A study on the main sewage channel in Erbil city Destiny and its matching to irrigation purpose

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Abstract

Studying the water quality of Erbil waste water, and how much it match with the world criteria to irrigation purpose, during Spring 2007 to Winter 2008 , ten stations within and along the city wastewater channel were chosen , the first formation (Qalaa in the city centre) till the last gathering station to form the main channel in the southern west of the city (Areb qand).Important measurements were taking in consideration :T. coliform, TP, TN, BOD_5, COD and TSS .The main results were :

* The seasonal values followed certain rhythm which was; Summer > Spring > Winter .
* Only for the reason of high number of T. cliform in the studies season except the winter season which was in low value, the wastewater in the main channel match to irrigation purpose only in Winter season.

Introduction

Any comprehensive wastewater monitoring for controlling pollution degree ,some important indicators must be taken in consideration like ; five days biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total nitrogen (TN), total phosphorus (TP), total coliform ,and total suspended solid (TSS).Because these are good indicators to the pollution degree of the wastewater which get municipal ,agricultural , and industrial discharge with high amounts of chemical pollutants such as N , P and C with high degree of oxygen demand,(chemical or biochemical) and biological by microbial pollutants such as faecal coliform. (Sonune & Gate, 2004; Sarioglu, 2005; Hussein, 2004; Henz et al., 2002; Viessman & Hammer,1996 and Upadhyay,2004).

The area of Erbil city, which is about 150 square kilometers, according to WFP of Erbil sector (2002),the population of the city during that year was 589000an became 762,139 inhabitants in 2006 while it reaches 1491460 inhabitants in 2010.(Al-Naqshabandi,2002) . The necessity of water for different purposes of life has been doubled with progress development of

technology and lifestyle in different areas. According to WFP of Erbil sector (2002) water requirement for domestic uses may reach to more than 320000 $m^3.d^{-1}$, while water demand for agricultural and industrial uses was not estimated in Erbil city yet. The main source of water supply is the Greater Zab river (Ifraz project), in addition to more than 500 wells scattered within the city.

Yet, Erbil city like many other cities in Iraq dose not have sewage treatment or pre treatment plant .So, this research is an attempt to understand Erbil's wastewater destiny following its formation in the beginning in which mixing of many types of wastes; municipal, agriculture and industrial, till they gathered to form the main sewage channel in Twreq village, even after this point by several kilometers in (Areb qand village). And studying wastewater recovery by the action of so called self purification, then to compare these information with the world standards and how far it matching irrigation purposes, and as a result to establish database of Erbil's waste water.

Materials and Methods

Description of the stations:

Location of Areb qend (station 10) is the north-western downtown by about 12 kilometers which is the final point, then discharged to Greater Zab river. The location of station (9) is in Tureq village which is a small village (about 50 small houses) , it is about 10 kilometers far from the city centre, and it collect only the villages wastewater and discharged it to the main pathway. Station (8) is about one kilometer above station (7).Station (7) is the gathering point branches and the formation of the main sewage pathway, it is about 9 kilometers down the city centre, Station (6) is collecting waste waters from (Alaskary quarter) and discharged to the main channel ,located just few meters before station 7. Station (5)is the main channel in the (Sailo quarter) and it is(5)kilometers down the city centre. Station (4) is the branch which collects the sewages from the previous station. Station (3), is the branch which collects the wastewater from the southern industry area located in south east of the city centre by (5) kilometers. Station (2) , is the (Runaky quarter) sewage branch , away from the city centre by (1.5) kilometers. Station (1) is the central of Erbil city (Qalaa quarter), it is the start point of the study and the highest elevation point of the city. (Figure, 1 shows the city and the studied stations allocation on Iraq satellite map).

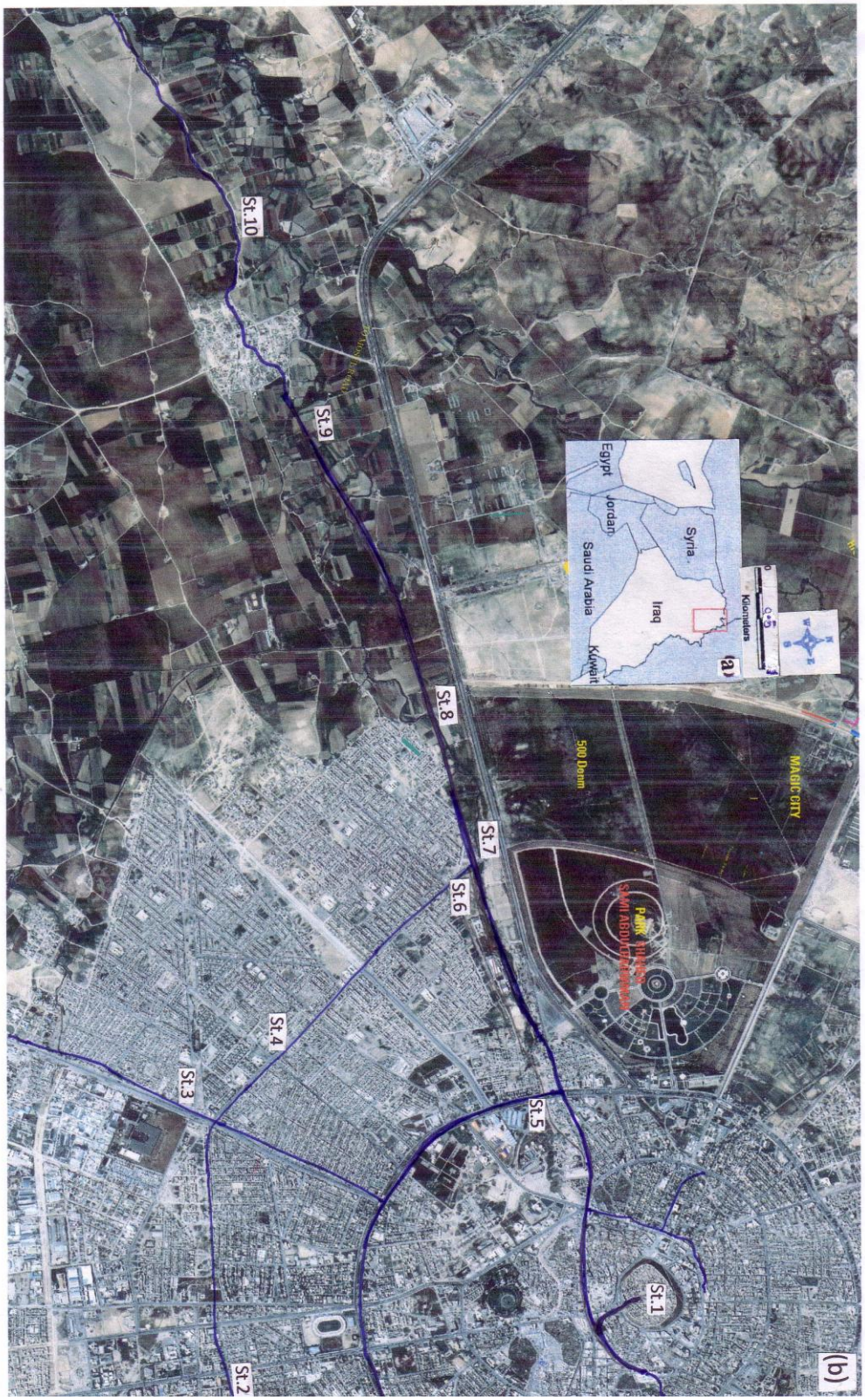


Fig. (1): (a).Republic of Iraq, (b).Erbil city shows the study stations along the sewage channel from station.1 Qlaa till the last station Areb kend.

Collecting of the samples

The sampling was began at 7 am from the first location and finished at 12 o'clock and the samples were collected in clean and dry polyethylene bags for the chemical analyses and in sterilized bottle for microbiological analysis. The analyses were started on the arrival to the laboratory immediately.

The analyses:

Total coliform: Counting of the most probable number (MPN) of faecal coliform was determined using the method described by APHA, (1998).

Total Nitrogen: Total organic nitrogen was determined after digesting the samples using K_2SO_4 then determined by microkjldahle method as described by Rump,(1999).And the nitrate was determined directly using Nitrachek instrument (from Hanna,Inc.).The two amounts were then collected and expressed as Total nitrogen in $mg.l^{-1}$

Total phosphorus: Total phosphorus was determined as described in (Rump,1999). The amounts expressed in $mg.l^{-1}$

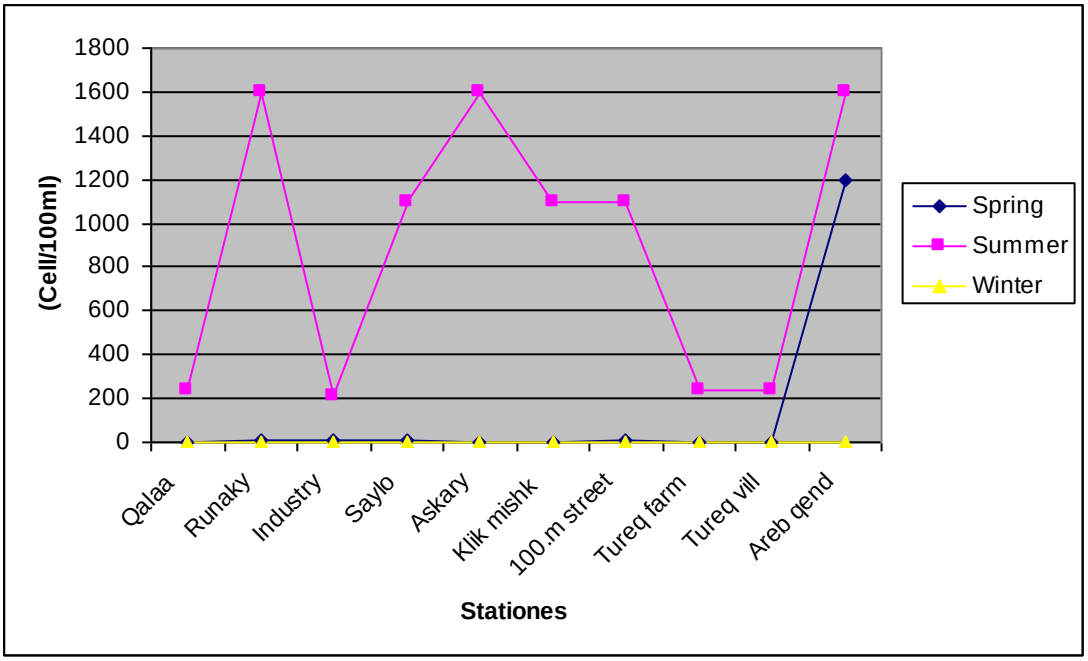
Total suspended solids: It was determined using the procedure described in APHA, (1998) ,The amounts expressed in $mg.l^{-1}$

Biochemical oxygen demand (BOD_5): Determined as described in APHA, (1998). The amounts expressed in $mg.l^{-1}$

Chemical oxygen Demand (COD): Chemical oxygen demand was determined after oxidation of organic matter in strong acid medium by K_2MnO_4. Results were expressed as $mg.l^{-1}$. COD. (Rump, 1999).

Results and Discussions

Total coliform; It is a group of microorganisms which are used as indicators to show the hygienic condition of the water, they are not pathogens by themselves but their appearance is an indicator to the pathogens (Cunningham and Saigo,2001), from table,2. And the graph, we found the Summer reading with high values and it reached 1600 cells /100ml water in three stations within the city,(Runaky, Askary Q. and Areb Qend), and dropped to 240 cells /100ml water , only in one occasion which was in an industrial area .Whereas in winter the value were too low and in many stations there were no detected ,even in spring the readings were so low but not as in winter states which ranged between (3-1200) cells /100ml water. Moreover the seasonal values followed certain rhythm which was; Summer > Spring > Winter due to the effect of the temperature and the evaporation action in the Summer, (Shekha, 2008). (Fig.2 and tables,1,2 and).



Figure(2): Total coliform in the Erbil waste water channels during the three studied periods.

Table (1): shows the standard guidelines of the usage of the waste water to irrigation of parks and vegetations.

	Total Coliform (cell/100ml)	Total Phosphorus (P) in $mg.l^{-1}$	Total Nitrogen (N) in $mg.l^{-1}$	Total suspended solid in $mg.l^{-1}$	Chemical Oxygen Demand in $mg.l^{-1}$	Biochemical Oxygen Demand in $mg.l^{-1}$
Standard for irrigation parks	200	15	100	50	200	50
Standard for irrigation vegetations	1000	15	100	200	500	150

Table (2): The measurement of the different values in ten stations of the studied Erbil waste water, during spring 2007 till Winter, 2008

Test / Location	Time of sampling	Total Coliform (cell/100ml)	Total Phosphorus in $mg.l^{-1}$	Total Nitrogen in $mg.l^{-1}$	Total suspended solid in $mg.l^{-1}$	Chemical Oxygen Demand in $mg.l^{-1}$	Biochemical Oxygen Demand in $mg.l^{-1}$
Station one (Qalaa)	Spring 2007	2	1.850	37.10	400	86.550	44.50
	Summer2007	240	7.931	29.00	40	256.671	62.50
	Winter2008	1	0.650	8.55	76	95.990	20.04
Station two (Runaky)	Spring 2007	11	1.905	40.40	20	20.850	11.00
	Summer2007	1600	5.278	23.10	100	223.649	140.00
	Winter2008	0	1.225	7.94	70	87.904	38.06
Station three (Industry)	Spring 2007	12	0.460	9.60	1000	10.550	3.50
	Summer2007	210	1.617	14.00	280	159.106	69.50
	Winter2008	1	0.000	5.95	96	40.115	10.08
Station four (saylo)	Spring 2007	5	2.10	27.40	20	19.500	11.50
	Summer2007	1100	5.056	41.70	160	162.108	82.50
	Winter2008	0	1.907	6.55	56	50.905	14.87
Station five (Askary)	Spring 2007	3	0.505	40.20	150	17.530	15.00
	Summer2007	1600	5.982	39.20	20	180.120	75.00
	Winter2008	2	0.1870	6.40	65	70.015	15.50
station six (klik mishk)	Spring 2007	4	1.200	25.20	100	5.700	4.55
	Summer2007	1100	8.196	18.70	40	135.090	92.50
	Winter2008	3	0.870	5.85	44	65.350	21.68
Station seven (100m.street)	Spring 2007	11	1.750	29.50	180	7.200	6.50
	Summer2007	1100	7.575	38.10	80	225.150	76.50
	Winter2008	4	1.905	9.90	50	90.125	10.67
Station eight (Tureq farm)	Spring 2007	3	1.850	16.70	50	13.950	9.00
	Summer2007	240	7.424	34.40	220	130.587	92.50
	Winter2008	4	1.565	6.55	68	89.901	15.90
Station nine (Tureq vill.)	Spring 2007	4	1.550	16.00	48	12.200	8.16
	Summer2007	240	6.9680	57.80	40	126.084	60.00
	Winter2008	2	1.508	10.15	60	54.870	27.70
Station ten (Areb qend)	Spring 2007	1200	1.350	15.32	45	15.115	9.01
	Summer2007	1600	5.866	41.20	80	180.012	75.00
	Winter2008	2	0.560	9.54	80	70.087	30.50

When we consider guidelines of W.H.O. (1989) and Jordan guidelines for wastewater usage in irrigation proposes,(Al-Radayda,2002, and Al-Hussain, 2004), (table, 1),such amount of T. coliform (200 cell MPN/100ml) ,that can not be used for irrigation proposes only in Summer. Total Phosphorus; Is the major component of the detergents that discharged from the house holds (Kitchen and bathrooms). (Sawyr & McCarty,1978). It ranged between 0.00 – 7.9mg/l(Industrial area and Runaky quarter, respectively) and it followed ascending increases which was the Summer with higher records then the Spring and the lowest records was going to the Winter.(Table,2 and fig.3).

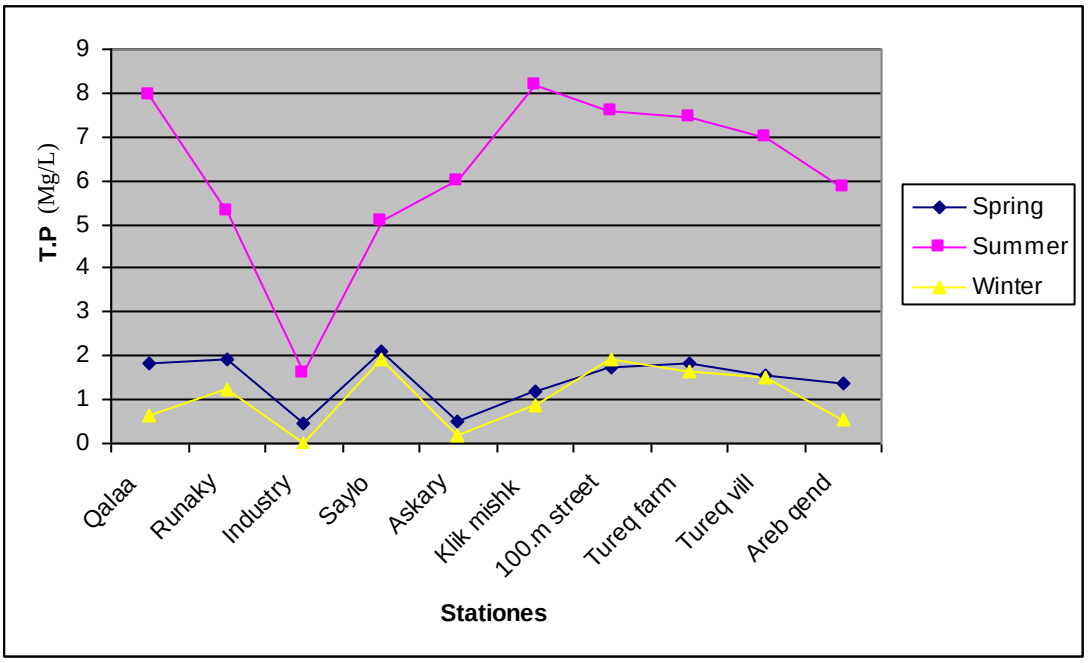


Figure (3) Total phosphorous in the Erbil waste water channels during the three studied periods.

This rhythm with high records of Summer time may be due to the effect of the low levels of the wastewater in the Summer (certainly in the house area), so the detergents and the fertilizers concentrated in these season, while the industrial area gain lowest vales. (Round, 1972).

Our results were higher than what was found by other researchers who studied the area, (Shekha, 1994, 2008; Ali, 2002 and Azez et al., 2001) and also from those who studied other places within Iraq wastewater, (Khamees,1979,and Rasheed,2008 who studied Sulaimanya sewage water). Still it can be used in irrigation purposes with regarding of this element , because there is not any limit of this element in the waste water.(W.H.O., 1993; Al-Radayda, 2002 and Al-Hussain , 2004).

Total Nitrogen; Ranged with high variation which was between 5.85- 57.80 mg/l (Klik mishik and Tureq village, respectively), the values followed ascending arrangement in the farm area differ from that arrangement of the house area, which in the first case was; Spring >Summer > Winter, and in the farm area the arrangement was; Summer >Spring > Winter, in which the reason goes to that in the farm area and because of the high use of the fertilizers by the farmers in the summer, which contains nitrogen element and discharged to the wastewater way, and the high values in the domestic area to discharge organic wastes rich with nitrogen, and these values decrease at winter season because of dilution action of the rain water.(Table,2and fig.4).(Upadhyay, 2004).

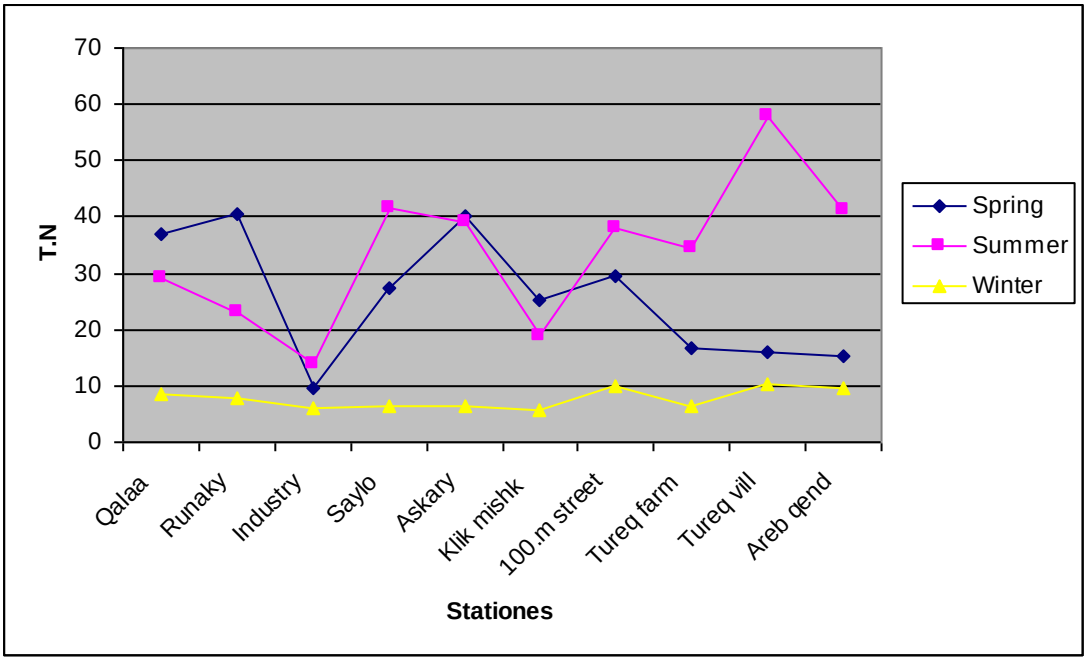


Figure (4) Total Nitrogen in the Erbil waste water channels during the three studied periods.

Although the nitrogen quantities are higher than what was found by Shekha, (2008)who studied the same area, still it is suitable for irrigation purposes according to (WHO , 1989; Al-Radayda, 2002 and Al-Hussain ,2004) .(Table1).

Biochemical oxygen demand (BOD_5); As table (2) and fig.(5).

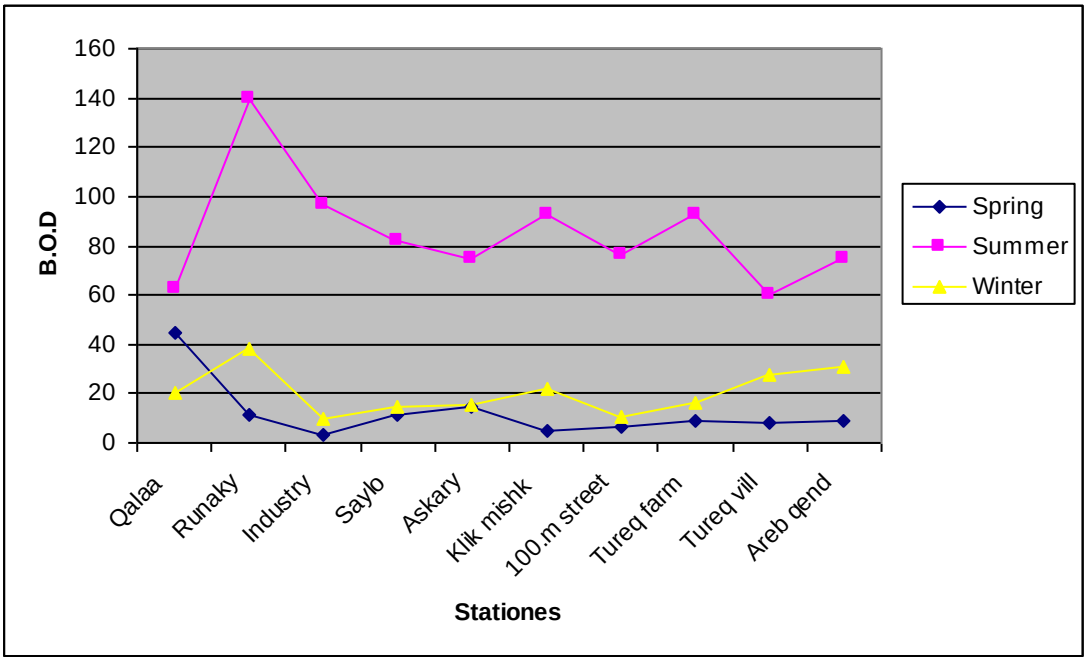


Figure (5) Biochemical Oxygen Demand in the Erbil waste water channels during the three studied periods.

shows the great variations of BOD_5 records, either between the different stations or within the same station in the different seasons, which ranged between 3.5 – 140 mg/l at spring in the industrial area and at summer in Runaky quarter, which may return to that the Runaky quarter containing houses discharge organic wastes continuously, as this test reflect the amount of the organic waste (Miller,1992) so it obtained high variables along the year seasons, on the other hand the lower value goes to the industrial area which the area is void of houses, so the wastewater here, did not contain high amount of organic wastes this records of variable were lower than what was found by other researchers, who studied the same location,(Aziz,2006; Lak,2007 and shekha,2008)in which BOD_5 in their studies ranged between 5- 208 mg/l, and it was close to what other searchers found like; Amen and Aziz,in 2005 and Bapeer, in 2004, when they studied the same area, and also with, Sherif et al. When they studied Saklawyea irrigation channel in Baghdad governorate, in 1992, and what found by Rashid, et al. , in 2000 when they studied the lower part of Diyala river in the middle of Iraq. And the results were higher than what found by Rasheed in (2008) in Tanjero polluted river and other tributaries of Darbanekhan reservoir in Sulaiymania city in which never exceeded more than (8) ppm. And in almost all stations the variation between the seasons in the same station follows a rhythm that was highest value in summer, moderate in winter and the lowest in spring, in which the high

value of winter returns to the high erosion of the soil and the organic wastes with it discharged into the main channel. In which any reduction or rhythm was not found between the different stations, because the main channel when it pass through the different regions within the city it gets more amounts of different types of organics carrying wastewaters; Like domestic wastes rich of organic waster ,agricultural wastes ,(point and non-Point discharge).(Cunningham & Saigo,2001).

Finally we can classify the wastewater of Erbil city as week to moderate category, depending on BOD_5 values, according to Bitton classification (2005) which ranged BOD_5between 0-220mg/l.

Chemical oxygen demand(COD): Its amount were with high variation , as $BOD_{5,}$ between or within the stations, the highest level recorded in station 0ne,which is the started point of the study as table,2 and fig.6 shows that,

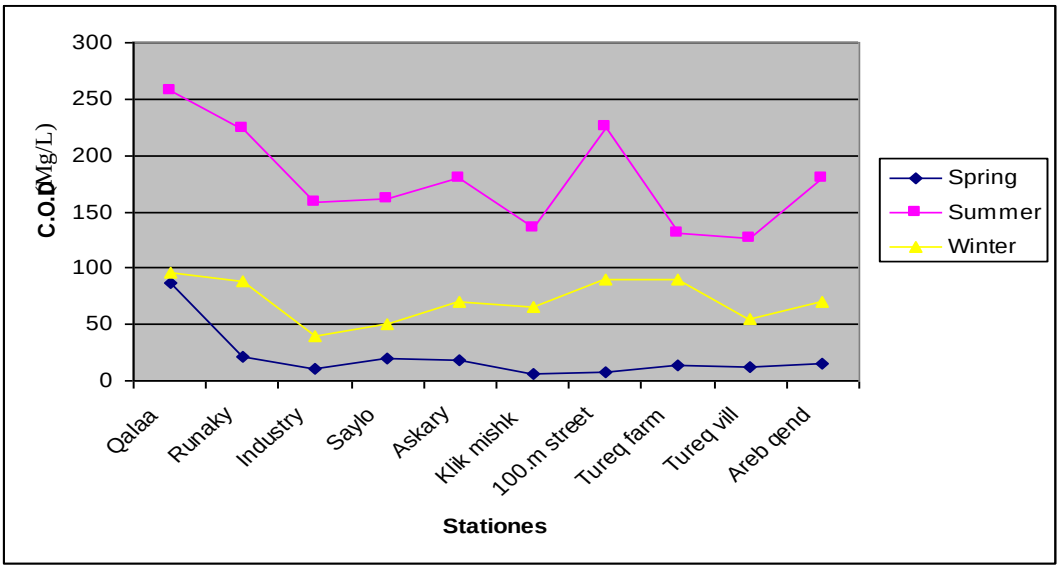


Figure (6) Chemical Oxygen Demand in the Erbil waste water channels during the three studied periods.

in another speech it is the fist location that gets wastewater in which it is at its richness with the organic materials and when we followed the levels we found a gradual declination in the COD amounts in which it showed the decreasing in the organic materials due to the so called self purification which oxidized different types of organics in the water.(Hynes,1960). This phenomenon found by other workers studied the area (Shekha,2008;Anber,1984; and Lak,2007).COD levels between the different seasons followed certain sequence which was; summer value> spring value > winter value, (as shown in the table), which may due to the dilution act by the water of the wintertime rain and less of the springtime rain, which act to dilute the amount of the COD gradually, which the

results are close of what found by Shekha, in 2008 who studied the area previously.

Erbil wastewater ,can be classify as fare to moderate level ,depending on COD records, according to Bitton,(2005) category who classified the wastewater types according to COD ranges .

Total suspended solid(TSS); It reflects the degree of the chemicals dissolved in the water body such as carbonate salts, and other minerals which dissolved or discharged in the water,(Cunnengham &Saigo,2001), so no wonder if we found that the content of this factor is highest throughout whole periods of the study in the station three,(spring,1000;,summer;280 and winter,96 mg/l, respectively)(table,2 and fig.7),

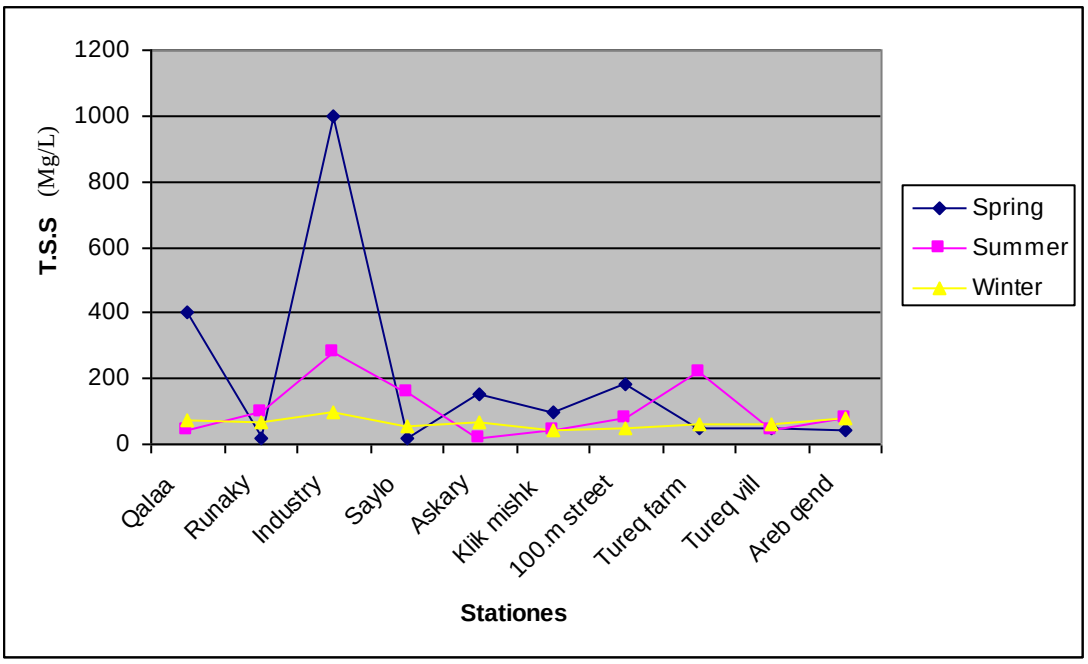


Figure (7) Total Suspended solid in the Erbil waste water channels during the three studied periods.

which collects the waste water from the industrial area especially ,cement brick cast, mosaic, aluminum ,factories with high levels of chemicals such as carbonate salts, minerals metals....close to results found by other investigators worked in the same area, (Ganjo et al.2006;Lak,2007 and Shekha, 2008).

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دراسة القناة الرئيسية للمياه العادمة لمدينة اربيل : مصيرها ومدى ملائمتها لاغراض السقي

عمران حسين قنبر بابير

قسم علوم الحياة

كلية العلوم – جامعة صلاح الدين

تاريخ الاستلام:١٠/٥/٢٠١٠ ، تاريخ القبول:١/٦/٢٠١٠

الخلاصة

لدراسة نوعية مياه فضلات مدينة اربيل ومدى تطابقها مع المحددات الدولية وصلاحيتها لاغراض سقي الحدائق العامة والمحاصيل ، لهذا الغرض تم اختبار (١٠) محطات على طول مجرى مياه فضلات اربيل ابتداءا من قلعة اربيل والتي تمثل اعلى في المدينة وانتهاءا بمنطقة عرب كند والتي بدورها نقطة التقاء المياه الرئيسية وتقع في الجنوب الغربي من المدينة .بدأت الدراسة في ربيع ٢٠٠٧ وانتهت في شتاء ٢٠٠٨ .واخذت قياسات مثل المجموع الكلي للاحياء المجهرية والمواد العالقة والفسفور الكلي والنايتروجين الكلي والمتطلب الحيوي والكيمياوي للاوكسجين . واهم النتائج التي حصلنا عليها كانت:

* اغلب المتغيرات الموسمية اتبعت ايقاعا تصاعديا معينا وهي ان قيم الصيف كانت اكبر من قيم الربيع والتي بدورها كانت اكبر من قيم الشتاء.

* كل المحددات كانت مطابقة لاغراض السقي المختلفة ماعدا فيما يتعلق بالمجموع الكلي للاحياء المجهرية الامراضية والتي فقط كانت واطئة في الشتاء وبذلك استنتجنا بأن يمكن استعمال المياه لاغراض سقي الحدائق العامة والمحاصيل فقط في الشتاء.