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Study the Efficiency of two waste Treatment Plants in the Al-Karkh and Al-Rusafa of Baghdad Region in 2015

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Abstract: This study was conducted to demonstrate the efficiency of wastewater treatment plants in Baghdad. Al-Rustamiyah and Al-Karkh wastewater plants were chosen for this purpose. Several critical parameters (DO, BOD_5, COD, TSS,TDS and Nutrients) were selected for the study of the efficiency of each plant and its impact on the river water (Tigris River). Water samples were collected from different locations (two samples from each location) for each unit, during the months of February and June of 2015. It was observed that the level of efficiency of the stations below the required level for several reasons, the most important factor was lying on the 1st stage, which failed to withdraw TSS and TDS, which caused stagger to the rest of the stages. Also the amount of water entering the plant more than the designed capacity, leading to discharge of untreated water directly into the river without treatment

Keywords: *wastewater treatment plants, river contamination*

Introduction

Rivers contaminated by sewage water discharged from the wastewater treatment plants, causing large quantities changing in the chemical, physical and biological specifications in the rivers (Davis, 2005). Most of these stations must be constructed depending on many active parameters by decreasing the real effects of these stations on the sources of water (Henze, 2008).

As a result of the expansion of the city of Baghdad with increasing population density, there has become an increased demand for water uses, It was constructed two units of sewage treatment in Baghdad representative of the Karkh and Rusafa regions. Al-Karkh wastewater treatment plant, which was located in the south of Baghdad (Doura district) discharged their waste directly into the Tigris River (Baghdad Municipality, 2014). Al-Rustumiya wastewater treatment plant, the old and the new expansion, and discharged their wastes in the Diyala River and then into the Tigris River. The assimilation of these two units of surplus water as a result of the growing demand for it, leads to reduced their efficiency, according to the available contaminants in it (Baghdad Municipality, 2010).

The previous studies on these two stations shows reducing their efficiency for pollutant treatment which was discharged into the River Tigris (Ali *et al.*, 2001), while the recent years show a deterioration in the specifications recorded in these two units because of the quality and quantity of water discharged into it, and that exceed the design capacity of these two projects, as the design capacity of the Al- Karkh wastewater treatment plant of up to 410 000 m^3/day. The design capacity of the Al- Rusafa was up to 600 000 m^3/ day (Baghdad Municipality, 2010). While the incoming wastewater to them was more than 980000 m^3/day for each station, an increase higher than 100% of design capacity for each. Add to that breakdown some of the units to work, and electric power dropping(Baghdad Municipality, 2014).

As a result of pollution occurred in the Tigris and Diyala because of these two units, it has become necessary to study the efficiency of the two units in the treatment of water discharged to, a goal which came by the study.

Materials and Methods

Water samples were collected from different locations in each of units, two samples from each location during the months of February and June of 2015. Using polyethylene bottles of 5 liters for this purpose. The sample was washed with water well before starting the process of collection. Oxygen bottles used in a 250 ml to measure the oxygen and the biological oxygen demand; all the measurements recorded in this research out, according to the methods as follows:

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1- pH : measured in the field using a device type Hanna 961
2- Turbidity: measured using a digital portable turbidity meter device type HATCH. The results were expressed as NTU (Nephelometric Turbidity Unit).
3- Dissolved oxygen (DO), and Biological oxygen demand (BOD_5): calculated by using an Azide modification Winkler method (APHA, 2012).
4- Chemical oxygen demand (COD): calculated by using the method described in (APHA, 2012), where the COD samples were measured by photolab-6000 series type (WTW,Germany) ,which calibrated by using standard solution, the results expressed as mg/l.
5- Total Hardness: calculated with EDTA method titration (Francis, 1962), as the equation below:
   TH mg/l as $CaCO_3$= $\frac{\text{Titration in ml.(less blank)X1000}}{volume\ of\ sample(ml)}$
6- Total suspended solids (TSS) and total dissolved solids (TDS): calculated using the gravimetric method (APHA, 2012). As follows:
   TSS mg/l = $\frac{A-B}{ml\ of\ sample}X1000$
   A: weight of filter paper with residue (mg)
   B: weight of filter paper
7- Sulphate: calculated using a spectrophotometric method described by Brands &Triple (1982).where:
   SO_4 mg/l = $\frac{ml\ \ titration\ for\ sample}{50}$
8- Nitrate: calculated using spectrophotometric method (APHA,2012), as
   NO_3-N mg/l = $\frac{B}{A}$
   A (standard) = $\frac{[(\lambda 220-2(\lambda\ 275)]}{2}$
   B (sample) = $\lambda 220 - 2(\lambda 275)$
9- Phosphate: calculated using spectrophotometric method (APHA,2012).
10- Chloride: calculated using titration method (APHA, 2012).as the following:
   mg Cl/l= $\frac{\text{N} * \text{V} * 35450}{ml\ of\ sample}$
   N: Standardized silver nitrate
   V: Volume of silver nitrate titrated
11- Calcium: calculated using titration method (APHA, 2012).as the following:
   mg Ca/l = $\frac{v*N*400.8}{ml\ of\ sample}$
   N: Standardized of EDTA
   V: Volume of EDTA titrated
12- Magnesium: calculated from the equation:
   mg Mg/l = 12.16 X (mEq. Hardness/l – mEq. Ca/l) where:
   mEq. Hardness = mg/hard. X 0.01998
   mEq. Ca = mg Ca/l X 0.0499

Results and discussion

The results of laboratory analysis were shown in Tables 1, 2, 3 and 4, the efficiency of these two units decreased in varying degrees and clear in the year 2015. It was found that the efficiency of Al-Rustumiyah wastewater plant with all expansions did not exceed 29.3% in February and 35.6% in June of the factors studied only. Also the important elements in this study for environmental pollution like dissolved oxygen, biological oxygen demand, chemical oxygen demand, hardness, sulphate and chloride appeared in high concentrations before and after treatment, where the average efficiency of the plant to remove contaminants ranged between 10.3% for the month of February and 5.8% for the month of June.

Musa (2009) recorded higher efficiency in Al-Rustamiyah wastewater treatment plant ranged between 81-87.9% in summer and winter of the year before 2009 for the most factors studied. However, there is a clear imbalance recorded during the summer of this year, when measuring the chemical oxygen demand, which shows a decline in its efficiency extent of 45%. In general, did not register lower efficiency than those values during the last ten years (Al-Zehairy, 2009).

Al Any (2000) pointed out that the Al-Rustamyiah station was caused by the pollution of the rivers Tigris and Diyala as a result of higher discharge output from the plant compared to the Diyala river lowland of scarcity, therefore this influence extends to the apparent imbalance in the composition of the population in the Diyala river (Rasheed *et al.*, 2000 b,c). Study of (Rasheed *et al.*, 2000a) showed that the physical and chemical properties of the Tigris river greatly affected during the summer by pollutants resulting from Al-Rustamyiah station. Al- Dulaimi (2015) noted in his study on Al-Rustamirah wastewater treatment plant that the water resources in Iraq like Tigris and Diyala river influenced by a higher discharge of pollutants resulting from this station. Sabri *et al.*, (2000) showed that the environment of Iraq (after the Gulf war in 1991) effects deeply, especially the resources of fresh water, this resulting from the discharge of wastewater to trocar (as a part of the economic policy and to maximize agricultural resources), then to Tigris river.

Table 1. Efficiency of Al- Rustumiyah wastewater treatment plant in February 2014

Sample	pH	Turb.	DO	BOD_5	COD	TH	TSS	TDS	SO_4	NO_3	PO_4	Cl	Ca	Mg
Before treatment	7.23	1250	2.0	261.3	1950	950	536	1960	859.4	1.068	56.83	379.8	204.4	106.7
After treatment	6.68	500		178	1732	860	114	1780	822.9	0.336	29.13	359.8	180.4	99.47
Efficiency %		60		31.8	11.2	9.5	78.8	9.1	4.2	68.5	48.7	5.2	11.7	6.7

**All the results expressed in mg/l*

Table 2. Efficiency of Al- Rustumiyah wastewater treatment plant in June 2014

Sample	pH	Turb.	DO	BOD_5	COD	TH	TSS	TDS	SO_4	NO_3	PO_4	Cl	Ca	Mg
Before treatment	7.45	600	1.0	283	2102	1040	916	1808	996	28.5	70	489.8	288.5	77.5
After treatment	7.89	9	0	269	2075	980	1.2	1386	990	13	35.5	379.8	184.3	26.2
Efficiency %		98.5		4.9	1.3	5.7	99.8	23.3	0.6	54.4	49.5	22.4	36.1	66.2

**All the results expressed in mg/l*

Table 3. Efficiency of Al- Karkh wastewater treatment plant in February 2014

Sample	pH	Turb.	DO	BOD_5	COD	TH	TSS	TDS	SO_4	NO_3	PO_4	Cl	Ca	Mg
Before treatment	7.45	660	0	250	1634	870	172	1910	792.1	0.5	31.3	409.9	152.3	118.9
After treatment	7.80	15	0	159	1440	830	27.6	1676	790	0.3	13.8	379.9	148.3	111.6
Efficiency %		97.7		36.4	11.8	4.6	83.9	12.2	.89	40	55.9	7.3	2.6	6.1

**All the results expressed in mg/l*

Table 1. Efficiency of Al- Karkh wastewater treatment plant in June 2014

Sample	pH	Turb.	DO	BOD_5	COD	TH	TSS	TDS	SO_4	NO_3	PO_4	Cl	Ca	Mg
Before treatment	7.7	310	3	488	1750	820	884	1512	980	18.5	77.5	329.8	152.3	106.8
After treatment	8.1	66	0	145	1697	800	1.2	1386	976	6.3	21.4	309.9	136.4	96.2
Efficiency %		78.8		7.3	3.1	2.4	99.7	2.1	0.41	65.9	72.4	6.1	10.4	9.9

**All the results expressed in mg/l*

Bashy and Alabd-Rabah (2000) found that the capture basin in the first stage is not efficient because of falling the separation wall (during the Gulf War 1991), which causing a lot of problems in the other stages. In addition, highly sedimentation occurs in ventilation process and increase the number of bacteria in all stages.

At Al-Karkh station, it was found that the proficiency was low from previous years and recorded the efficiency between 21.5% in February to 28% in June. The important pollutant factors in this station ranged between 4.4% in June to 10.2% for the month of February, as well as the emergence of algae in most operating units in this station, caused reduced nitrates, phosphates and the observed high efficient checkout which ranged between 33.9-72.4% of the concentration of phosphate and 40-65.9% of the nitrate. Few studies are found on this station because of its local sensitives beside Iraqi Atomic Energy organizer.

Conclusions

1. The amount of water entering the plant more than the designed capacity, leading to discharge of untreated water directly into the river without treatment.
2. The repeated interruptions in the power supply lead to a lack of plant efficiency.
3. The water is discharged to the station treated with physical and biological methods only, and there is no other treatment leading to high concentrations of the chemical elements such as phosphates and sulphates affecting the water source.
4. The lack of specialized technical staff in sufficient numbers for the operation and maintenance of the plant in all its stages.
5. The discharge of effluents from the industrial and service activities directly via the sewer system or by irregular bundles in addition to human waste, which negatively affects the terminal units and hampering the liquidation process.
6. Fats resulting from the processing plant are landfilled at the site itself does not treat.

References

Al-Any HJ, (2000) River water pollutants and its impact on the environment. *The 1st Conference on the environmental and methods to protect from pollution*.5-6/ 11/ 2000. 306-318.

Al-Dulaimi MA, (2015) *Physical and chemical characteristics of treated water of Rustamyiah sewage treatment plant and the efficiency of treatment methods*. MSc. Theses, University of Baghdad. Pp.98.

Al-Zehairy MS, (2008) Future evaluation of the efficiency of the performance of wastewater treatment plants in the Baghdad city. *Technical Journal*. **21**(1): 14-23. (In Arabic).

Ali ZH, Salman KAbd, Abd-Alateef KA, (2001) Evaluating the efficiency of the filter in Al-Rustamiya wastewater treatment plant. *Almustansriyah J.* **12**, 200-212.

American Public Health Association (APHA) (2012), Standard methods for the examination of water and wastewater. 22nd ed. Washington DC.

Andew S, Harum J, Jonathan S, Robert B, (2003) *Municipal wastewater treatment evaluating improvments in national water quality*. John Wiely and Sons Inc. New York: 17-35.

Baghdad Municipality, (2010) *Baghdad sewer department, The old Rustamyiah wastewater treatment plant*, Brief on Rustamyiah project. Pp.84. (In Arabic).

Baghdad Municipality, (2014) Baghdad sewer department**,** Department of Designs, Division of Geographic Information (GIS). (In Arabic).

Bashy NY, Alabd Rabah WM, (2000) Finding efficient removal using activated sludge with a long-term ventilation. *J. of Environmental and Sustainable development Research*. **3**, 82-86.

Brands HJ, Tripke E, (1982), Water manual. Vulkan-Veriag,Essem. pp.320

Davis P S (2005), The biological basic of wastewater treatment. Strath Kelvin Instruments.

Francis W (1962), Boiler house and power station chemistry. Edward Arnold LTD. London, Pp. 434.

Henze M, (2008) *Biological wastewater treatment:principles modeling and design*, IWA publishing, London,Uk.

Musa S A (2009) Study the effects of disposing Rustamiyah treatment plant effluent on some physical and chemical characteristics of river Diyala. College of Science, Babylon Unv.. 14th *Scientific Conference*.

Rasheed KA, Sabri AW, Shahatha HA, (2000a) Study of the physical and chemical properties of the lower part of the Tigris and Diyala rivers south of Baghdad. *Diyala J. of Appl. Sci.* **2**, 95-104.(in Arabic)

Rasheed KA, Sabri AW, Shahatha HA, (2000b) The distribution and spread of zooplankton in the lower part of the Tigris and Diyala rivers south of Baghdad. *Diyala J. of Appl. Sci.* **2**, 1-10. (in Arabic)

Rasheed KA, Sabri AW, Al-Lami AA, Sabti HA, Kassim TI, (2000c) The effect of Diyala river on the Tigris river:Distribution and spread of benthic fauna. The 1st Conference on the environmental and methods to protect from pollution.5-6/ 11/ 2000. 56-64. (in Arabic)

Sabri AW, Ali ZH, Rasheed KA, (2000) The effects of Gulf war on Iraq: Biological contamination. The 1st Conference on the environmental and methods to protect from pollution.5-6/ 11/ 2000. 663-672. (in Arabic)