

## STUDY OF WASTE WATER TREATMENT MEANS IN ASSIUT THERMAL POWER PLANT

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**Mahmoud Bady<sup>a</sup>, Hassanien Manaa<sup>b</sup>, Adel M. Kamal El-Dean<sup>c</sup> and A. M Hussein<sup>d</sup>**

*a-Mechanical Engineering Department, Faculty of Engineering, Assiut University,*

*b-Study, Research and Development Sector, Assiut Power Plant, Assiut*

*c-Department of Chemistry, Faculty of Science, Assiut University*

*d-Department of Chemistry, Faculty of Science, Al Azhar University*

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*In the present study's course; the reduction of wastewater effluents (by recycling as raw water supplies, classifying and arrangement between the incoming wastewaters), the treatment of the wastewater effluents (by evaporation and aeration) and the using of the treated effluents for irrigation purposes, has led to, the corresponding operating time of the waste water treatment unit (WWTU), the amount of chemicals such as acids, alkalis, ferric chloride (FeCl<sub>3</sub>) and polyelectrolyte and the discharged treated wastewater to the River Nile are reduced which has a positive impact on the environment through: Reduction of the amount of Total Dissolved Solids (TDS) discharged to the River Nile, the electrical energy consumed which reduces the pollution associated with its production and the air pollution with SO<sub>x</sub> and mercury (Hg) dissolution due to the reduction of sulfuric acid, hydrochloric acid and sodium hydroxide used, in addition, Egyptian Environmental Legal Wastewater discharge Regulations are obeyed.*

### 1. INTRODUCTION

The characteristics of industrial waste water can differ considerably both within and among industries. The impact of industrial discharges depends not only on their collective characteristics, such as biochemical oxygen demand and the amount of suspended solids, but also on their content of specific inorganic and organic substances [1]. Industrial wastewater is discharged by manufacturing processes and commercial enterprises, processed wastewater can contain rinse water including such things as residual acids, and toxic chemicals. The Environmental Protection Agency in the USA (USEPA) manages effluent limits for point sources in two ways; through technology-based controls or through water quality-based controls. Industry wide effluent limits are established on a technology basis and water effluent limits are established on a water-quality basis [2, 3]. Three available techniques in controlling industrial wastewater are, control can take place at the point of generation in the plant, control by pretreatment for discharge to municipal treatment sources or completely treatment at the plant and either reused or discharged directly into receiving waters. In general, the first step in minimizing the effects of industrial waste waters on treatment plants is to reduce the volume of such wastes. This may be accomplished by:

- *Classifying wastewater;*
- *Conserving wastewater; or*

- *Reusing effluents as raw water supplies.*

If waste waters are classified, the volume of water requiring intensive treatment may be reduced considerably, sometimes it is possible to classify and separate the process waters themselves so that only the most polluted ones are treated and the relatively uncontaminated ones are discharged without treatment [4]. Three alternative modes of operation may be considered in the light of the preliminary considerations;

- *Zero discharge involves the reuse or safe disposal of all waste water on site,*
- *Treatment of waste water before discharge,*

If more than one stream of waste water is produced it may be economical to keep the streams separate before discharge, i.e. the stream with low contamination may be fit for discharge without treatment, whereas the stream that is highly contaminated may require treatment. It is possible of course that mixing lightly and heavily contaminated streams may produce a discharge stream that is acceptable.

- *It may be allowed to discharge some streams without treatment,*

Discharge without treatment may also be possible where the receiving water has a large volume in relation to the discharge volume, and rapid mixing is assured to reduce the overall concentration to acceptable levels. In some locations "indirect discharge" may be possible where the waste water is used for irrigation purposes [5].

Electricity production utilizes water and produce wastewater contaminated even if it was only in the form of increased temperature, but this was a start, in electrical energy water pollution will continue to grow with sophistication in electricity output increased [4]. There are two types of waste water discharged from thermal power stations; plant waste water associated with operation; and domestic waste water. Plant waste water is collected into a storage tank for coagulation, sedimentation, and filtration, and domestic waste water is purified [6]. Thermal power plants wastewater are high in Total dissolved solid (TDS), sodium salts and sulfates, the wastewater streams in a thermal power plant include [7].

- 1- *Ion exchange regeneration,*
- 2- *Low-conductivity rinse water,*
- 3- *Boiler blowdown,*
- 4- *Air heaters wash water,*
- 5- *Fireside and heat transfer surfaces chemical cleaning waste,*
- 6- *oil-water separators before discharge,*
- 7- *Condensate polishing systems regeneration,*

Wastewater is generated as blowdown purged from boilers to keep the concentration of dissolved salts at a level that prevents salt precipitation and consequently scale formation, the blowdown will be high in TDS. The amount of wastewater generated depends on whether cooling is performed in open or closed cycle and on the recycling of steam condensate. Also, contamination may arise from lubricating and fuel oil thermal power plant [8].

## 1.1. Wastewater Treatment

Wastewater treatment is the physical, chemical, and biological processes used to remove physical, chemical and biological pollutants from wastewater before discharging it into a water body. Wastewater is treated to remove pollutants

(contaminants) to improve and purify the water, removing some or all of the contaminants, making it fit for reuse or discharge back to the environment. Basic wastewater treatment facilities reduce organic and suspended solids to limit pollution to the environment. In general, physical processes may be used to remove solids, biological processes to remove organics and chemical treatment, such as precipitation and neutralization, is also widely used [9,10]. Physical treatment as a primary treatment, floating and suspended solids are settled and removed by sedimentation in clarifiers, where inorganic and organic suspended solids are settled out. Sludge that settles to the bottom of the clarifier is pumped out and dewatered, disposed of in a landfill. Generally physical treatment includes processes like filtration, sedimentation used to separate and concentrate various components of a waste stream without chemically altering their form and also combined on the following processes [11]:

➤ *Discharge untreated water to an Evaporation Pond,*

Using an evaporator will reduce the plant wastewater stream by 90 percent, in the California high desert; one acre of pond area will evaporate a continuous stream of wastewater equivalent to 13.2 l/min. Evaporation ponds will eventually contain all of the mineral salts, chemical constituents and sediment (from suspended material in the waste stream) disposed from the operation in the plant.

➤ *Water conservation and recycling,*

Water conservation and recycling to reduce wastewater from sources other than the cooling water, some candidate streams for recycle are, plant area wash down water, ion-exchanger backwash and low-conductivity rinse water, boiler blowdown. Process waste water system mainly contains; Segregated collection systems for oily and chemical wastewater; Oil removal by oil separators for all waste water and surface water streams which could contain oil; and neutralization and detoxification for all chemicals containing waste water streams (e.g. chemical storage, acid cleaning, and other wash water) [12]. Chemical treatment technologies make pollutants less harmful or completely decompose them. The chemical processes used to treat industrial wastewater include chemical oxidation and reduction, coagulation-precipitation, neutralization, ozonation, and sulfide precipitation. The equipment used for these processes tends to be less complex than the required for physical or biological methods, involving effluent delivery systems, chemicals, control equipment, and tanks [13]. Neutralization is a basic reaction for a number of wastewater treatment operations. It is the reaction between an acid and alkali used to adjust the pH of the solution to within the desired range, so the water is suitable for discharge. Neutralization may also be necessary to establish proper conditions for proper clarification and for better filtration [14]. There are many acceptable methods for neutralizing over acidity or over alkalinity of wastewater, such as:

- *Mixing wastewater so that the net effect is a near-neutral pH;*
- *Adding the proper proportions of concentrated solutions of caustic soda NaOH, soda ash  $Na_2CO_3$  or  $Ca(OH)_2$  to acidic waste water;*
- *Producing  $CO_2$  in alkaline wastes; and*
- *Adding acid solution to alkaline waste water.*

Finally wastewater filtration through sand filters utilizes media such as sand, some modern filters use mixed media, graded coarse to fine, in the direction of the water flow. The filters are regularly backwashed to remove the collected sludge

[14]. Treated effluents may be discharged into a receiving water body or sewer system or evaporated. Sludge from the sedimentation process in the clarifiers may be pumped into a filter press for de-watering. Sludge is the semisolid or concentrated liquid residue generated during the treatment of wastewater, is pumped into the rotor belt, water exits through the filter and concentrated solids are screwed out and periodically removed and land fill [15]. Treated wastewater can be used in Irrigation and its effect was investigated on soil chemical and physical properties with two water treatments of wastewater and groundwater under sprinkler and surface irrigation systems for three crops of sugar beet, corn and sunflower. Irrigation systems had no significant effect on extractable heavy metals in soil. The accumulation of Pb, Mn, Ni and Co in the soil increased significantly in the wastewater treatment as compared to the groundwater treatment. The accumulation of Pb, Mn, Ni, Co, Cu and Zn decreases with the soil depth. Treated wastewater showed no effect on the increase of Fe, Cd, Ni, Cu and Zn during growing season [16].

## 1.2. Wastewater discharge regulations

Wastewater discharge is regulated by Law No. 93 of 1962 and its Executive Regulations, Decree 649 of 1962, as well as by Law No. 48 of 1982, and its Executive Regulations, Decree 8 of 1983 and amended executive decree No. 4 for year 2000 regulates discharge to public sewer systems. Industries in Egypt are required to discharge their wastewater into public sewers except when they are located outside the coverage area. Among other things, these laws list the types of industrial establishments that need licenses to discharge wastewater into public sewers and the standards to which they must keep. Law No. 48 of 1982 prohibits the discharge of untreated wastewater into underground reservoir and branches or canals of the Nile, or the main stream of the Nile, as well as to municipal and agricultural drains. To discharge treated wastewater into a waterway requires a license from the Ministry of Public Works and Water Resources. Table (1) presents the permissible limits of Egyptian Environmental Legal Requirements for Industrial Wastewater for discharges to the different recipients (sea, Nile, canals, agricultural drains, public sewer) according to the different relevant laws [17].

**Table (1); Egyptian Environmental Legal Requirements for Industrial Wastewater [17]**

Parameter (mg/1 unless otherwise noted)	Law 4/94: Discharge Coastal Environment	Law 93/62 Discharge to Sewer System (modified by Decree 4/2000)	Law 48/82: Discharge into:	
			Underground Reservoir & Nile Branches/Canals	Nile (Main Stream)
pH (Grease)	6-9	6-9.5	6-9	6-9
Oil & Grease	15	<100	5	5
Temp. (deg.)	10 °C > avg. temp of recipients	<43	35	35
T.S. Solids	60	<800	30	30
Settable Solids	-----	<10	-----	20
T. D. Solids	2000	-----	800	1200

## 2. SPECIFICATIONS OF ASSIUT POWER PLANTS

The present research has been developed for Assiut electric power plant with a maximum power of 2x312 MW each unit has a Pretreatment Water Unit (Pre.TWU) with 60m<sup>3</sup>/hr capacity, Demineralization Unit (Demi. U) with 45m<sup>3</sup>/hr capacity, Condensate Polishing Unit (CPU) with 850 m<sup>3</sup>/hr capacity and Wastewater Treatment Unit (WWTU) with 50 m<sup>3</sup>/hr capacity. The main parameters of the steam boiler are: steam capacity of 1024 t/hr (maximum), superheated steam pressure, and temperature are 170 bar and 540°C, respectively for both as in Table (2).

**Table (2); Units Specifications**

Item	Unit 1		Unit 2	
	Designed	N. operation	Designed	N. operation
Load MWh	312	155	312	200
Steam ton/hr	1024	484	1024	671
Fuel cons. m <sup>3</sup> /hr	70	35.8	78	51
No. of Burners	16	12	16	12
Steam temp. °C	541	540	541	540
Steam pressure bar	170	170	170	170
Stack height	120 m (+50 m from sea level)		120 m (+50 m from sea level),	
Stack width	φ = 5.13 m		φ = 4.9 m	

### 2.1. Water treatment in Assiut thermal power plant

Raw water contains suspended solids and dissolved solids so water treatment for make-up pass through a chain of operations typically includes;

- Pretreatment through Pre.TWU,
- Demineralization through ion exchanger units Demi. Unit and
- Polishing through ion exchange in CPU,

Where suspended solids removal usually requires such operations as clarification and filtration through Pre.TWU and dissolved solids removal usually requires demineralization through ion exchange resins at Demi. U. In the thermal cycle ammonia and hydrazine are typically added for corrosion control also the water stream is polished through ion exchange resin at CPU. Residues of all of these processes may flow to the WWTU and all the treatment sludge's that produced at the different treatment stages are typically gathered and burying in a landfill.

### 2.2. Sources of Wastewater at Assiut Thermal power plant

In this study we will take unit I as an example, sources of wastewater are included in the following effluent streams. Its sources and specifications are included in Table (3).

- Pre.TWU wastewater effluent,
- Demi. Unit wastewater effluent from ion exchange regeneration and low-conductivity rinse water,
- CPU wastewater effluent from condensate polishing systems regeneration,
- Furnace, heat exchanger surfaces and air heaters washing effluent from fireside, heat transfer surfaces and air heaters chemical cleaning waste,

- Boiler blowdown effluent,
- The oily-water effluent from oil drain pits, and wastewater effluent from wastewater area,

**Table (3); Sources and specifications of waste water**

Item	Quantity	PH	Chemical analysis
Pretreatment water unit's effl.	110m <sup>3</sup> /day	7-8	Fe <sup>+++</sup> , Ca <sup>++</sup> , Na <sup>+</sup> , Mg <sup>++</sup> , Al <sup>+++</sup> , .....
Demineralization unit's effl.	10m <sup>3</sup> /day+250m <sup>3</sup> /week +50m <sup>3</sup> /3month	7-9+3-5	Na <sup>+</sup> , Ca <sup>++</sup> , Fe <sup>+++</sup> , Mg <sup>++</sup> , .....
Boiler blow-down & bled off effl.	150m <sup>3</sup> + 50m <sup>3</sup> /day	8-9	NH <sub>4</sub> OH
Condensate polishing unit's effl.	188 m <sup>3</sup> /week	10-11	NH <sub>4</sub> Cl, NaCl, NaOH, NH <sub>4</sub> OH
Furnace and heat exchanger surfaces washing effl.	At unit shut down and not defined	2-5	Na <sub>2</sub> SO <sub>4</sub> +Na <sub>6</sub> Mg (SO <sub>4</sub> ) + Na <sub>6</sub> Mg <sub>3</sub> (VO <sub>4</sub> ) <sub>4</sub> + NaV <sub>6</sub> O <sub>15</sub> + Ni <sub>3</sub> V <sub>2</sub> O <sub>8</sub> +Fe <sub>4</sub> S <sub>5</sub> O <sub>21</sub> + Na <sub>3</sub> PO <sub>4</sub> + Mg <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> .

### 2.3. Wastewater from pretreatment water unit;

Wastewater at Pre.TWU came from backwash water for sand gravity filters; these filters need to be regularly backwashed to remove the collected sludge and the high turbid effluent (110 m<sup>3</sup>/day) is fed to the retention basin at WWTU.

### 2.4. Wastewater from water demineralization unit

In water demineralization units, water is passed through activated carbon filter; this filter is backwashed before the unit starts up and the produced effluent (10 m<sup>3</sup>/day) is fed to the LTDS (Low Total Dissolved Solids) basin, then the filtered water is passed through the ion exchange resin to eliminate the dissolved salts and after the resin is exhausted, it needs to be regenerated. The regeneration is accomplished by using acidic solution for cationic resin regeneration and alkaline solution for anionic resin regeneration. The regeneration exhaust, the almost acidic effluent in nature (107m<sup>3</sup>), is fed to the HTDS (High Total Dissolved Solids) basin. The demineralized water from anionic vessel is passed through the mixed bed (cationic and anionic resin together mixed in one vessel) ion exchange resin to accomplish the elimination of escaped dissolved salts from cationic or anionic vessels. After the resin in mixed bed vessel is exhausted, it needs to be regenerated too as reported above, the almost acidic effluent (50m<sup>3</sup>) in nature too. Also the effluent form the rinse step for anion and mixed bed tanks at demi.unit start up is fed to the H. T.D.S. basin. The effluent in the L.T.D.S. basin is fed to the retention basin and that in the H. T.D.S. basin is fed to the neutralization basin to be neutralized then fed to the retention basin too at WWTU, and are treated as wastewater.

### 2.5. Wastewater from boiler area and Condensate Polishing Unit

Power plants are usually designed to recycle condensed steam for boiler feed water as a means of conserving water. The plant operation requires boiler feed water to be highly pure; where, dissolved solids concentrate in the recycled condensate as a result of

evaporative water loss and to maintain total dissolved solids below allowable limits for boiler operation. The whole condensate water are pumped from the condenser through mixed (cationic and anionic resin) ion exchange resin filters called "Condensate Polishing Unit" when these filters are exhausted need to be regenerated, the regeneration is accomplished by using acidic solution for cationic resin regeneration and alkaline solution for anionic resin regeneration. The regeneration exhaust that gathered in the condensate polishing drain pit, the almost alkaline effluent in nature ( $188 \text{ m}^3/\text{week}$ ) is fed to the neutralization basin to be neutralized at W.W.T.U. then be pumped to retention basin, and a controlled amount is continuously bled off through the continuous blowdown valve, this blowdown effluent ( $150 \text{ m}^3/\text{day}$ ) and also the leakage through valves, pump glands and flanges bled off effluent ( $50 \text{ m}^3/\text{day}$ ) are gathered in the drain basin and then fed to the retention basin at W.W.T.U. too and treated as wastewater. Finally, these losses in the thermal cycle must be replaced with high purity make-up water from demi.unit.

## **2.6. Wastewater from furnace and heat exchanger surfaces cleaning;**

Cleaning of this equipment usually requires strong chemicals to remove fuel residues and metal oxides and scales formed on these surfaces. The cleaning is not successful unless the surfaces are cleaned to bare metal, and this means that some metal must be dissolved in the cleaning solution. The chemicals used for cleaning are typically alkalis such as sodium carbonate and sodium triphosphate. The effluent that contains the cleaning agents, ashes and dissolved metals is collected at air heater wash basin and were treated with an alkali (NaOH) for complete neutralization, then fed to neutralization basin at WWTU, the residual solid was collected and burying in a landfill.

## **2.7. Wastewater from fuel area**

The oily water from the fuel area drains gathered in the oil drain pit and pumped automatically to the oil separator in the wastewater treatment unit, where the floating oil is scrubbed and collected in the oil holding tank and the clean water is directed to the retention basin.

## **2.8. Wastewater from wastewater area**

Water from wastewater area is from;

- Sand gravity filters in wastewater treatment unit are regularly backwashed to remove the collected sludge and the high turbid effluent water is collected in wastewater area drain pit.
- Sludge that settles to the bottom of the clarifier in Pretreatment and Wastewater treatment units are pumped out to the thickener tanks in the wastewater area and the slurry pumped into the filter press in the depress filter unit for dewatering, water exits through the filter to the wastewater area drain pit and concentrated solids are screwed out and periodically removed and disposed of in a landfill.

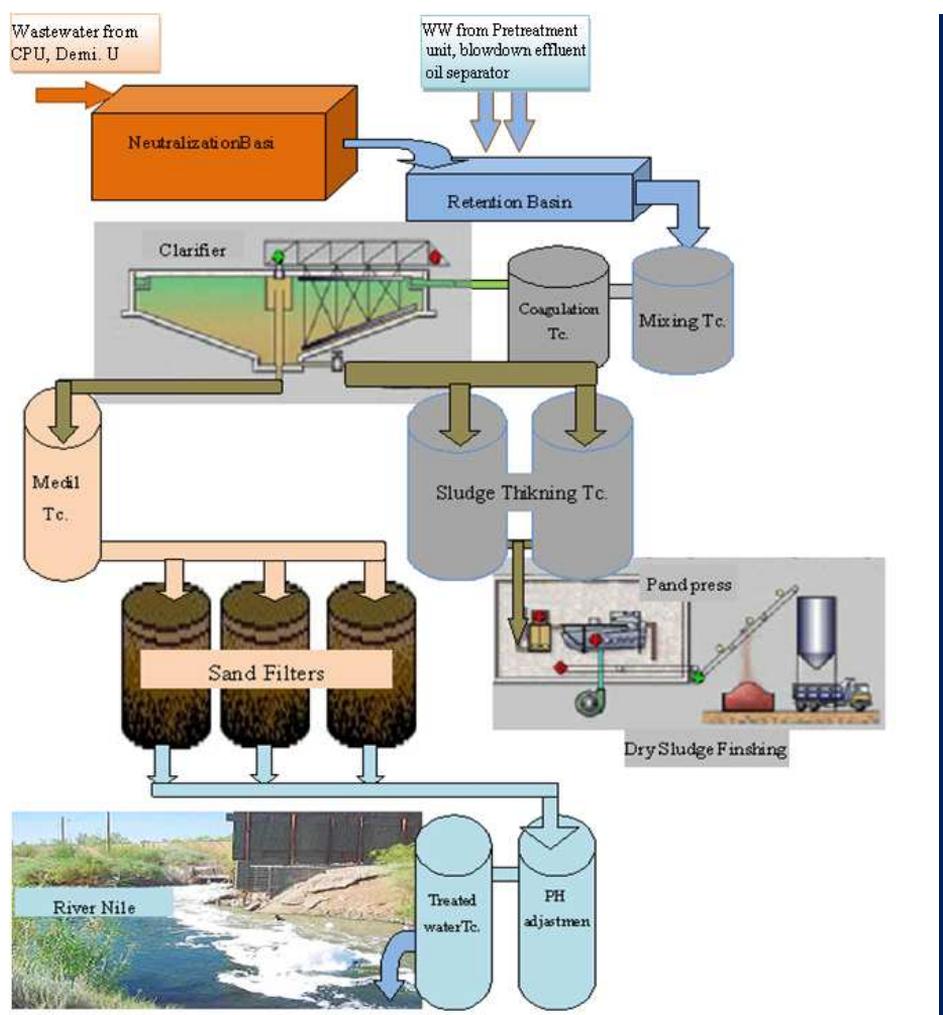


Fig (1); the waste water treatment ( unit I)

### 3. DISCUSSION AND ANALYSIS

Wastewater treatment in WWTUI, Fig (1), at Assuit power plant is gone within two ways; the conventional method and the new one.

#### 3.1. The conventional method

The conventional method for wastewater treatment is carried out through the following steps:

##### 3.1.1. Wastewater in neutralization basin

Wastewater that gathered in the neutralization basin from the air heater washes basin and H. T.D.S. basin is neutralized with hydrochloric or sulfuric acid then fed to the retention basin but that from C.P.U. drain pit is neutralized with sodium hydroxide then fed to the retention basin also.

### 3.1.2. Wastewater in retention basin

Wastewater that gathered in the retention basin from the blowdown effluent (150 m<sup>3</sup>/day) and also the leakage through valves, pumps' gland and flanges bled off effluent (50m<sup>3</sup>/day) from boiler area, the high turbid effluent (110 m<sup>3</sup>/day) from pretreatment water unit, the L.T.D.S. effluent (10 m<sup>3</sup>/day), the clean water effluent from the oil separator, and that from neutralization basin are subjected to conventional suspended solids removal processes (flocculation, clarification, and media filtration), where the pH of the water is adjusted in neutralization tank. Then it is pumped to the flocculation tank in which the flocculant agent (FeCl<sub>3</sub> and/or Ca(OH)<sub>2</sub>) is injected with adjusted dose for complete flocculation then fed to the coagulation tank in which the coagulant agent aid polymer (polyelectrolyte substance) is injected. Then the stream is fed to the clarifier tank for sedimentation process of the sludge and complete clarification. After that the clarified water is gathered by overflow in the clarified water tank then pumped to the sand gravity filters for removing particles from water. The filtered water is then gathered in the PH adjustment tank that when filled with adjusted PH water is overflowed to the treated water tank, Table (4) shows the daily technical data sheet, the treated water then pumped to the River Nile by the treated water pumps, the PH is monitored online and the lab. Chemical analyses, Table (5) are operated and taped periodically.

**Table (4); The waste water treatment units' daily technical data sheet**

Date / / Time	Level of Neut. Basin%	Level of Reten. Basin%	Flow Rate to Clea.%	PH In Coag. Tc.	Sand Filter L/S	PH In PH adj. Tc.	PH in Treated water	Treated water pump L/S	Treated water F. Rate %	Notes
08:00										Sand Filter A is In back wash
09:00										
10:00										
11:00	56	30	25	7.0	A,B,C	--	--	--	--	
12:00	75	33	25	7.0	A,B,C	--	7.2	B	50	
13:00	98	25	30	7.0	A,B,C	--	7.2	B	--	
14:00	18	35	30	7.1	B,C	--	7.3	B	50	
15:00	19	29	30	7.0	B,C,	--	7.4	B	50	
16:00	20	25	30	7.3	A,B,C	--	7.4	B	50	Sand Filter B In back wash
17:00	21	21	30	7.2	A, C	--	7.3	B	--	
18:00	24	14	30	7.2	A, C	--	7.5	B	50	
19:00	25	10	30	7.3	A,B,C	--	7.6	B	50	

**Table (5); The waste water treatment units' daily chemical analysis**

Item	Unit	Value	Notes
PH	--	7.0	Where; C.O.D is the Chemical Oxygen Demand B.O.D. is the Biological Oxygen Demand
Oil	ppm	5	
Turbidity	NTU	<1.0	
T.S.S.	ppm	<5.0	
T.D.S.	ppm	1150	
C.O.D.	ppm	10	
B.O.D.	ppm	<5.0	

## 3.2. The New Methods for Treatment

In our present study's course the following ideas and arrangements are applied;

### 3.2.1. Volume reduction

The main control and treatment methods for wastewater involve recycling and reusing wastewater [8], to minimize the effluent streams of wastewater to WWTU are by reducing the volume of such streams, this can be achieved by classifying wastewaters, reusing effluents as raw water supplies and arrangement between the incoming wastewaters;

- Reusing effluents as raw water supplies;

The high turbid effluent (110 m<sup>3</sup>/day) backwash water for sand gravity filters at Pre.TWU is fed back to the clarifiers as raw water through the tie valve between backwash out pipe to the wastewater and raw water pipe to the clarifiers. By this way no chemical are used and the operation time reduced (about 2hr) required for WTU to treat and discharge it.

- Classifying and arrangement between the incoming wastewaters;

Classifying the exhaust effluent by type [4] as acidic and alkaline one, where acidic regeneration effluent (250 m<sup>3</sup>/week, PH=3-5) from demi. Unit exhaust at H.T.D.S basin to the neutralization basin at WTU is retained waiting for the alkaline effluent (188 m<sup>3</sup>/week, PH=10-11) from the drain pit at CPU the two effluent are mixed by circulating water pumps on the neutralization basin where the PH is monitored continuously and showed that the PH equal to 6.3 and this value enough for discharging the neutralized water to the retention basin, where it is possible of course that mixing lightly and heavily contaminated streams may product a discharge stream that is acceptable [5] to be treated as wastewater. By this way the alkali and acid required for neutralizing are saved, so the amount SO<sub>x</sub> emitted during sulfuric acid production, (Hg) dissolute during hydrochloric acid and sodium hydroxide production are reduce.

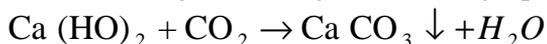
### 3.2.2. Wastewater Evaporation

For minimizing the effluent streams of wastewater to WTU are by reducing the volume of such streams also this can be achieved by evaporating the highly contaminated effluent after neutralizing, where the highly contaminated effluent from air heater, furnace and heat exchanger surfaces cleaning that was collected at air heater wash basin was treated with an alkali (NaOH) for complete neutralization, then fed to retention pond (evaporation pond) then left to complete evaporation, By this way the volume of water requiring intensive treatment reduced and the high content of TDS, that would be thrown to the River Nile was eliminated. Finally, chemicals (FeCl<sub>3</sub> and polyelectrolyte) and operation time required to be treated and discharged at WTU were reduced, the TSS and Ashes were collected as a solid wastes in the basin bottom.

### 3.2.3. Wastewater aeration

The effluent streams from WTU were found to have a high content of T. D. S. (out of limit) especially after using lime in neutralization (1500 ppm) as shown in Table (5), so aeration blower was used to aerate the effluent stream before entering the clarifier and

the result was a reduction in the TDS content where it reached to 1000-1200 ppm and this due to the excess of calcium hydroxide was precipitated in the clarifiers as calcium carbonate sludge according the following equation;



Also aeration contributes in the removing of dissolved iron and manganese salts.

### 3.2.4. Irrigation purposes;

Due to the good quality of the treated wastewater, as illustrated in Table (5), and in accordance with wastewater discharge regulations together with the aim of saving water at all levels, it is recommend using water in irrigations the green area of the Assiut power plant camp. Accordingly, as an indirect discharge way for the treated wastewater, modifications were done for routing the treated water for irrigating the green areas between camp buildings.

## 4. ENVIRONMENTAL IMPACT

As mentioned before; the new arrangements that applied in dealing with effluent streams to wastewater treatment unit are:

1. Reduction of the effluent volumes by re-using it as a raw water and evaporating the high contaminated effluent,
2. Treatment by aeration, and neutralization of the acidic water by the alkaline one, and
3. Using the treated wastewater in irrigations,

As a result, the corresponding operating time of the WWTU, the amount of chemicals such as acids, alkalis,  $\text{FeCl}_3$  and polyelectrolyte and the discharged treated wastewater to the River Nile are reduced. This will have a positive impact on the environment through:

- 1- Reduction of the amount of TDS discharged to the River Nile
- 2- Reduction of the electrical energy consumption by reducing the operating time of the WWTU and this leads to a reduction in pollution associated with electrical energy production.
- 3- Reduction of the amount of chemicals especially acids and alkalis, such as:
  - Reducing the amount of sulfuric acid used reduces the air pollution with  $\text{SO}_x$  during sulfuric acid production.
  - Reducing the amount of hydrochloric acid and sodium hydroxide used will reduce the pollution due to mercury (Hg) dissolution, where it is used as the negative electrode in the electrochemical cell required for the electrolysis of the sodium chloride during manufacturing the hydrochloric acid and sodium hydroxide [18].
- 4- Reduction of the amount of treated wastewater discharge in accordance with Egyptian Environmental Legal Wastewater discharge Regulations.

## 5. CONCLUSIONS

The reduction of wastewater effluents to wastewater treatment units, by recycling as raw water supplies, classifying and arrangement between the incoming effluents, treatment of the wastewater effluents by evaporation and aeration, and due to the good quality of the treated wastewater, and in accordance with the aim of saving water, using the treated effluents for irrigation purposes, led to, the corresponding reduction operating time of the WWTU, and the reduction of the amount of chemicals (acids, alkalis, ferric chloride ( $\text{FeCl}_3$ ) and polyelectrolyte) and the discharged treated wastewater to the River Nile, which has a positive impact on the environment through; Reduction of the amount of TDS discharged to the River Nile, the electrical energy consumed which reduces the pollution associated with its production and the air pollution with  $\text{SO}_x$  and mercury (Hg) dissolution due to the reduction of sulfuric, hydrochloric acids and sodium hydroxide used. At the end the Egyptian Environmental Legal Wastewater discharge Regulations were obeyed.

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### دراسة سبل معالجة مياه الصرف الصناعي بمحطة كهرباء اسيوط الجديدة

خفض مياه الصرف الصناعي الي وحدة معالجة مياه الصرف الصناعي بإعادة استخدامها وتصنيفها والترتيب بين المياه الحامضية والقاعدية والمعالجة بالتهوية و التبخير واستخدام المياه بعد معالجتها بوحدة معالجة الصرف الصناعي في اغراض الري، ادت كل تلك العمليات الي خفض كمية المواد الكيماوية والمياه المعالجة المنصرفة الي نهر النيل و زمن تشغيل وحدة معالجة مياه الصرف الصناعي ، والذي كان له الأثر الإيجابي بيئيا ومنع التلوث من خلال: خفض كمية الاملاح الصلبة الذائبة المنصرفة الي النيل، خفض الطاقة الكهربائية المستهلكة في وحدة معالجة مياه الصرف الصناعي مما يخفض من الانبعاثات الملوثة مثل اكاسيد الكبريت، والزنك الذي يتسرب الي البيئة نتيجة لخفض كمية حمض الكبريتيك الهيدروكلوريك والصودا الكاوية المستخدمة في عملية المعالجة، وبذا تم التوافق مع قوانين حماية البيئة المصرية.