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Estimating the Water Properties Which Effluent From Sewage Treatment Plants of Al-Kut Province Into the Tigris River, Iraq

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Abstract:

The aim of the present study is to know the water specification which ejected from Al-Kut sewage treatment plants in the Tigris River the main great river in Iraq and going through Al- Kut City the center of Wasit Province. It is located 32.51 latitude and 45.82 longitudes and it is situated at elevation 22 meters above sea level. Al Kut City has a population of 315,162 making it the biggest city in Wasit. Four sewage treatment plants stations were selected in Al-Kut City, Bimonthly sampling was carried out from January 2016 till December 2016; two samples were taken each month. Station one was AL-Shohda plants. The second station was AL-Horaa plants, the third station is AL-Salam plants and the four stations is AL-Kajia plants In the present study thirteen physical and chemical parameters were selected on the importance of these parameters. These thirteen parameters are ranged as follows:, water temperature 13.5 to 35 °C, pH 7 to 8.1, EC 1339 to 4800 µS/cm, BOD_5 30 to 319mg/L, TDS 800 to 3400 g/L, TSS 40 to 560 mg/L, and NO_3^{-2} ND to 10 mg/L and PO_4^{-2} ND to 19.5 mg/L, Sulfate 123 to 987 mg/L, Cl^- 153 to 448 mg/L, NH_3 22 to 100 mg/L, $NO_2^=$ ND to 1.3 mg/L, H_2S 5 to 81 mg/L, COD 96 to 369 mg/L and Oil& Greas 60 to 240 mg/L. Concluded from the current study, all wastewater treatment has a direct impact on the water characteristics of the Tigris River.

Key words: Tigris River, Water Properties, sewage treatment plants

INTRODUCTION

Water is the most important natural resource in the world. It is an essential element in the maintenance of all forms of life. Without it life cannot exist and most industries could not operate [1]. Approximately, 20% of the world's population lacks safe drinking water and nearly half the world population lacks adequate sanitation. This problem is acute in many developing countries, which discharge an estimated 95% of their untreated urban sewage directly into surface waters. Iraq, which is one of the nine middle eastern countries have insufficient fresh water [2]. Water pollution is a major global problem. It has been suggested that it is the leading worldwide cause of deaths and disease [3]. Surface waters are most exposable to pollution due to their easy accessibility for disposal of wastewaters [4]. The term "sewage" means gray water that generated by the many activities in the process of meeting his various living requirements. The sewage can be described as wastewater from a community. Wastewater refers to spending or used water containing dissolved or suspended matter. Wastewater from residential areas is referred to as domestic sewage [5; 6]. Sewage from various homes and institutions (private and public) in a community constitute municipal sewage [7]. The aim of the present study is to know the water specification which ejected from Al-Kut sewage treatment plants to Tigris River the main great river in Iraq and going through Al- Kut City the center of Wasit Province.

MATERIAL AND METHODS

STUDY AREA

Wassit AL-Kut is located in eastern Iraq, on the border with Iran. Tigris River divides the city into a right and left sections with a flow direction from north to south. Wassit shares internal boundaries with the governorates of Diyala, Baghdad, Babil, Qadissiya, Thi-Qar and Missan. Wassit is intersected by the Tigris River, along which a ribbon of irrigated farmland runs, giving way to a dry desert landscape to the north east (Figure 1).

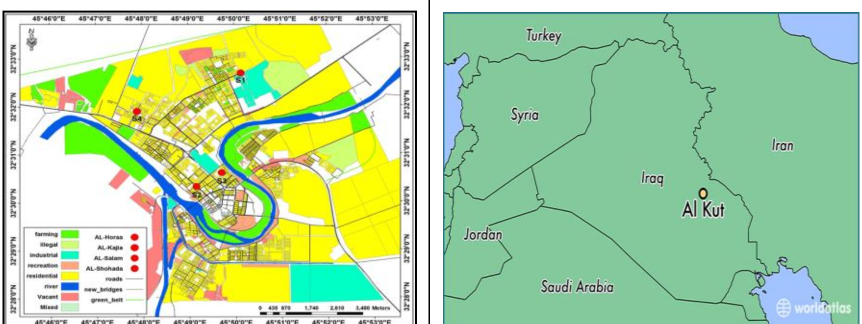


Figure (1):- Maps of Iraq and Al-Kut Province showing the sampling site on Tigris River, Iraq.

Samples for physical and chemical variables were performed from four stations during 2016 period. Station one is AL-Shohda was located at 578465.214408X, 3601124.6465Y. The second station was AL-Horaa situated at 576973.436355X, 3596757.44122Y. Third station is AL-Salam located at 577826.453068X, 3593597292.07846Y. The fourth station is AL-Kajia situated at 574953.028227X, 3599640.878Y . Water samples were collected for Physio-chemical analysis by using polyethylene bottle 5L capacity, which was washed by water sample twice before filling. The sample collected under the surface water about 20-40 cm, then kept at 15°C in refrigerator

[8]. Physical and chemical parameters included:- Water temperature (by using precise mercury thermometer), Hydrogen ion concentration (by using pH-meter), Electrical conductivity and total dissolved solid (by using EC-meter), Biological oxygen demand and Chemical oxygen demand (Winkler methods), Nitrate, Nitrite, Phosphate, Ammonium, Sulphat, Total Suspended Solid (by using spectrophotometric methods), Chloride and H_2S (by using titrimetric methods), measured according to APHA[9] [10], Oil&Grease(by using Soxhlet) and use hexane as a solvent [11]. In this study, the water properties were applied and tested for all the sites on the Tigris River using of Iraqi standard guidelines for wastewater discharged to the watercourse [12].

RESULTS AND DISCUSSION

Table (1) shows monthly changes in water temperature for the four selected stations. Values ranged from 13.5 ºC in station-1 during January (2016) to 35º C in station-2 during July (2016) (Figure 2). Water temperature is an important factor in any aquatic environments affecting on biological processes, This result was similar to previous studies done by [11]. Monthly changes in values of Oil&Grease ranged from 60 mg/L in station 4 during March 2016 to 240 mg/L in station1 during January (2016) (Figure 3). It was found that the values of the indicators of the pollution of sewage water are large, So in areas with a high social level the values were lower than other rest regions, and this fact has been observed [13]. Oil&Grease ranged were exceeding the standard value for wastewater discharged into the watercourse in all sites.

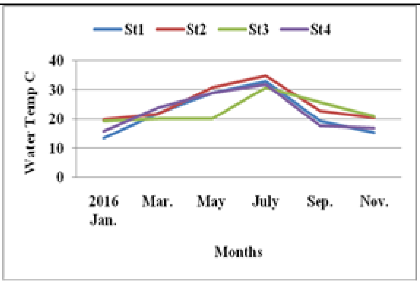
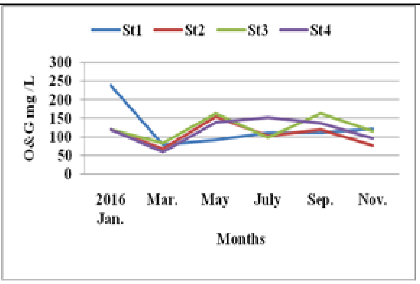
	

Figure (1): Variation of water temperature.	**Figure (2): Variation of oil and grease.**

Monthly changes in values of biological oxygen demands (BOD_5) shows the lowest value 30 mg/L was recorded in November 2016 from station 4 and the highest 319 mg/L was in March 2016 on station 2(Figure 3).The biological oxygen demand is defined as the quantity of DO which is able to oxidize the organic components in the water with the assistance of microorganisms under defined experimental conditions [14] .Generally, results indicate that increasing levels of BOD_5, especially at station 2 during the March , this may be due to decomposition of organic matters that run directly to the river with domestic sewage. These results were slightly higher than that reported by [15; 16]. The results denoted that the mean concentrations of BOD_5 were exceeding permissible levels recommended by Iraqi standard guidelines value for wastewater discharged to the watercourse in all sites.

The lowest of monthly changes in values of The Chemical oxygen demand 96 mg/L was recorded in March 2016 at station 4 and the highest 369 mg/L was in January 2016 at station1(Figure 4). Chemical oxygen demand is defined as the amount of a specified oxidant that reacts with the samples under controlled conditions[17] also is often used as a measurement of pollutants in wastewater and natural water. COD ranged were exceeding the standard value for wastewater discharged into the watercourse in all sites.

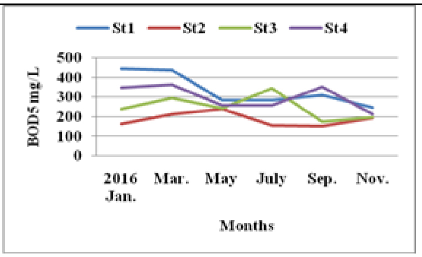


Figure (3): Variation of BOD5.

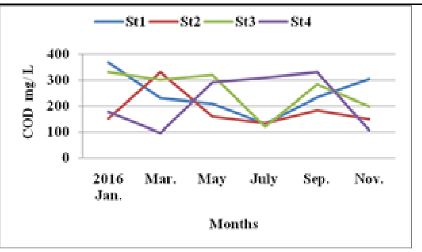


Figure (4): Variation of COD.

Monthly variation in pH values varied from the lowest value 7 was recorded in November 2016 at station 1and 4 whereas the highest value 8.1 was in September 2016 recorded at station 4(Figure 5). The pH of water is directly related to carbonate and bicarbonate ions present in it which is closely associated with CO_2 pressure and the ionic strength in the aquatic solutions. It is well known that the pH is an important parameter in evaluating the acid-base balance of water. The pH value of water at sewage plant which received a discharge from the Paper Mill area was found was usually higher than that of the river water. Water having a pH greater than 8 contains carbonates and pH range 4.5-8 contains bi-carbonates and carbonic acids. The waters having a pH less than 4.6 contain carbonic acid. Monthly changes in values of Chloride were recorded the lowest 153 mg/L was measured from station 2 in September 2016 and the highest 448 mg/L was observed in January 2016 from station1(Figure 6). Chloride is a natural substance present in all portable water as well as sewage effluents as metallic salt. Generally high concentration of chloride indicates to organic pollution in the water [18]. Our result was similar to previous studies done by [20; 21].

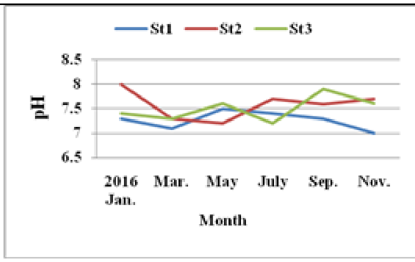


Figure (5): Variation of pH.

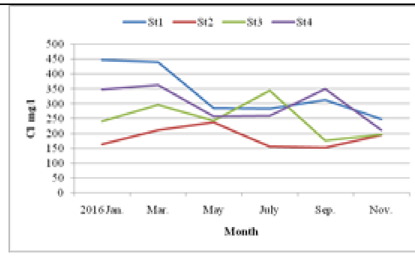


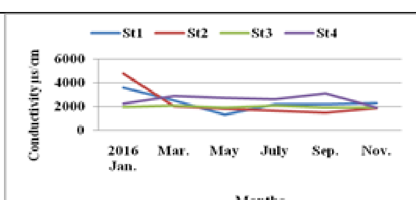
Figure (6): Variation of Chloride.

Table (1): Minimum and maximum (First Line), mean and standard deviation (Second Line), for physical and chemical characteristics at study stations.

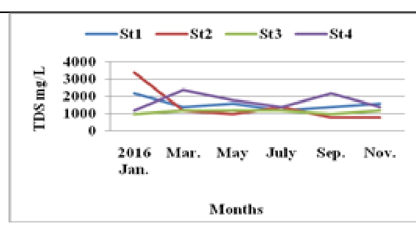
Stations / Parameters	1	2	3	4
COD mg/L	249.5 ±119.5 (69 – 3130)	231.5±99.5 (331 – 132)	226±148.49 (31 – 3121)	186.87±882.43 (96 -330)
Water Temp. °C	23.25 ±9.75 (13.5 – 33)	27.5±7.5 (20 – 35)	25.2±8.202 (19.4 – 31)	23±884.08 (16 – 32)
O&G mg/L	160±80 (80 – 240)	112±44 (68 – 156)	124±56.56 (84 – 164)	114.5±873.51 (60 – 152)
E .C µS/cm	2469.5±1130.5 (1339 –3600)	3140±1660 (1480 –4800)	2015±120.20 (1930 – 2100)	2555±863.86 (1910 – 3100)
H_2S mg/L	25.5±8.5 (17 – 34)	27±10 (17 – 37)	26±29.69 (5 – 47)	31.98±539.02 (5 – 81)
TDS mg/L	1700±500 (1200 –2200)	2100±1300 (800 – 3400)	1100±141.42 (1000 – 1200)	1750±544.46 (1200 – 2400)
$NO_2^=$ mg/L	0.25±0.25 (ND – 0.5)	0.45±0.45 (ND – 0.9)	0.45±0.353 (0.2 – 0.7)	0.5±199.27 (0.1 – 1.3)
TSS mg/L	100±60 (40 – 160)	290±230 (60 – 520)	140±141.42 (40 – 240)	227.5±204.40 (90 – 560)
pH	7.25±0.25 (7.– 7.5)	7.6±0.4 (7.2 – 8.0)	7.55±0.494 (7.2 – 7.9)	7.4±205.80 (7– 8.1)
NH_3 mg/L	50±10 (40 – 60)	41.5±19.5 (22 – 61)	61±55.154 (22 – 100)	45.87±212.86 (22 – 84)
BOD_5 mg/L	141±87 (54 – 228)	186.5±132.5 (54 – 319)	197±124.45 (109 – 285)	130.12±224.06 (30 – 239)
Cl^- mg/L	348±100 (248 – 448)	608.5±455.5 (153 –164)	261±118.79 (177 – 345)	295.87±244.86 (212 – 363)
SO_4 mg/L	637.5±349.5 (288 – 987)	428.5±302.5 (123 – 728)	3280.5±116.67 (246 – 411)	560.25±280.87 (370 – 699)
$NO_3^=$ mg/L	3.25±3.25 (ND – 6.5)	3±3 (ND – 6)	5.4±6.505 (0.8 – 10)	4.637±5.509 (1.8 – 7.5)
PO_4 mg/L	9.5±9.5 (ND– 19)	9.75±9.75 (ND – 19.5)	15± 0 (15 – 15)	9.516±7.353 (2 – 19)

The monthly variation in values of Electrical conductivity was recorded the lowest 1339µs/cm was measured from station1 in May 2016 and the highest was 4800µs/cm that observed in January 2016 from station 2(Figure 7). Electrical conductivity used as an indicator of water quality based on total dissolved salts [*18*;*19*]. The increase EC values at station 2 reflect the strong effect of domestic sewage effluent discharge in this area. Also, EC values recorded in the present study is coincided with findings of [*20*; 2*1*]. The monthly changes in total dissolved solid was recorded the lowest800 mg/L encountered on September 2016 on station 2 and the highest 3400 mg/L was recorded in January 2016 at the same station(Figure 8). Total dissolved solids (TDS) are the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. These results were slightly lower than that reported by [23]. The results denoted that the mean concentrations of Electrical conductivity and total dissolved solid within permissible levels recommended by Iraqi standard guideline value for wastewater discharged into the watercourse in all sites.

The monthly variations in total suspended solid was recorded the lowest 40 mg/L was observed in May and September 2016 on station 1and 3, the highest value 560 mg/L was observed in January 2016 on station 4. High concentration of total suspended solids can cause multiple problems affecting the water body and aquatic life, such as:- stop the production of DO due to non-entry of light into the depths causing the lack of ability of plants to carry out photosynthesis, and also due to the increasing of the temperature of the surface water because the suspended particles absorb heat from sunlight and decrease the proportion of DO in the water [24] .



Figure(7): Variation of conductivity.



Figure(8): Variation of TDS.

The highest TSS in a water body can often mean higher concentrations of bacteria, nutrients, pesticides, and metals in the water because suspended particles provide attachment places for these other pollutants [25] (Figure 9). TSS ranged was exceeding the standard value for wastewater discharged into the watercourse in all sites.

The lowest monthly variations in Nitrite ND mg/L was observed in May and January 2016 on station1and 2, Whereas the highest value 1.3 mg/L was observed in January 2016 on station 4. Anaerobic conditions may result in the formation and persistence of Nitrite is a consequence of microbial activity and may be intermittent [26]. Nitrite ion is never found in pure water source of nitrite in sewage wastewater come from the common usage of detergents may cause decreased Nitrite concentration in sewage because of high organic matter content [27](Figure 10).

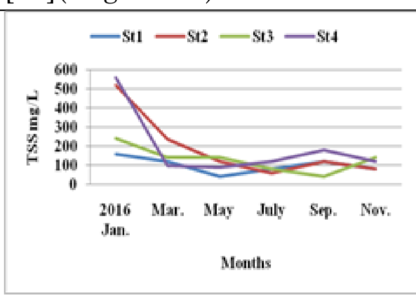
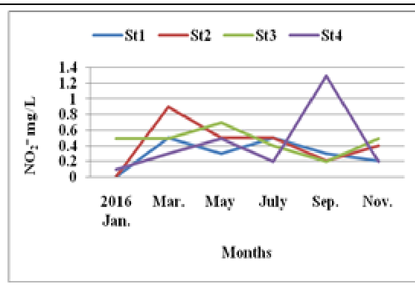


Figure (9):Variation of TSS.



Figure(10):Variation of Nitrite.

The lowest monthly variations of Nitrate ND mg/L was in January 2016 from station1 and 2, While as the higher 10 mg/L was observed in May 2016 on station3 (Figure 11). Nitrate is the stable form of combined nitrogen and it is an important factor which might limit growth of phytoplankton [28]. The results of nitrate have agreed with those of [29;*30*]. The monthly variation in the values of Reactive phosphate recorded the lowest NDmg/L was observed on January 2016 at station 1 and 2, Whereas the higher 19 mg/L was observed on July 2016 at station 1 and 4 (Figure12). Our result may be related to human activities as well as the use of detergents which was observed along the four study stations agricultural land-use, anthropogenic activities and industrialization. Farming operations around the area were said to have contributed immensely to elevated values of ammonia and phosphate [31]. Nitrate and Phosphate ranged were exceeding the standard value for wastewater discharged into the watercourse in all sites.

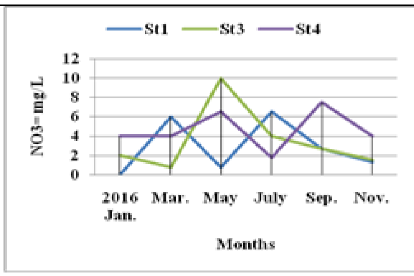


Figure (11): Variation of Nitrate.

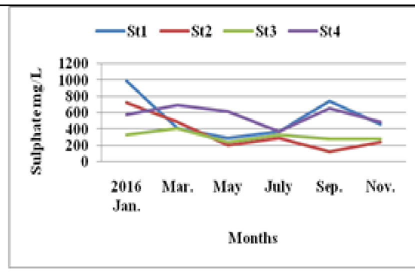


Figure (12): Variation of Phosphate.

The values of Sulphate varied from the lowest 123mg/L were observed in September 2016 on station 2, While as the higher 987 mg/L was observed in January 2016 on station 1 (Figure13). Sulphate is widely distributed in nature and may be present in natural waters. The main source of Sulphate is the rocks present near the water bodies and biochemical action of anaerobic bacteria [32]. The results denoted that the mean concentrations of Sulphate were exceeding permissible levels recommended by Iraqi standard guideline value for wastewater discharged into the watercourse in all sites.

The monthly variation in values of Ammonia varied from the lowest 22mg/L was observed in July 2016 on station 2 and September 2016 on station 3 and November 2016 from station 4 , Whereas the highest value 100 mg/L was observed in March 2016 on station 3 (Figure14).The term ammonia includes the non-ionized NH_3 and ionized NH_4 species higher concentrations of ammonia in sewage samples give arise to heavy pollution power, sources of ammonia in sewage effluent reflect influence of liquid wastes, high usage of detergent and increasing organic substances ,which lead to ammonification [33]. An increased of ammonia in sewage wastewater are reused for irrigation in farmlands and can cause plant and tree damage [34]. The results denoted that the mean concentrations of Ammonia within permissible levels recommended by Iraqi standard guideline value for wastewater discharged into the watercourse in all sites.

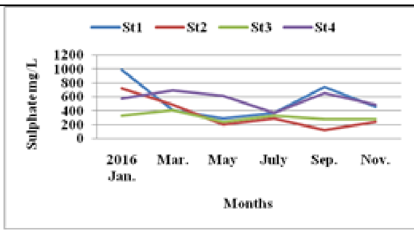


Figure (13): Variation of Sulphate.

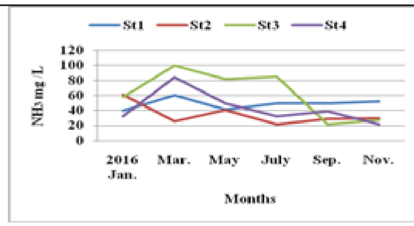


Figure (14): Variation of Ammonia.

The monthly variation in values of Hydrogen sulfide varied from the lowest 5mg/L was observed on September 2016 at station 3 also at station 4 on November 2016, Whereas the higher 81 mg/L was observed on September 2016 on station 4(Figure15). Hydrogen sulfide is a gas with offensive "rotten eggs" odor that is detectable at very low concentration is formed when sulfides are hydrolyzed in water the taste. Also odor threshold of sulfides in well aerated or chlorinated water, and hydrogen sulfide levels in oxygenated water supplies are normally very low, natural waters subjected to unusual conditions maintain high concentration of hydrogen sulfide [35], hydrogen sulfide forms in sewage water in the absence of dissolved oxygen may be results from the action of bacteria that is normally present in the sewage and acts on the sulfur containing organic matters, sewage waste water sample show high (H_2S) concentration which may be derived from detergents ,sulfates and bacterial actions[36].

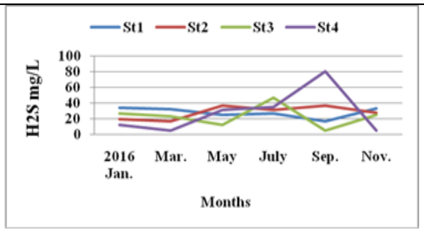


Figure (15): Variation of Hydrogen sulfide.

Finally, it was concluded by the current study, all wastewater treatment plants have a direct impact on the quality of the Tigris River due to be exceeding permissible levels recommended by Iraqi standard guideline value for wastewater discharged into the watercourse in all sites.

REFERENCE

1-Cheepi, P. (2012). Musi River Pollution Its Impact on Health and Economic Conditions of Down Stream Villages-A Study. J. of Environmental Science, Toxicology and Food Technology,1 (4): 40-51, ISSN: 2319-2402.

2-Pimental, D., Berger, B., Filiberto, D., Newton, M., Wolfe, B., Karabinakis, E., Clark, S., Poon, E., Abbett, E. and Nondagopal, S. (2004). Water resources: Agricultural and environmental issues. Bioscience J., 54(10):909-918.

3-Yehia, H.M. and Sabae, S.Z. (2011). Microbial Pollution of Water in El-Salam Canal, Egypt. American-Eurasian J .Agric. Environ. Sci., 11: 305-309.

4-Samarghandi, M., Nouri, J., Mesdaghinia, A. R., Mahv,I.A. H., Nasseri, S. and Vaezi, F. (2007). Efficiency removal of phenol, lead and cadmium by means of UV/TiO2/H2O2 processes. Int. J. Environ. Sci. Tech., 4(1):19-25.

5-Porteous, A. (2000). Dictionary of Environmental Science and Technology; 3rd Edition, John Wiley and Sons Ltd., England.

6-EPA (Environmental Protection Agency).(2012). Attains parent cause category summaries, adapted from doc. no. EPA-841-R-12-104. http://epa.gov/waters/ir/.

7-Uwidia, I.E. and Ademoroti, C.M.A.(2011). Characterisation of Domestic Sewage from an Estate in Warri, Nigeria .International J. of Chemis.Vol. 3, No.3.

8-WHO (World Health Organization) (1996). Guidelines for Drinking Water Quality, 2nd Ed, : 206-951.

9-APHA(1998). Standard methods for the examination of water and waste water, 20th ed.

10 APHA,AWWA and WFF (2005) Standard Methods for the Examination of Water and wastewater, 21th ed., edited by Eaton, A. D. ; L. S. Clesceri; E. W. Rice, and A. E. Greenberg. American Water Work Association and Water Environment Federation,USA.

11 Abumoghli , I. A. and Ghuneium , N. A. (1991) Manual of water and soil analysis . Jordan Univ. , Jordan .

12 Standard Specification of Drinking Water, Iraq. (2001). IQS (no.417), First modernization, the Council of Ministers, Central Organization for Standardization and Quality Control, 5pp. [in Arabic].

13 Bush, P.B. (2000) Laboratory Results for Fat, Oil and Grease Sample. For: Private Client. University of Georgia Feed and Environmental Water Laboratory

14 Fahad,K. K. (2005). Ecological survey for southern sector of Al-Garaf River, southern Iraq. Ph. D. Thesis. Collage of Agriculture, University of Basrah.:201p.

15 Sadek and Kamel(2007).Seasonal variations in abiotic ecological conditions in Al-Garaf canal one of the main Tigris branches at ThiQar province.J. Coll. Sci. Univ., Basrah :3-6

16 Lind, O. T. (1979). Hand book of common methods in limnology. 2nd .Ed. London (109)

17 Abed Al-Razzaq H. T.(2011) Effect of Domestic Wastewater from Pumping Station of Al-Kadimiya on Ecological Properties of Tigris River.MSc. Thesis. Collage of Science, Baghdad University.

18 Al-Kuraishi,R.A.(2011). A study of the effects of some ecological factors of Kut Dam on the Benthic Invertebrates of River Tigris. MSc. Thesis. Collage of Science, Baghdad university.

19 Joseph, N. C.; Eddy, A. O.; Elijah, J. P. and Ikechukwu, O. N. E. (2011). Physicochemical evaluation of the effects of total suspended solids, total dissolved solids and total hardness concentrations on the water samples in Nsukka Town, Enugu State of Nigeria. Amr.J. Sci., 7 (5):827-836.

20 Rasheed, R. O. (1994). A limnological study on some water systems in Erbil province. Iraq. M.Sc. Thesis. Univ. of Salahaddin-Erbil, Iraq. ,:121pp.

21 Al-Saadi, H. A. ; Hadi, R. A. M. and Al-Lami, A. A. (1989). Limnogical studies on some marsh areas in southern Iraq . Limnogica, 20 (2).

22 Hashim, N. N. (2010). Investigation of Cadmium and Mercury in Water,Sediments and Some Benthic Invertebrates at section of Tigris River in Baghdad City.Ms.C. Thesis, College of Science, Baghdad University: 125 PP.

23 AL-Zamili,H.F. (2007). Monthly variations of some environmental factors of AL-Gharraf River, J. of DhiQar, 3 (3) :17-2.

24 Lawson, E.O.(2011). Physico-chemical parameters and heavy metal contents of water from the mangrove swamps of Lagos Lagoon, Nigeria. Advan. Biol. Res., 5 (1): 08-21.

25 Health Canada. (2012). Guidelines for Canadian Drinking Water Quality-Summary Table. Water, Air and Climate

Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa,Ontario.

26 WHO (World Health Organization). (2006). Guidelines for drinking-water quality. 3rd.Ed. first addendum, Vol. 1. World Health Organization, Geneva: 515 pp.

27 Elhatip,H, and Gullu,O.(2005). Influence of wastewater Discharges on the water quality of Mamasin Dam watershed in Aksaray ,central Anatolian part of Turky .Environ Geol. ,48:829-834.

28 Al-Lami,A.A. and Kassim, T. I. And Dulymi, A.A. (1999).A limnological study on Tigris River. Iraq . The Sci. J, IAEC., 1:83-98.

29 Al-Ani, S. A. (2002). Effect of Diyala River on the chemical and physical propereties of Tigris River in southoren Baghdad region. Ph.D. Thesis,College of Edu. Ibn- Al-Haithem, University of Baghdad: 170 pp.

30 Maulood, B. K. ; Al-Azzawi, M. N. and Saadalla, H. A. (1994). An ecological study on the Tigris river pre and after crossing Baghdad. J. Coll. Educ. Univ. Baghdad, 5 (1) : 43-50.

31 Olajire, A.A. and Imeokparia, F.E. (2000). Water Quality Assessment of Osun River: Studies on Inorganic Nutrients, Environmental Monitoring and Assessment., 69:17-28.

32 WHO (World Health Organization). (1996). Guideline for Drinking Water Quality Health Criteria and Other Supporting Information 2nd. Ed. Vol. 20.Geneva.

33 Yuce,G., Pinarbasi ,A., Ozce like ,S. and Ugurlnoglu, D.(2006). Soil and water pollution Derived from Anthropogenic Activities in the porsuk Rivre Basin ,Turkey. Environ Geol.,49:359-375.

34 Priestly,A.J.(2002). Report on sewage sludge Treatment and Disposal. Envirnmental Problrms and Research Needs from An Australian prospective CSIRO.Division of chemical and polymers,:48pp.

35 Hem,J.D.(1985). Study and Interpretation of the chemical characteristics of Natural water .USGS water supply paper 2254,:263pp.

36 Canada .(2006). Guidelines for Canadian water quality .federal –provincial, Territorial Committee on Drinking water.