Evaluation of Tigris River Water Quality in Selected Sites within Baghdad City

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Abstract

The present research focuses on the evaluation of the Tigris river water quality within the city of Baghdad. Thirty samples were collected monthly from ten sites (each site contains three positions center of river, Rasafa side, Karkh side) on the Tigris river within Baghdad city along one year (from Feb.2010 to Feb. 2011). Samples were analyzed for eleven water quality variables including physical, chemical, and biological parameters. The results showed increases in pH, TDS, TSS, Cl^{-1}, SO_4^{-2}, and BOD values in some of the sites through study area, but all values remain within the allowable Iraqi and WHO limits except of SO_4^{-2}, it was exceeded the allowable limits in multiple sites.

Key words: Tigris River, water quality, pollution, Baghdad city

تقييم نوعية مياه نهر دجلة في مواقع مختارة ضمن مدينة بغداد

شيماء طالب كاظم

الخلاصة

يركز هذا البحث على تقييم نوعية مياه نهر دجلة ضمن مدينة بغداد. تم تجميع ثلاثين نموذج من الماء شهريا من عشر مواقع (كل موقع يتضمن ثلاث نقاط هي وسط النهر، جانب الرصافة، وجانب الكرخ) على نهر دجلة داخل مدينة بغداد وعلى مدى عام كامل (من شباط 2010الى شباط 2011). تم تحليل النتائج لاحد عشر من المتغيرات النوعية للمياه وتتضمن متغيرات فيزيائية ، كيميائية، وبايولوجية. اظهرت النتائج زيادات في قيم pH, TDS, TSS, Cl^{-1}, SO_4^{-2}, and BOD في بعض المواقع خلال منطقة الدراسة، لكن جميع القيم بقيت ضمن الحدود المسموحة للمقاييس العراقية ومحددات منظمة الصحة العالمية ماعدا قيم الكبريتات حيث تجاوزت الحدود المسموحة في مواقع عديدة.

1. Introduction

Water is a vital resource not just for humans, but for a variety of aquatic ecosystems, including wetlands, watersheds, riparian zones, estuaries, and coastal areas [1]. It is no different now than it ever has been in Baghdad; life is sustained by the Tigris River. This 1,150mile-long channel of water is known for its swift flow and ancient history – and every bottle of water in the victory Base Complex is filled to the brim from this river [2], [3], and [4].

Globally, there is an increasing awareness that water will be one of the most critical natural resources in future. Water scarcity is increasing worldwide and pressure on the existing water recourses is increasing due to the growing demands in several sectors such as, domestic, industrial, agriculture, hydropower generation, etc. There- fore, the evaluation of water quality in various countries has become a critical research topic in the recent years [5], [6].

The particulate problem in case of water quality monitoring is the complexity associated with analysis the large number of measured variable [7].

Discharge of pollutants to a water resource system from domestic sewers, storm water discharges, industrial wastes discharges, agricultural runoff and other sources, all of which may be

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untreated, can have significant effects of both short term and long term duration on the quality of a river system [8]. The Tigris River which bisects Baghdad and several other major Iraqi cities has about one billion cubic meters of polluted materials dumped into it, according to a senior environment expert [9].

There are four types of water pollution [10], [11], and [12]:

1- Physical pollution which causes change in the watercolor, turbidity, temperature, suspended solids, foam and radioactivity.

2- Physical pollution, caused by several substances, particularly hydrogen sulfide and results in the change of taste and odor.

3- Chemical pollution caused by organic and inorganic chemicals and resulting un the change of pH value which increase toxicity by heavy metals, and other toxic materials.

4- Biological pollution is caused by viruses, bacteria, protozoa, and helminthes

2. Methodology

Samples were collected from ten sites ,Baghdad gate (S1), Greaat (S2), AL-Aimma bridge (S3), AL-Adhamiya bridge (S4), AL-Sarafiya bridge (S5), Bab ALmuadham bridge (S6), AL-shuhadaa bridge (S7), AL-Ahrar bridge (S8), AL-Sinak bridge (S9), AL-Jumhuriya bridge (S10). Each site was divided into three positions (center of river, Rasafa side, Karkh side) through Tigris River with Baghdad city, fig.(1) show the study area map. Monthly samples were collected from these positions over a period of one year (Feb. 2010 to Feb. 2011); so 360 samples were taken through this period, the samples were taken at the depth (70cm). Water sample were collected in plastic bottles.

All samples were analyzed physically, chemically, and biologically by standard methods [13].The laboratory work had been done in the sanitary engineering lab, the chemical engineering department labs, and the applied sciences department lab in the University of Technology. For each sample eleven parameters had been done. These parameters including: pH, Ec, TDS, TSS, Hardness, Ca^{+2}, Mg^{+2}, Cl^{-1}, SO_4, Na^{+1}, BOD.

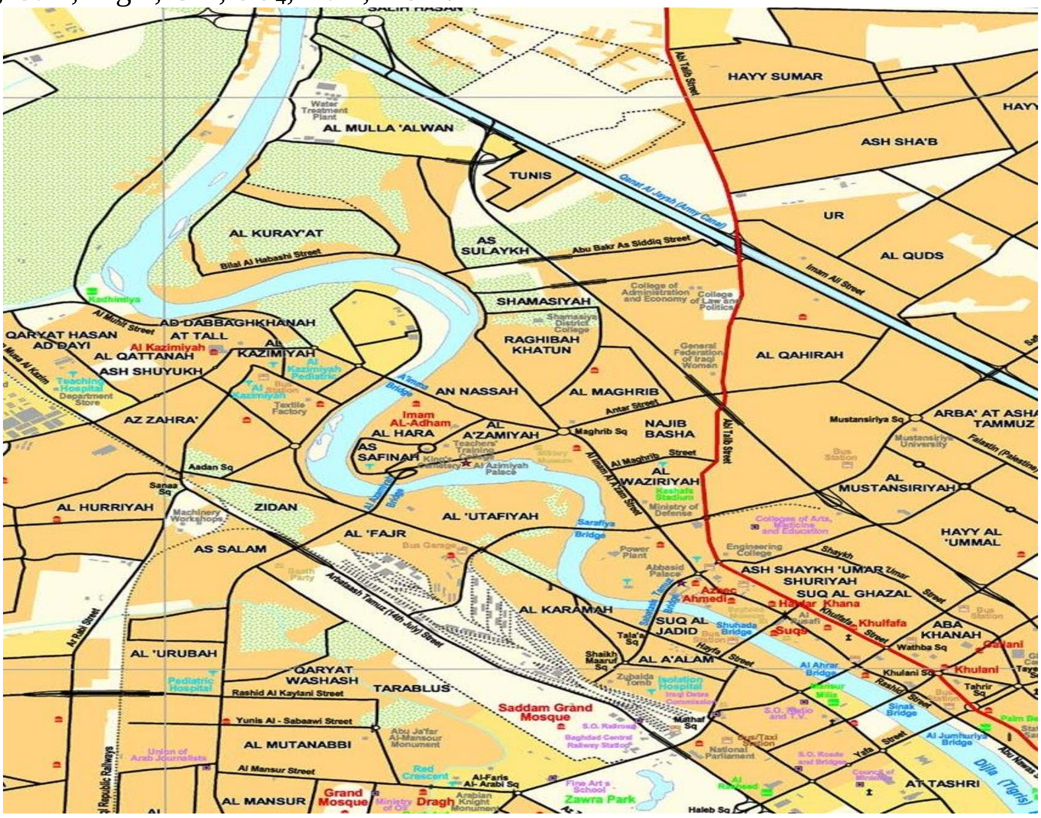

Fig 1: Tigris river map within Baghdad city between Baghdad gate and Al- jumhuriya bridge

3. Results and Discussion

The average of monthly laboratory tests results of all samples for all sites through one year are shown in figs. (2 -12).

pH

pH is defined as the negative log (base 10) of the hydrogen ion concentration [14], and it is a measure of the acidity or basicity of an aqueous solution [15]. Fig.(2) shows that pH value at (S2) increase over than (8),but all values for all positions still within the acceptable values (6.5-8.5) [16].

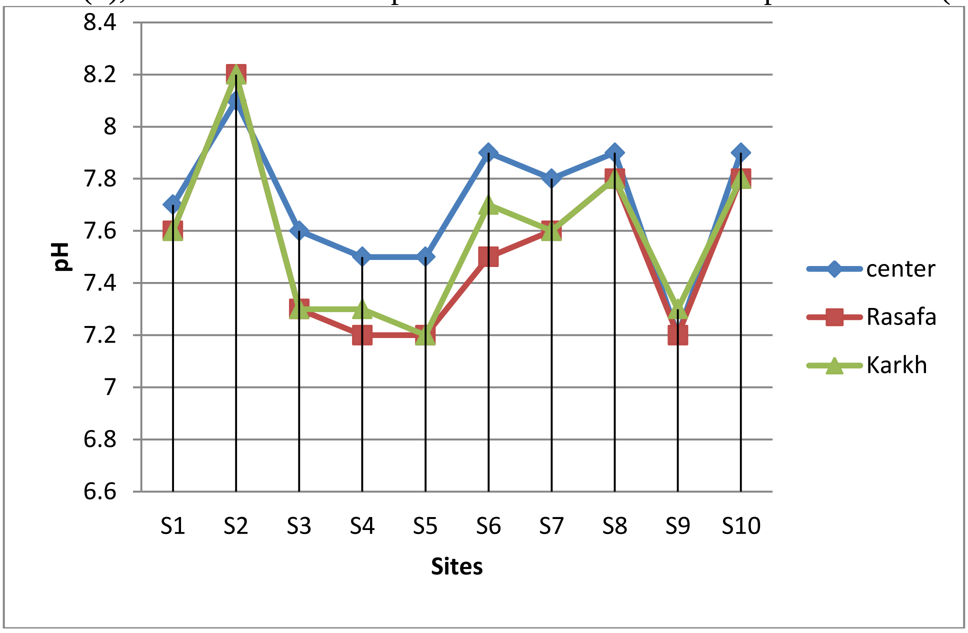

Fig 2: Values of pH in study area

Electrical Conductivity (EC)

Conductivity is the ability of water to conduct an electrical current, and the dissolved ions are the conductors [17]. Fig. (3) shows that there is a convergence in values, and all values are less than (1200µs/cm), and less than the maximum allowable Iraqi limits (2000µs/cm) [16].

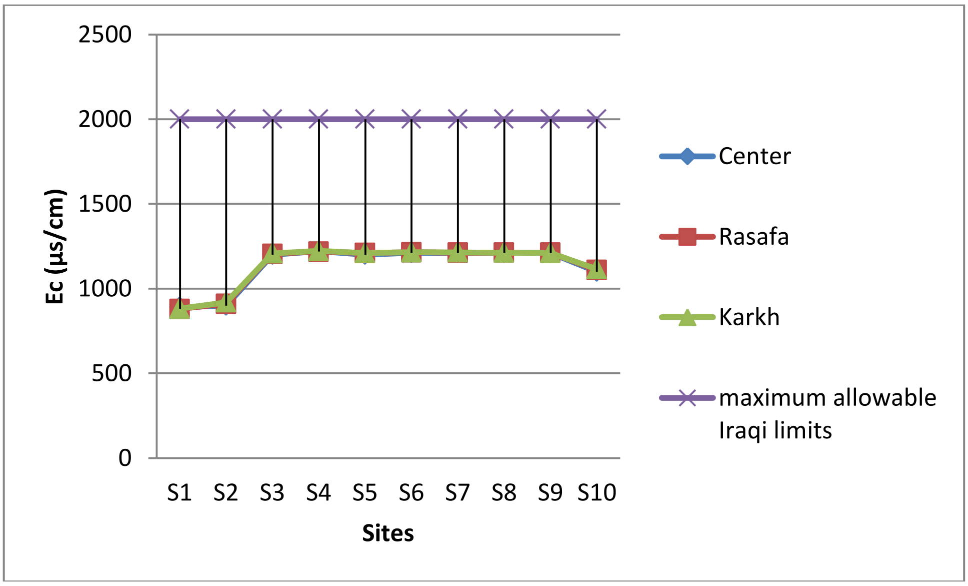

Fig 3: Values of EC in study area

Total Dissolved Solids (TDS)

Total dissolved solids (TDS) are the total amount of mobile charged ions, including minerals, salts, or metals dissolved in a given volume of water [18].From the results, S1, S2 with TDS values about 500mg/l but there is a clear increment in TDS of the rest sites (fig. (4)). The explanation of this increment of TDS may be based on the presents of multiple sewage pumping stations across the river. Although the increment in some of the sites, but all values still within the allowable Iraqi standards (1500mg/l), and WHO standards (1000mg/l) [16].

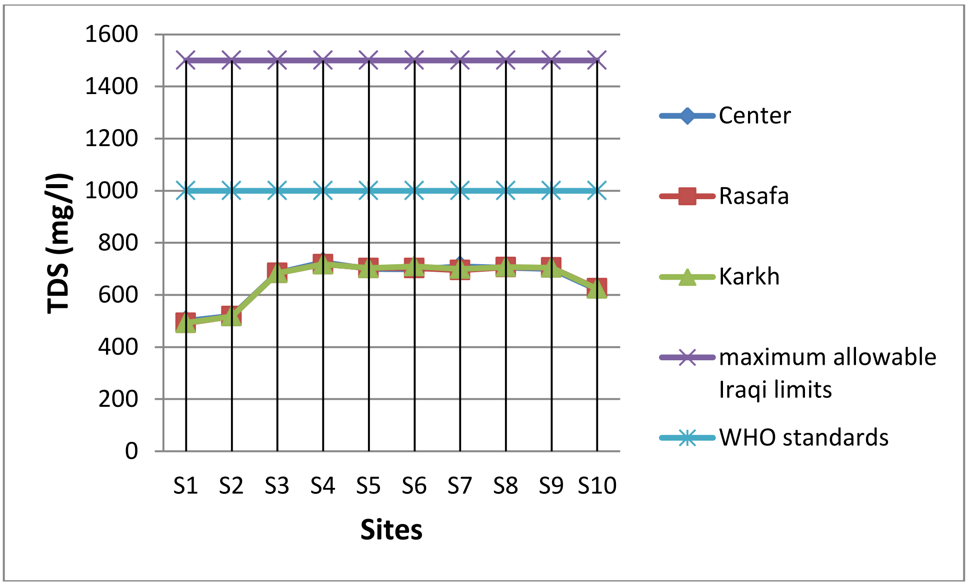

Fig 4: Values of TDS in study area

Total Suspended Solids (TSS)

The results in fig.(5) have shown a gradual increment of TSS along the river flow direction, this may be because the suspended solids carried with water flow and cause a gradual accumulation.

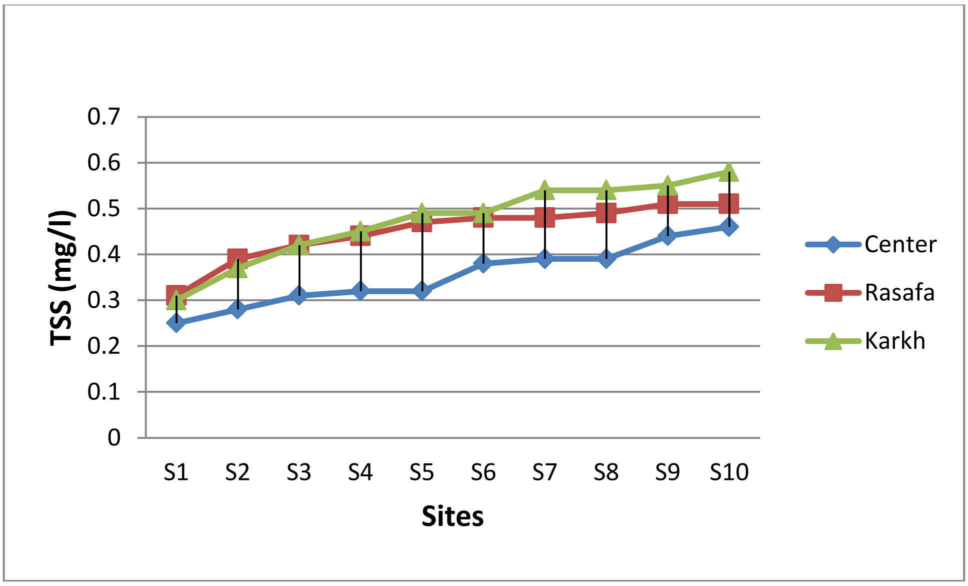

Fig 5: Values of TSS in study area

Hardness

Fig (6) shows that the total hardness at (S1) is about (180mg/l), the values at the rest sites range between (280-420mg/l), but also all the values remain within the maximum allowable Iraqi and WHO standards (500mg/l).

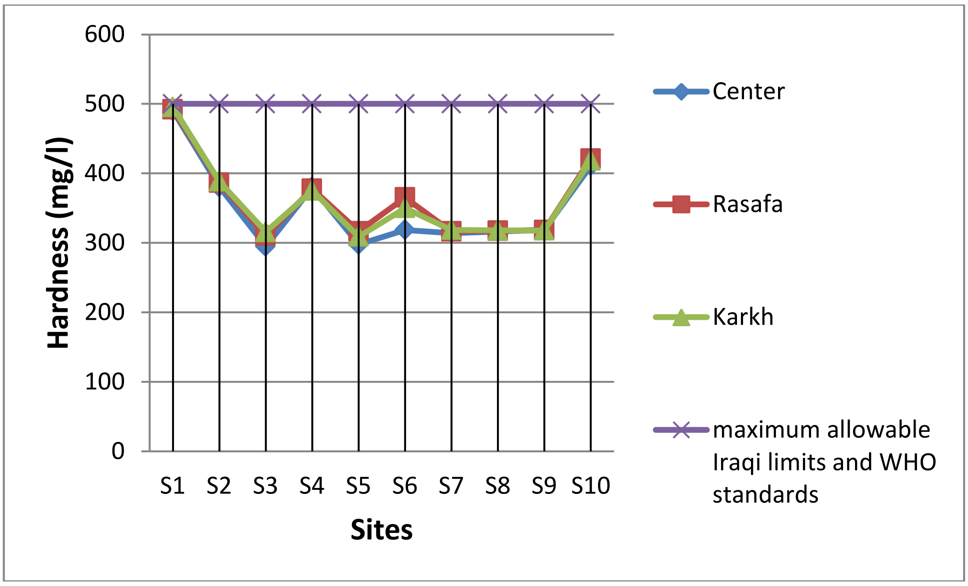

Fig 6: Values of total hardness in study area

Calcium and Magnesium (Ca^{+2} & Mg^{+2})

Calcium and magnesium are metals common in rocks found on continents .They exist as salts of various types like calcium chloride and magnesium chloride .High levels of calcium and magnesium contribute to "hard water", this can make detergents less effective and cause scaling and buildup in pipes and fittings [19].Results in fig. (7) show that all the values of Ca^{+2} are less than the maximum allowable Iraqi limits (200mg/l), and fig.(8) show that all the values of Mg^{+2} are less than the maximum allowable Iraqi limits (150 mg/l).

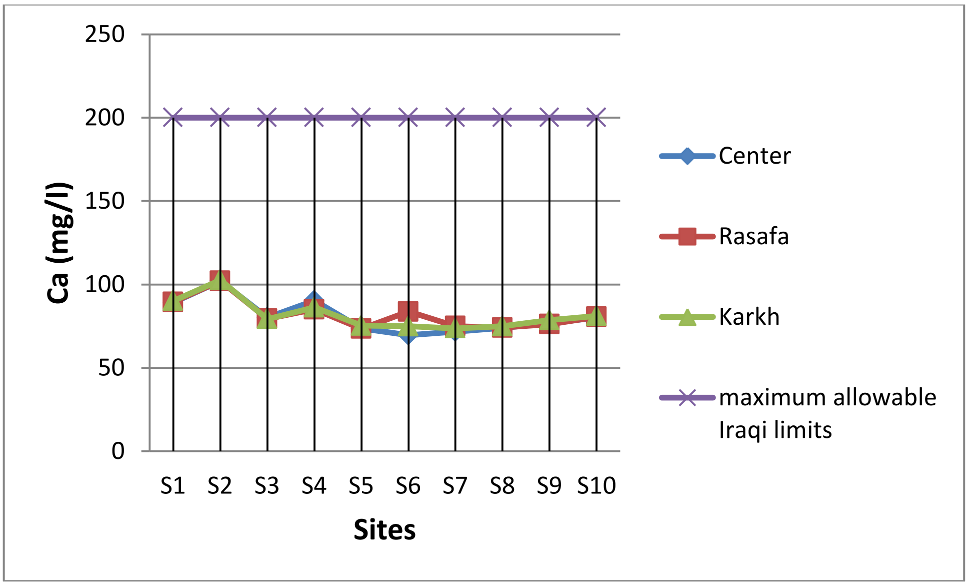

Fig 7: Values of (Ca^{+2}) in study area

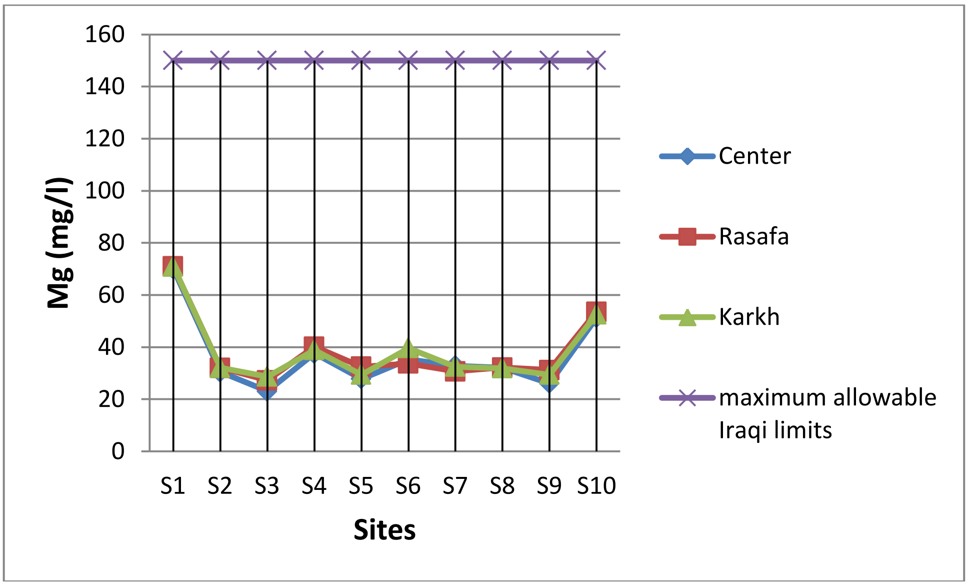

Fig 8: Values of (Mg^{+2}) in study area

Chloride (Cl−1)

Fig. (9) shows that there is a convergence in values of Cl^{-1} for all sites except in (S1) there is clear increment in it, but all values remain within the maximum allowable Iraqi limits (600mg/l) and WHO limits (250mg/l).

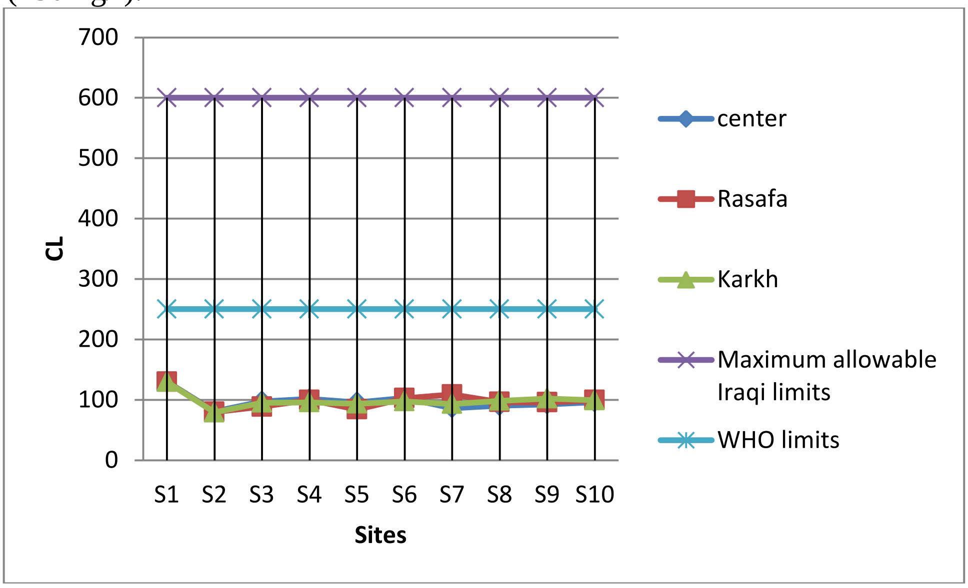

Fig 9: Values of (Cl^{-1}) in study area

Sulphates (SO_4^{-2})

When we look at the results in fig.(10), we find the values of So_4 in (S1, S3, and S6) are within the maximum permissible Iraqi and WHO limits , but in the rest sites the values are exceed the maximum permissible Iraqi limits (200mg/l) and WHO limits (250mg/l). These increases in $S0_4$ values due to the high concentrations of $S0_4$ in the sewage water which discharge without treatment to the river [20].

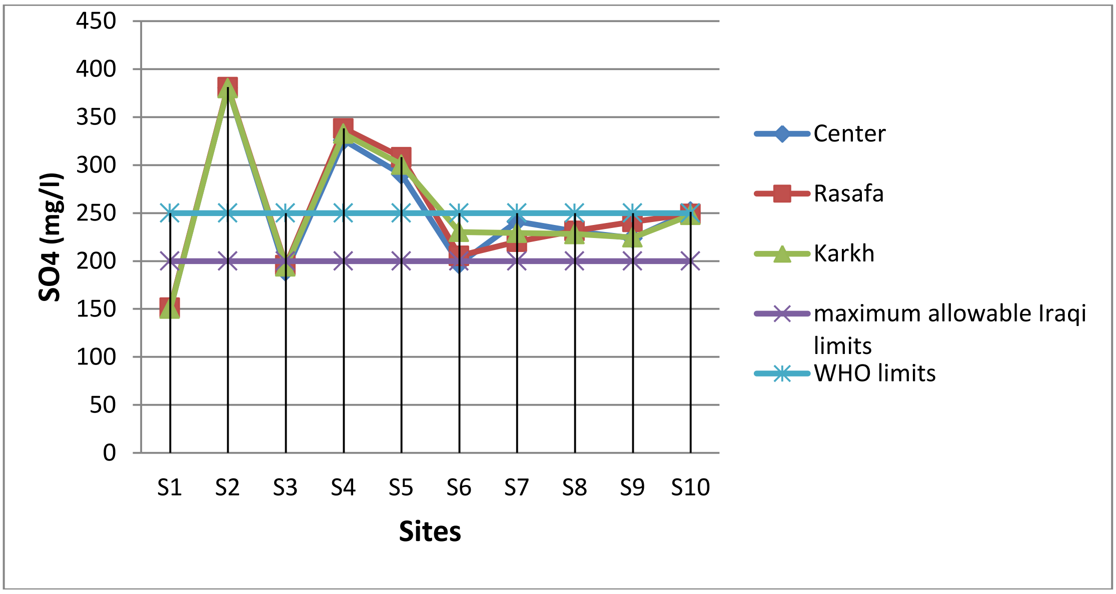

Fig 10: Values of (SO4-2) in study area

Sodium (Na^{+1})

Results of Na^{+1} concentration tests in fig.(11) show that all the values of sodium concentration are within the maximum allowable Iraqi and WHO limits (200mg/l).

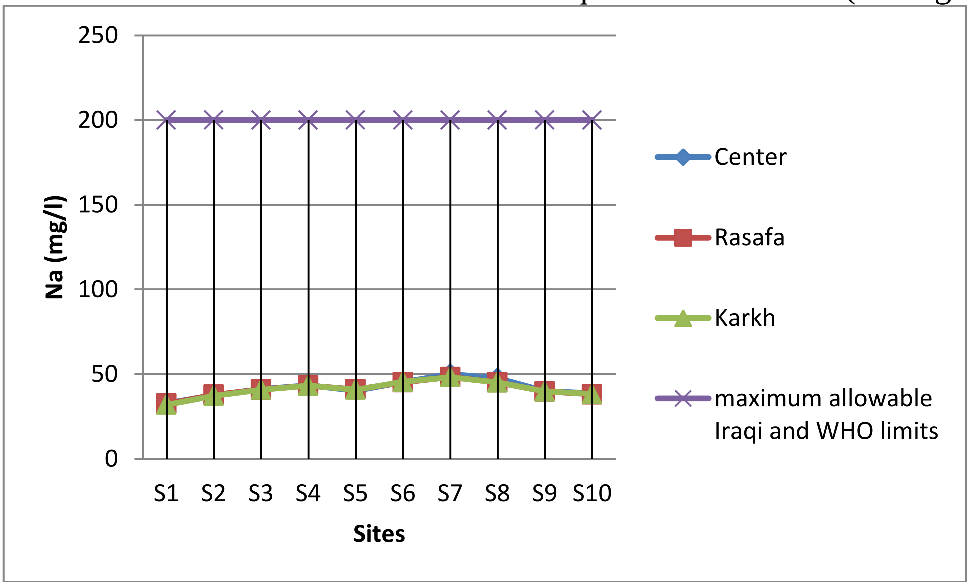

Fig 11: Values of (Na+1) in study area

Biological Oxygen Demand (BOD)

BOD is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. It is not a precise quantitative test, although it is widely used as an indication of the organic quality of water [21]. Fig.(12) shows the results of BOD values which are all within the allowable Iraqi standards (5mg/l).

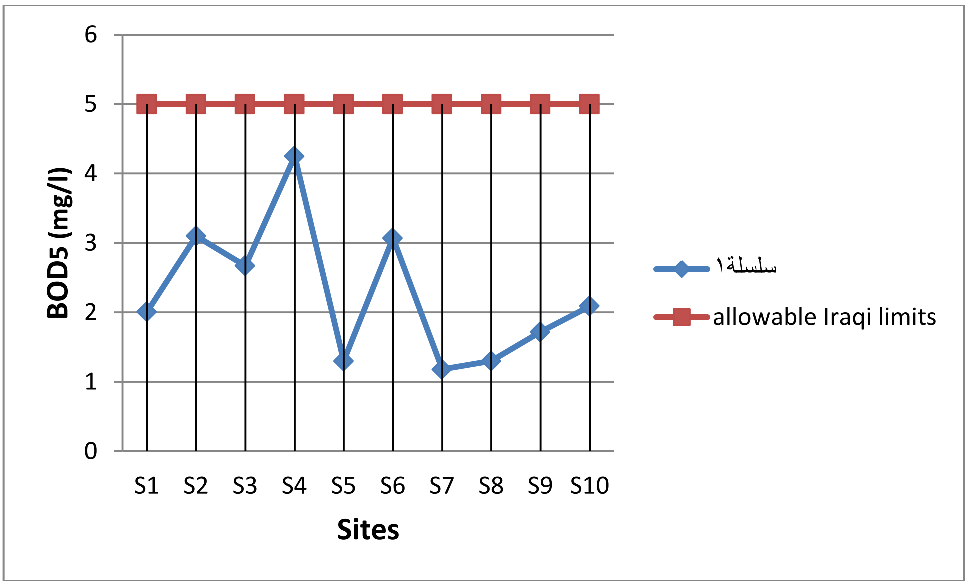

Fig 12: Values of (BOD5) in study area

4. Statistical Analysis

Table (1) shows the statistical analysis of all data obtained from the laboratory tests of all sites of study area. The statistical analyses have included finding minimum, maximum, mean, and the standard deviation values for all the parameters which were produced by analysis of the samples collected alongside the river in the three areas Rasafa, center and Karkh .

Table1: Statistical analysis of water quality parameters

Property	Position	Minimum	Maximum	Mean	St. Deviation
pH	Center	7.2	8.1	7.71	0.264
	Rasafa	7.2	8.2	7.5	0.330
	Karkh	7.2	8.2	7.6	0.311
EC (µs/cm)	Center	890	1220	1121.8	131.213
	Rasafa	880	1218	1123.5	132.396
	Karkh	882	1222	1125.9	130.579
TDS (mg/l)	Center	500	725	649.08	82.169
	Rasafa	492	718	646.58	83.237
	Karkh	493	718	647.75	83.883
TSS (mg/l)	Center	0.25	0.46	0.354	0.068
	Rasafa	0.31	0.51	0.443	0.062
	Karkh	0.30	0.58	0.467	0.088
Hardness (mg/l)	Center	295	490.1	358.966	62.570
	Rasafa	310.5	492.3	368.783	59.642
	Karkh	309	495.2	367.541	60.238
Ca^{+2}(mg/l)	Center	69.6	102.1	81.575	10.217
	Rasafa	73.4	102.1	75.257	8.828
	Karkh	73.6	102.6	82.725	9.099
Mg^{+2} (mg/l)	Center	23.1	70.12	38.333	14.071
	Rasafa	27.3	71	40.233	13.607
	Karkh	28.7	70.9	40.466	13.466
Cl^{-1} (mg/l)	Center	80.9	79.8	98.725	13.345
	Rasafa	130.2	129.6	99.50	13.345
	Karkh	98.72	99.50	99.283	13.962
SO_4^{-2} (mg/l)	Center	150.6	380.5	250.991	13.345

	Rasafa	151.2	381.1	254.433	68.206
	Karkh	150.2	380.2	254.025	70.171
Na^{+1} (mg/l)	Center	32.8	50.1	41.658	13.345
	Rasafa	32.5	48.3	41.075	5.080
	Karkh	31.9	48.2	40.9	4.543
BOD_5 (mg/l)	Center	1.18	4.25	2.343	0.993

5. Conclusions

1- Results showed that when we compare between all sites in study area, we'll find different increases and decreases in pH, Ec, TDS, TSS, total hardness, Ca^{+2}, Mg^{+2}, Cl^{-1}, So_4, Na^{+1},BOD values.

2- All values of pH, Ec, TDS, TSS, total hardness, Ca^{+2}, Mg^{+2},Cl^{-1}, Na^{+1}, BOD were within the limits of maximum allowable Iraqi and WHO standards.

3- The values of So_4 in (S2, S4, S5, S7, S8, S9, and S10) are exceeding the maximum permissible Iraqi limits and WHO standards with So_4 greater than 200mg/l.

4- There is a clear improvement in Tigris river water quality. The application of the new legislations of the ministry of Iraqi environment [22], may be the causer of this improvement.

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