biological, thermal or radiological substances at a certain level in water systems. These pollutants tend to degrade or adversely affect the quality of water and consequently affecting it usefulness [Mustapha *et al*, 2014].

Today's rapidly growing societies generate different types of wastewater (Fig.1) include those derived from domestic, commercial, industrial and agricultural sectors, as well as surface runoff (storm water) from urban areas [Abdel-Raouf *et al*., 2012, Metcalf and Eddy, 2003] increase attention toward the discharge, presence and potential effects of persistent pollutants in the environment. While many of these pollutants break down relatively quickly in the environment, many others are highly resistant to degradation [Sena *et al*., 2009 and Kumar *et al*., 2020]. Water quality assessment is mainly based on its physicochemical components, biological quality and heavy metals concentrations [Mahapatra *et al*, 2012].

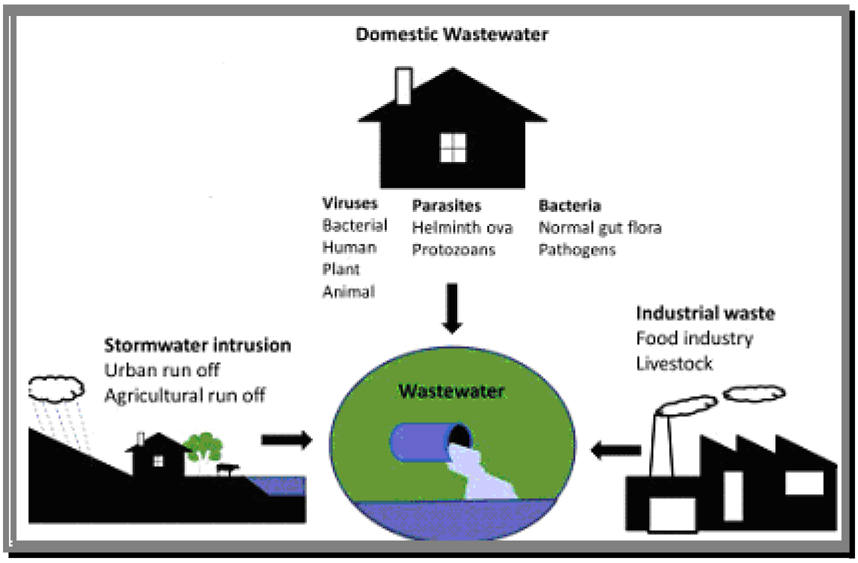

Fig.(1): Major Sources of Wastewater Contamination

European Council Directive 91/271/2002 is the legal basis regarding the legislation on wastewater. This Directive, transposed by G.D. 188/2002, defines water treatment as the process of "removal from wastewater of toxic substances, microorganisms, etc., aiming to protect the environment, the envoy first, and also soil and air. Hence, water treatment is a complex process of withholding and neutralizing harmful dissolved substances, in colloidal state or in suspension, present in industrial and municipal wastewater, that are not supported in the aquatic environment into which is discharged the treated water and that allow restoring the physicochemical properties of water before use [Luigi *et al*., 2020]. The variation of location, economic resources, living standards of different countries, and characteristics of water and its pollutants, many nations approve diverse techniques for wastewater treatment [Bustillo and Mehrvar, 2015].

Wastewater treatment processes include mechanical treatment (primary), chemical treatment and biological treatment or combined (Fig.2). Mechanical treatment is physical-mechanical type, consists of: withholding of coarse bodies and suspension of wastewater, sedimentation (settling) of the solids in suspension, floating of impurities with lower density than that of water or which are brought by aggregating to this status, filtration and centrifugation, methods generally used in the sludge treatment and ultraviolet disinfection. European Council Directive 91/271/2002 stipulates that mechanical treatment processes reduced biochemical oxygen demand and the total suspended solids of the incoming wastewater at least 20 % and 50 % before discharge respectively [Osuolale and Okoh , 2015].

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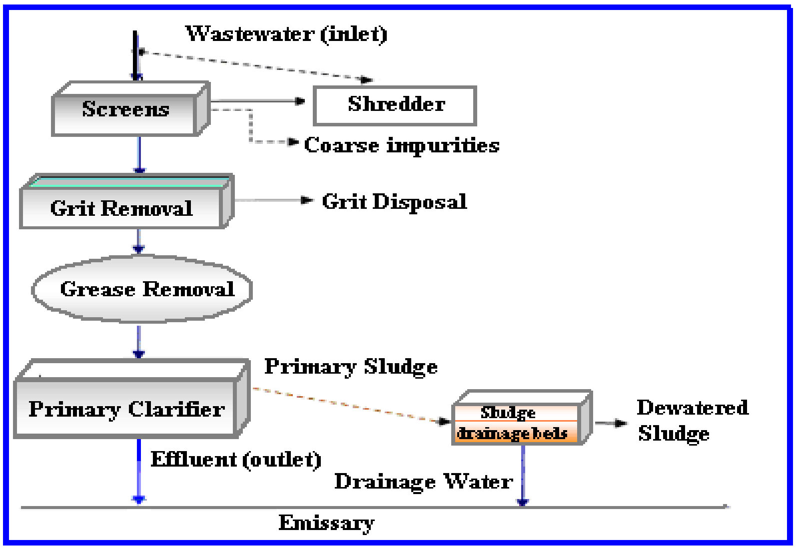

Fig.(2): Diagram of a Mechanical Wastewater Treatment Plant

Chemical treatment is processes physico-chemical nature that is applicable in wastewater property large quantities of fine matter in suspension, colloid, or even dissolved substances. These matters are very difficult to separate by classical mechanical methods and water disinfection at the end of the treatment process using chemical substances [Lin *et al.*, 2020]. While biological treatment both physical and biochemical processes refers to the decomposition of organic materials by bacteria and are of two types, depending on the nature of the bacteria (aerobic or anaerobic bacteria). Tertiary treatment removes excess compounds (nutrients - nitrogen and phosphorus) and ensures water disinfection by chlorination [Chahal, *et al.*, 2016]. This tread may be biological, mechanical, chemical or combined, using conventional technologies (filtration) and special processes (adsorption on activated carbon, chemical precipitation). Treated waters in various degrees are used for irrigation or in other purposes which must have an acceptable quality in accordance to the standards for treated wastewater. The study aimed to present the role of pH control system as mechanical stage of a wastewater treatment plant and relation status of physicochemical parameter controlling wastewater treatment plant

2. Method and Materials

2-1) Study area: The River Nile enters Egypt at its southern boundary with Sudan and runs through a narrow valley (1000 km long). Subsequently, it is bifurcate at a distance of 25 km (north of Cairo) into the Rosetta and Damietta branches forming a delta. This study is focused on spot location of El-Rahawy drain (mixed with industrial wastewater) where it gets an area of the Greater Cairo wastewater. It receives combined wastewaters release from the two sewerage plants (Zenein: 430,000 m3/day and Abo-Rawash - 400,000 m3/day), industrial wastewaters with huge quantities of organic and inorganic wastes that are causing serious negative impacts on the branch environment [El Gammal and El Shazely, 2008; Abdel-Satar *et al*., 2017] as shown in Fig.(3).

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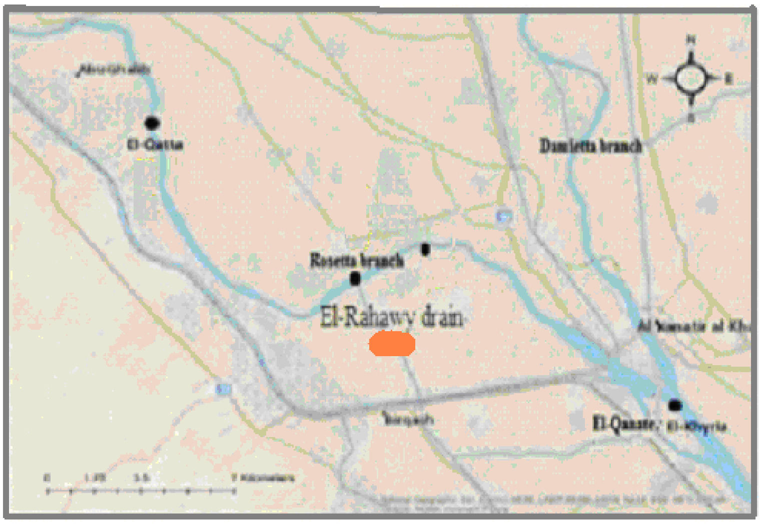

Fig.(3): Map of El-Rahawy Drain

2.2) Sampling: Composite wastewater samples were gathered from El-Rahway drain. Water samples were gathered in plastic bottles that were quickly transported in a water cooler at 4°C to the laboratory. Physicochemical characteristics that are electric conductivity (EC), pH, turbidity, dissolved oxygen (DO), salinity measured in the field using multi-probe system, model Hydrolab-Surveyor according to standard strategies for testing water and wastewater.

2.3) Analysis: pH was estimated utilizing an WTW Info Lab meter. Alkalinity was determined titration metrically against 0.2 N–H_2SO_4, utilizing phenolphthalein and methyl orange indicators. Turbidimeter HACH Turbid meter Mode l2100A was utilized to quantify the turbidity of the water samples utilizing purchased calibration solutions of 0.1, 15 and

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100 NTU. Total dissolved solids (TDS) were determined by weighing the solid residue gotten by evaporating a measured volume of filtered water sample to dryness at 103-105 ºC. Total suspended salt (TSS) was the distinction between the total solid (TS) and total dissolved solid (TDS) determined gravimetrically at 105 ºC [APHA, 2017].

Total nitrogen (TN) concentration determined applying Kjeldahl Method. Total phosphorous (TP) determined colorimetric detection utilizing continuous flow analysis after digestion with alkaline persulphate [APHA, 2017]. Major anions; chloride (Cl-), sulfate (SO2-4) and nitrate (NO-3) were estimated utilizing Ion Chromatography (IC model DX-600, USA). Major cations; (calcium (Ca2+), potassium (K+), magnesium (Mg2+), and sodium (Na+)) and true filtered water sample with a 0.45 micron (µ) filter estimated for trace elements utilizing Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES model Perkin Elmer optima 3000) [APHA, 2017].

Organic measurements are analyzed in terms Biological Oxygen Demand (BOD) estimated utilizing BOD fast respirometry system model TS606/2 at 20ºC incubation in a thermostatic incubator chamber model WTW for 5-day and Chemical Oxygen Demand (COD) estimated calorimetrically using a strong chemical oxidant (potassium dichromate) in acid medium, and then heated to oxidize organic carbon. COD Reactor (block heater operates at 150±2°C) and Spectrophotometer Huch-DR-3900 were utilized to measure

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the amount of dichromate consumed in the breakdown of organic matter [APHA, 2017].

Bacteriological Analyses: Collected raw wastewater samples examined through 6 hours using membrane filter that utilized filtration system finished with stainless steel autoclavable manifold and oil-free" vacuum/pressure pump for total Coliforms enumeration. The fiteration of samples were done through sterile (the membrane has a diameter of 47 mm & a pore size of 0.45 μm) [APHA, 2017]. The information was recorded as Colony Forming Unit (CFU/100 ml) utilizing the next equation:

$$\text{Total coliform colonies /100 ml} = \frac{\text{Coliform colony counted} \times 100}{\text{Sample filtered (ml)}}$$

All determinations were performed in duplicate and were repeated for accuracy was needed.

2.4) Treatment: pH is probably by far the most important physicochemical parameter controlling the behavior of other water quality parameters as well as metals concentration in the aquatic environments [Saalidong *et al*., 2022]. Chemical processes in aquatic systems such as acid-base reactions, solubility reactions, oxidation-reduction reactions and complexations are all influenced by hydrogen ions concentration (pH).

The study presented the role of pH control system as mechanical stage of a wastewater treatment and relation status of physicochemical parameter controlling wastewater treatment plant. Figure 4 described pH control system and geometry structure (Simulation IFIX program with SCADA System) for Treatment.

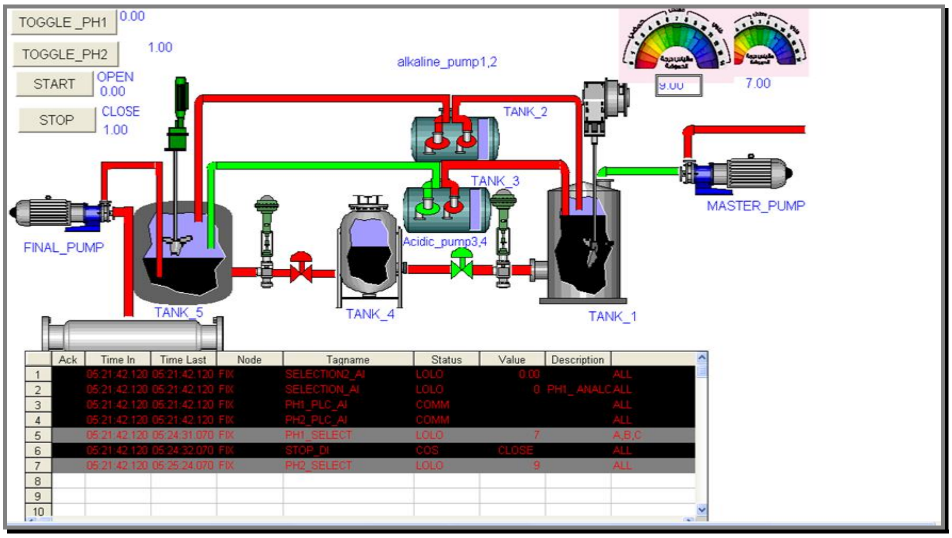

Fig (4): Simulation IFIX program with SCADA System: start pH value = 7in in first stage and PH=9 value of in the second stage.

Treatment process carried out in two steps (1-2) which checking the acidity and alkalinity of wastewater for naturalization (pH value = 7 and PH value=9) by acidic and alkaline pumps (Fig.5). Treatment unit use two pH sensors that can be replaced by two EC sensors for correlation and applying equations. This change can reduces treatment cost and improve treatment performance because stabilization time for pH sensor is too long than EC sensor.

Acid and Alkaline Solutions

One molar of calcium hydroxide: adding 7.4 grams of $Ca(OH)_2$ to 1000 ml (one liter)

One molar of sodium hydroxide: adding 40 gram of NaOH to 1000 ml (one liter)

Phosphoric acid (H_3PO_4) 2 %: adding 50 ml of H_3PO_4 85% to 1000 ml (one liter)

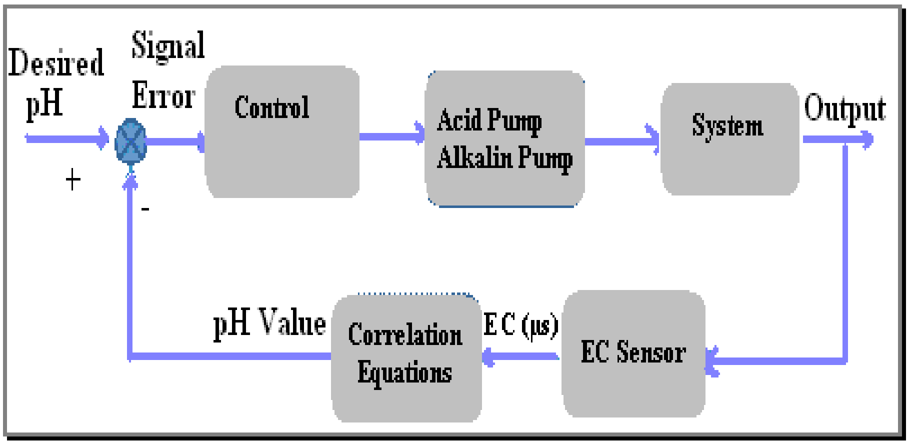

Fig (5): Two Stages of Treatment Process

Experiment Schedule

Table (1): Experiment Schedule for Treatment Process	
Treatment	**Neutralization of Wastewater**
Process (1)	Addition of one normal sodium hydroxide, ml to be alkaline
Process (2)	Acidify wastewater by addition of phosphoric acid 2%, ml (pH:5)
	Addition of one normal calcium hydroxide, ml
Process (3)	Alkaline wastewater by addition of one normal calcium hydroxide, ml (pH:9)
	Acidify wastewater by addition of phosphoric acid 2%, ml (pH:5)

RESULTS AND DISCUSSION

Experimental Setup: Characteristics of wastewater are presented in Table 1. Measurement of pH recorded to start treatment stages. Neutralization is a process for pH impact on wastewater to be adapting to renew wastewater environment and to maintain the performance of different environmental conditions for stage (1) and then stage (2). Treatment application requires strong acid and alkaline activity which their stability for strong salts. Then particles and compatibility with different pollutants were collected to remove.

El-Rahway Wastewater Quality: The wastewater characteristics were assessed relying upon the Law of Ministry of Irrigation and Water Resources (48/1982) by decision Number 92, 2013; article sets the guideline must be available in the drainage water before they are submitted to the freshwater bodies.

Wastewater has high concentrations of TN, TP, BOD, COD, Total Coliforms (TC) higher than the Egyptian limits. The data of the physico-chemical analysis and other measurements are listed in Table (2). These data reported the risks for wastewater quality that have negative environmental impacts on aquatic organisms [Lubna *et al.*, 2019 and Medhat *et al.*, 2020] and sediment [Al-Afify and Abdel-Satar, 2020].

Table (2): Wastewater Quality Parameters			
Parameter	**Unit**	**Concentration**	**Article 51-Decree 92 of Law 48 in 2013**
pH	Unit-less	7.59±45	6.5-8.5
EC	mmhos/cm	1.29	---
Alkalinity	mg/l	296. 85 ±16	---
TDS	mg/l	1193.33±150	1000
TSS	mg/l	614.11±117	---
Turbidity	NTU	47.14±4.2	---
T.N	mg/l	18. 44±1.5	1.5
Ammonia	mg/l	13. 55±2. 1	---
T.P	mg/l	5. 96±0. 47	3
Chloride	mg/l	792. 7±41	---
Nitrate	mg/l	4.07±1.27	---
Sulfate	mg/l	315.2±94	---
Phosphate	mg/l	0.2±0.0002	---
Calcium	mg/l	40.01±10.8	---
Magnesium	mg/l	25.09±3.15	---
Potassium	mg/l	18.21±5.15	---
Sodium	mg/l	921. 20±52	---
Aluminum	mg/l	0. 228±0.101	---
Cadmium	mg/l	0.009±0.0002	0.003
Copper	mg/l	0.069±0.004	1
Iron	mg/l	0.295±0.16 3	3
Manganese	mg/l	0.290±0.07	2
Lead	mg/l	0.05±0.002	0.01
Zinc	mg/l	0.041±0.052	2
DO	mg/l	1.8±0.228	≥5
BOD	mg/l	90.83±31.3	30
COD	mg/L	120.44±13.1	50
Total Coliforms	CFU/100ml	978×104	5000

Treatment

A) pH and TDS Records: The pH value represents the continuity of hydrogen ion activity and affects biological and chemical reactions in a water body that pH value is considered important factor for chemically and biologically system of aquatic environment. pH value of wastewater (7.59±45) was within National Environmental Guidelines Law 48 limits (6.5-8.5) as shown in Table (2) that reported mixing of large amounts of different pollution sources [Abd Elgawad, 2000; Hanan and Inas, 2007; and Mohamed, 2015]. Different pH and TDS values in field during 55 days were acceptable as shown in Fig.(6a,b,c) for biological activity range (5-8) where chemical reactions in water are controlled by pH value according to John D., 1990, Hanan and Doaa, 2011; Hanan and Amer, 2012 and Mostafa *et al*., 2015. The charts Fig.(6a,b,c) showed lack of correlation between pH and TDS in field measurements during 55 days.

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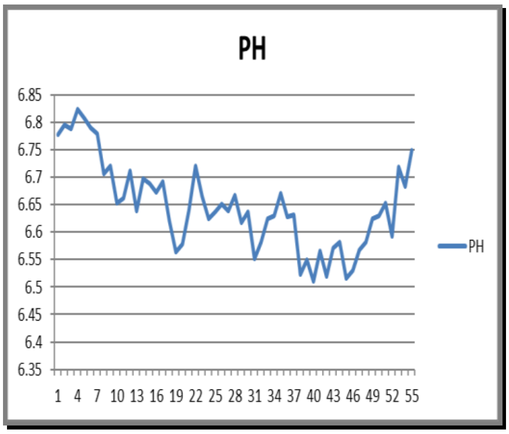

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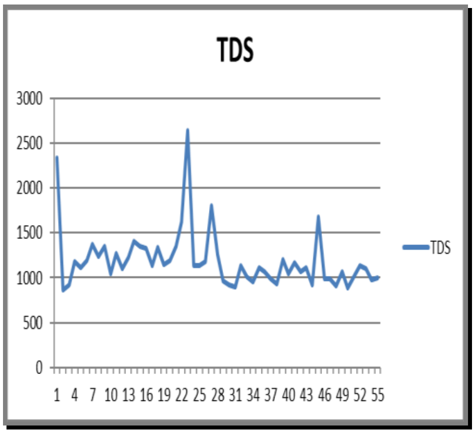

(b)

(c)

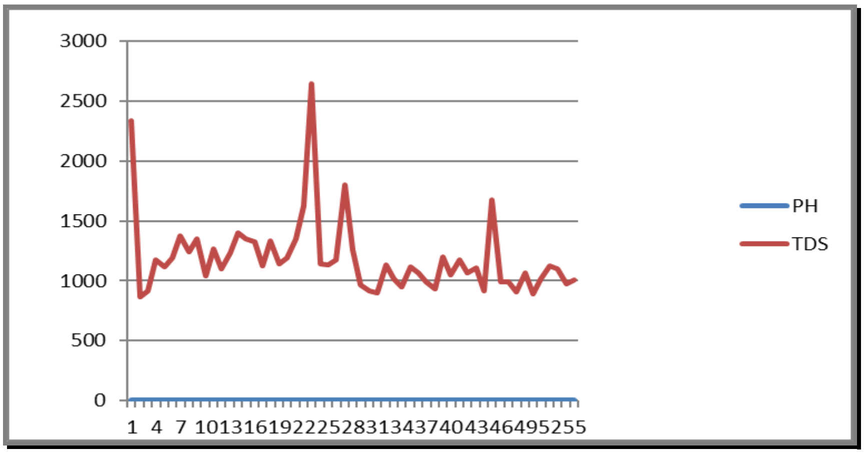

Fig.(6a,b,c): Different pH and TDS Values in the Field

The increase pH value related to photosynthesis and growth of aquatic organisms where photosynthesis is consuming CO_2 that leads to arise in the pH values. Toxicity of ammonia is pH dependent which ammonia-nitrogen

(NH_3-N) has a more toxic form at high pH and a less toxic form at low pH, un-ionized ammonia (NH_3) and ionized ammonia (NH^{4+}), respectively. In addition, ammonia toxicity increases as temperature rises. The toxic form, increases as pH rises and decreases as pH falls which causes ammonia to become more ionized. This resulted of irregular aquacultures fish ponds, human activities effluents impacts on wastewater quality that agreed with [Abd El-Gawad, 2019 and Khalil, 2016]. The data showed ammonia-nitrogen (NH_3-N) ammonia-nitrogen (NH_3-N) not toxic at pH value (7.59±45) that increases in alkaline.

Effect of pH (Acids and Alkaline) : Most of industrial wastewater such as cement industry and iron industry causes increase of pH level. The experiment used three process: (1) use sodium hydroxide (NaOH) as indication of dangerous industrial effluent discharge, (2) addition of calcium hydroxide to acidify wastewater by phosphoric acid (pH: 5 to 9) and (3) Alkaline wastewater by addition of one normal calcium hydroxide, ml (pH:9) then acidify wastewater by addition of phosphoric acid 2%, ml (pH:5) to decrease pH which calcium carbonate and phosphate salts are useful for aquatic environment organisms and useful nutrients for plants.

Treatment Process (1): Series of sodium hydroxide solution (1N) additions to wastewater that changed of pH values and total dissolved salts presented in Table (3). The data (Table 2) showed increased of pH values (alkaline values: reached to 9) as addition of sodium hydroxide one normal solution increased

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with display equation 0.08x - 5E-16 and correlation factor R^2 = 1 as shown in Fig.(7). While total dissolved salts concentrations decreases with increasing additions of sodium hydroxide one normal solution due to precipitates all of metal salts with display equation y = -0.0072x + 16.792 and correlation factor R^2 = 0.9593 as shown in Fig. (8a,b).

Table (3): Effect of NaOH Addition on Wastewater

No.	NaOH, ml	pH	TDS mg/l	No.	NaOH, ml	pH	TDS mg/l
1	0.08	7.20	2290	9	0.72	8.40	2208
2	0.16	7.30	2280	10	0.80	8.50	2204
3	0.24	7.40	2275	11	0.88	8.60	2200
4	0.32	7.50	2273	12	0.96	8.70	2182
5	0.40	7.60	2270	13	1.04	8.80	2173
6	0.48	7.90	22680	14	1.12	8.90	2160
7	0.56	8.10	2265	15	1.20	8.90	2150
8	0.64	8.30	2246	16	1.28	9.00	2142
Note: Sodium hydroxide (NaOH) 1N				17	1.36	9.00	2137

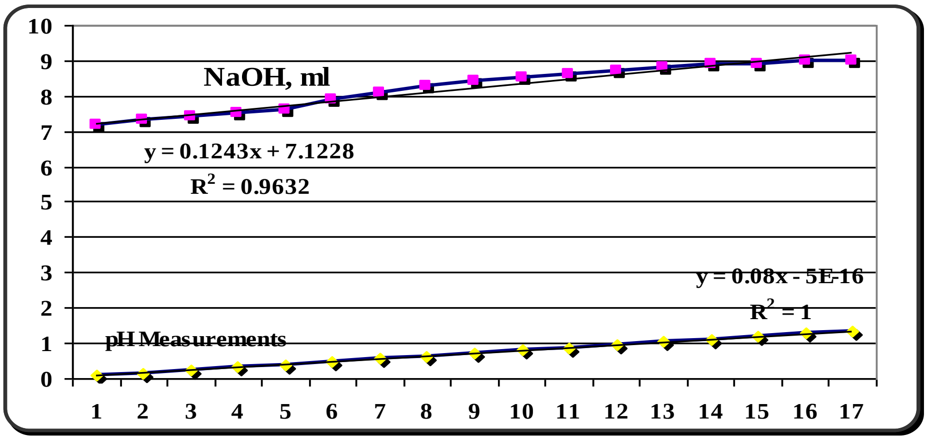

Fig.(7): Relation of NaOH (one Normal) Solution Addition and pH

Changes in TDS concentrations in wastewater sample result from industrial effluent, changes to the wastewater balance by limiting inflow, by increased water use or increased precipitation), or by salt-water intrusion. Microbial species combines with metal ion in treated wastewater then it will not react with the organic matter and decrease of dissolved oxygen. So, inhibition of BOD content related to oxidation of organic matter or metal oxide formation. This hypothesis is supported by the standard oxidation potential values for all the metal ions under consideration that agreed with Mittal and Ratra, 2000; Majid Sa'idi, 2010; Türkmen *et al*., 2022.

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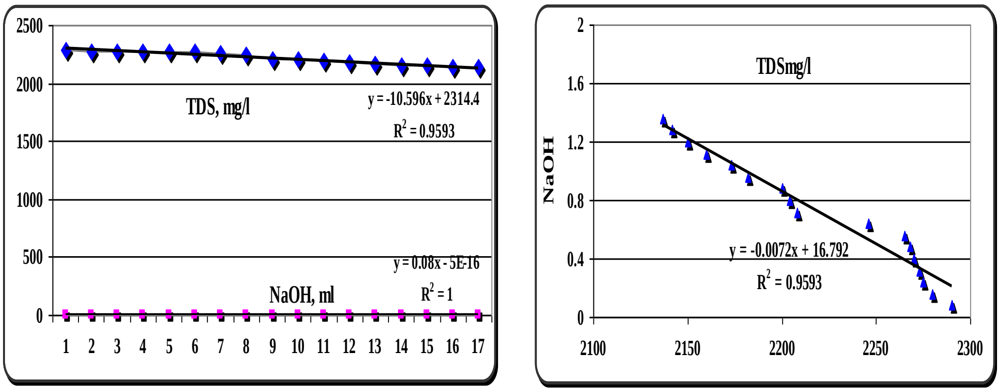

(a) **(b)**

Fig.(8): Relation of Addition NaOH (1N) Solution and pH&TDS mg/l

Treatment Process (2): The data (Table 4) showed increased of pH values (from acid medium using phosphoric acid (pH:5) then reached to 9 as alkaline values) as addition of calcium hydroxide one normal solution increased with display equation y = 0.1822x - 0.1264 and correlation factor R^2=0.994 as shown in Fig.(9a,b). While total dissolved salts concentrations decreases with increasing additions of calcium hydroxide one normal solution due to precipitates all of metal salts with display equation y = -0.0142x + 14.079 and correlation factor R^2 = 0.9916 as shown in Fig. (9a,b).

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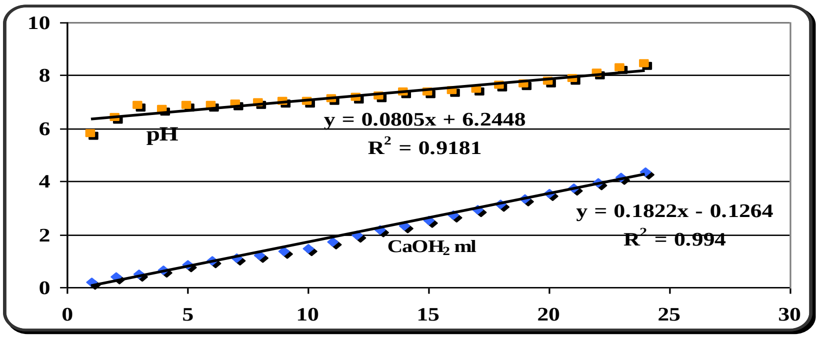
Table (4): Effect of $CaOH_2$ Addition on Acidify Wastewater

No.	$CaOH_2$	pH	TDS	EC	No.	$CaOH_2$	pH	TDS	EC
1	0.2	5.80	992	1986	13	2.16	7.21	839	1679
2	0.4	6.40	978	1959	14	2.36	7.35	832	1664
3	0.52	6.83	952	1904	15	2.56	7.37	825	1650
4	0.64	6.68	948	1.896	16	2.76	7.42	790	1.584
5	0.88	6.85	935	1.815	17	2.96	7.47	776	1.552
6	1	6.87	930	1.861	18	3.16	7.60	773	1.547
7	1.12	6.91	915	1.830	19	3.36	7.65	756	1.504
8	1.24	6.94	900	1.800	20	3.56	7.78	737	1.473
9	1.36	7.00	879	1.758	21	3.76	7.87	737	1.474
10	1.48	7.00	874	1.748	22	3.96	8.05	721	1.443
11	1.72	7.11	866	1.733	23	4.16	8.26	706	1.413
12	1.96	7.17	857	1.715	24	4.36	8.44	692	1.385

Note: Calcium hydroxide ($CaOH_2$) 1N ml, TDS mg/l and E.C mmhos/cm



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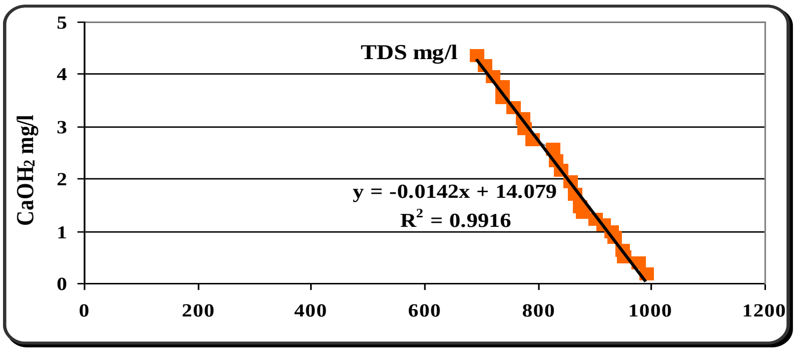

(b)

Fig (9a,b): Relation of Addition $CaOH_2$ (1N) Solution and pH &TDS mg/l

Changes in TDS concentrations in wastewater sample result from acid medium to alkaline medium by adding calcium hydroxide presented in Table (4). Decreasing of TDS concentrations related to solubility of all heavy metals salts and decomposition of organic content and microbial species that increased by increasing pH values. So, Reduction and removal of BOD and COD, suspended solids, nutrients and pathogenic micro-organism continued but at different levels. This hypothesis is supported by chemical precipitation values for all the metal ions under consideration that agreed with Hemraj *et al.*, 2021 and Lekhendra *et al.*, 2020.

Treatment Process (3): The data (Table 5) showed increased of pH values (from alkaline medium using calcium hydroxide one normal solution (pH:9) then reached to 5 as acidic values) as addition of 2% phosphoric acid solution increased with display equation y = -0.8111x + 8.6723 and correlation factor R^2=0.9438 as shown in Fig.(10a). While total dissolved salts concentrations decreases with increasing additions of calcium hydroxide one normal solution due to precipitates all of metal salts with display equation y = 86.478x + 1020.8 and correlation factor R^2 = 0.8556 as shown in Fig. (10b).

Table (5): Effect of H_3PO_4 Addition on Alkaline Wastewater							
No.	**H_3PO_4**	**pH**	**TDS**	**No.**	**H_3PO_4**	**pH**	**TDS**
1	0.2	9.00	1099	11	1.6	7.01	1137
2	0.3	8.74	1093	12	1.9	6.82	1152
3	0.5	8.52	1091	13	2.1	6.75	1167
4	0.6	8.13	1091	14	2.4	6.65	1186
5	0.7	8.01	1094	15	2.6	6.55	1209
6	0.8	7.91	10940	16	2.8	6.44	1235
7	1.1	7.75	1093	17	3.1	6.26	1255
8	1.3	7.56	1103	18	3.3	6.10	1342
9	1.6	7.30	1113	19	3.6	5.99	1395
10	1.4	7.20	1123	20	3.8	5.80	1431
Note: Calcium hydroxide ($CaOH_2$) 1N ml and TDS mg/l							

Changes in TDS concentrations in wastewater sample result from acid medium to alkaline medium by adding calcium hydroxide presented in Table (5). Increasing of TDS concentrations related to precipitate anions, cations and heavy metals salts and decomposition of organic content and microbial species that increased by increasing pH values. So, removal of precipitates of BOD and COD, suspended solids, nutrients and pathogenic micro-organism continued but at different levels. This hypothesis is supported by chemical precipitation values for all the metal ions under consideration that agreed with Durai and Rajasimman, 2011 and Louis and Ryan, 2020.

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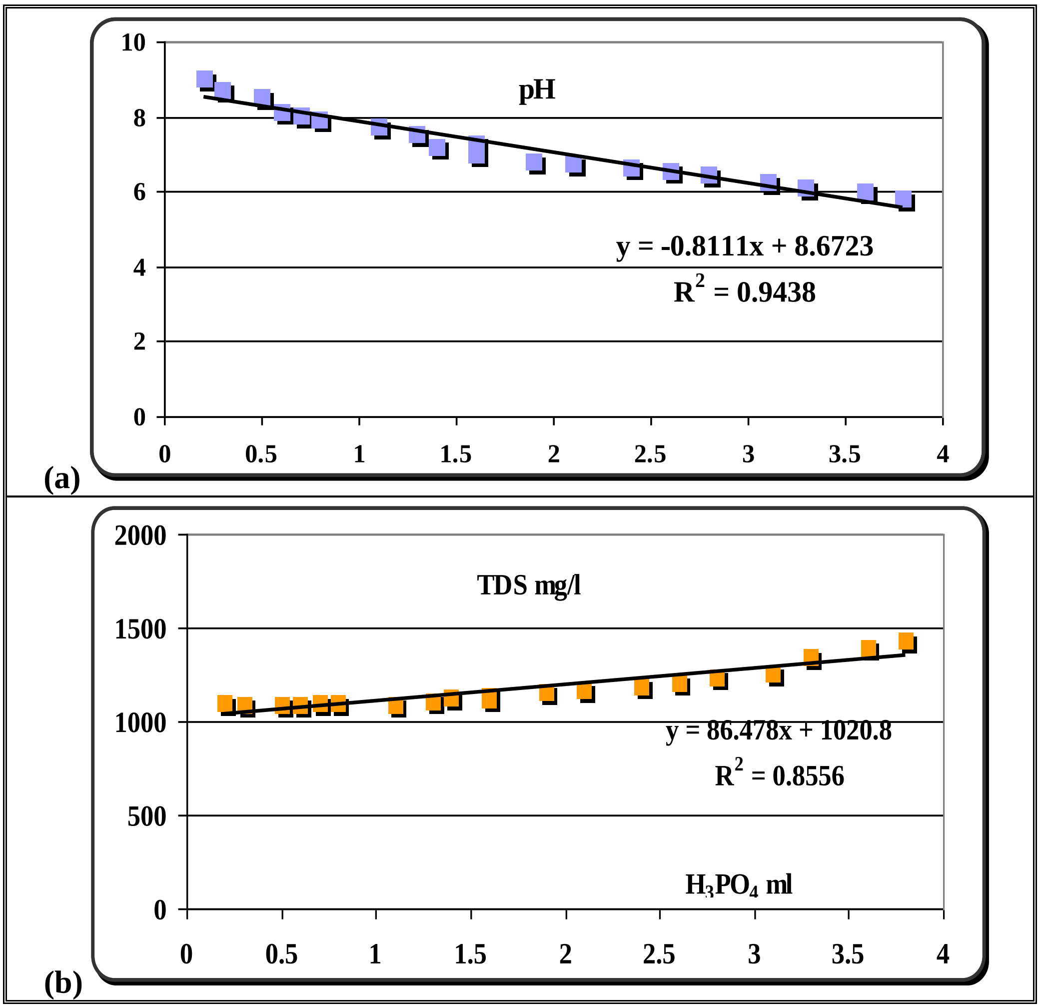

Fig. (10a,b): Relation of pH &TDS mg/l for Alkaline Wastewater and Addition H_3PO_4 2% Solution

The previous treatment process showed the results of treatment process graduated in order process (1) > process 3> process 2 at low and high pH

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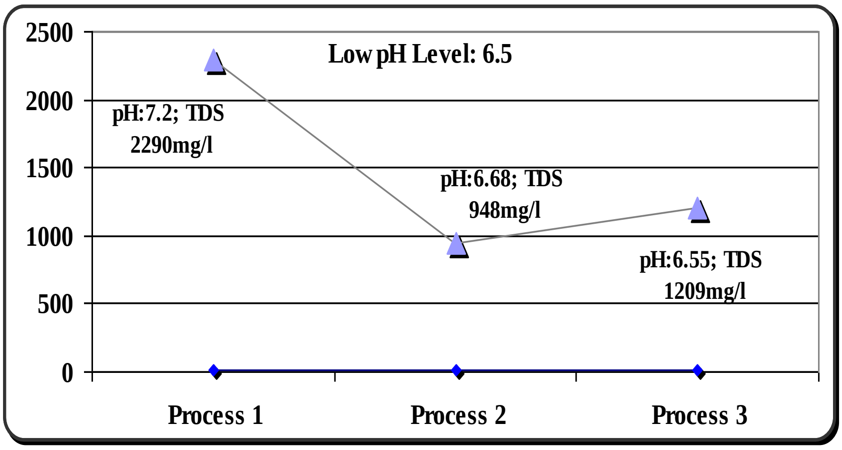
levels for National Environmental Guidelines Law 48 limits (6.5-8.5) then are optimum conditions for wastewater treatment as shown in Fig.(11,a,b) was process 2 .



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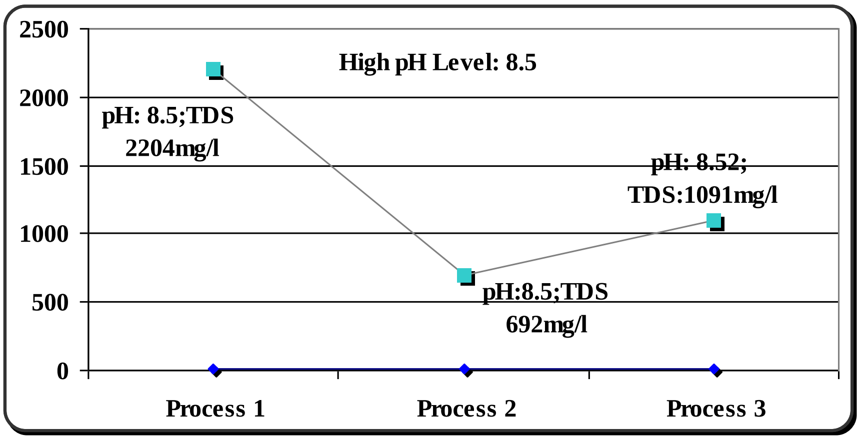

(b)

Fig. (11a,b): Relation of pH &TDS mg/l for Treatment process

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CONCLUSION

The wastewater characteristics showed high concentrations of TN, TP, BOD, COD, Total Coliforms (TC) higher than the Egyptian limits. Different pH and TDS values in field during 55 days were acceptable for biological activity range (5-8) and they showed lack of correlation between pH and TDS in field measurements. Experiment Schedule including three processes: (1) use (1N-NaOH), (2) use (1N-$CaOH_2$) for acidic wastewater by 2% H_3PO_4 (pH: 5 to 9) and (3) use 2% H_3PO_4 (pH:5) for alkaline wastewater (1N-$CaOH_2$, pH:9).

The results of treatment process (1) clarified the relation between pH and TDS concentrations in wastewater sample balance. Microbial species combines with metal ion and inhibition of BOD content related to oxidation of organic matter or metal oxide formation. Moreover, the data of treatment process (2) showed the relation between pH and decreasing of TDS concentrations related to solubility of all heavy metals salts and removal of organic content, nutrients and micro-organism by chemical precipitation. Treatment process (3) described increasing of TDS concentrations related to precipitate anions, cations and heavy metals salts and decomposition of organic content and microbial species that increased by increasing pH values.

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المعدات الأساسية لعملية معالجة مياه الصرف الصحي: دراسة حالة (مياه الصرف الصحي المختلطة)

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المستخلص

يستهلك العالم الموارد الطبيعية باستمرارية وبشكل كبير فى العديد من الأنشطة، بما في ذلك المياه ،فأصبح من الضروري تطبيق طرق معالجة مخلفات المياه السائلة مثل مياه الصرف الزراعى المختلط بمياه الصرف الصناعى والصحى. تهدف المعالجة إلى تحسين جودة المياه والتخلص من العديد من العوامل البيئية الضارة المختلفة لتكون صالحة لاغراض بيئة مائية آمنة . استخدمت الدراسة نظام معدات بسيط (نظام التحكم في الأس الهيدروجيني) الذي يستخدم في المرحلة الميكانيكية لمعالجة مخلفات المياه السائلة (الصرف الزراعى المختلط بمياه الصرف الصناعى على طول مصرف الرهاوى) فى محاولة لفهم العلاقة الرئيسية للقياسات الفيزيائية والكيميائية لمعالجة مخلفات المياه السائلة كعوامل تشغيل ومؤشرات إلى تحسين جودة المياه بما فى الموصلية الكهربائية(EC) ، ودرجة الحموضة والأملاح الذائبة الكلية (TDS) المختارة كظروف مثلى للتحكم في المعالجة.

الكلمات المفتاحية: مياه الصرف الصحي، المعالجة الميكانيكية للمياه، محطة المعالجة