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Environmental assessment of the water of the Tigris River for pollution caused by the dumping of human and industrial waste in some selected areas of Baghdad Governoratefor the year 2022

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Abstract:

Eight samples of water from the Tigris River were selected in Baghdad governorate to determine the water quality through analyses of physical-chemical variables. The study showed that the water is a moderate type and tends towards light alkaline in some areas. Both electrical conductivity and dissolved solids increase in concentrations of sodium, calcium, magnesium, potassium, sulfate, chloride, bicarbonate, and nitrate. The hydrochemical formula for most water is(Ca - SO4), (Na - SO4) due to the high concentrations of these ions in the water . Compared to the requirements of the World Health Organization and Iraqi standards, it was found that this water is fit for human consumption .
It is suitable for animals consumption and for construction purposes while the permissible limits are not exceeded. It was also found that this water is suitable for industrial purposes and irrigation, where crops can be grown.

Keywords: Environmental pollution , sewage, solids , Korloffs, formula

Introduction :

Fresh water is a valuable resource that is necessary to maintain life and health and to ensure the preservation of ecosystems. The pattern of human settlement throughout history is often determined by its availability, since good quality drinking water can be consumed in any desired quantity without adverse health effects (1).Civilization has polluted our water supply to the point that we have to purify water to drink, and the United Nations estimates that 2.7 billion people will face water shortages by 2025, even though the Earth is largely made up of water, fresh water only accounts for about 3% Of the total water available to us, this means that we can easily reach only 0.006%. This is reflected in the fact that more than 80 countries are now suffering from water shortage, it is clear that water is a rare and valuable commodity and we need to maintain its quality and use it wisely to ensure its continuity. Which causes a lack of oxygen that affects aquatic organisms, especially fish (2)The Tigris River, whose source is from the southern and eastern highlands of Turkey, whose altitude ranges from 1000 to 20000 meters above sea level.It and its tributaries are considered a source of goodness and giving in Iraq due to its great impact on the existence and development of life in the field of agriculture, industry, construction and other facilities (3)

Study area:

The city of Baghdad is located in the center of Iraq on the Tigris River, at latitude 33 and longitude 44, and in the middle of Iraq's main cities in the north and south. Its area is about 660 square kilometers, and the Tigris River divides it into two parts, "Al-Karkh" in the western part and "Al-Rusafa" in the eastern part. This site is of great importance to the city;As it is far from the sources of natural disasters such as floods, and close to water sources and natural resources, in addition to that the city represents a link and an important station between the countries of Southeast Asia, Turkey, India, and Syria. (4) For the

entrance of the Tigris River to the city of Baghdad, it is at a distance of 5 km before the island of Baghdad, while its exit point is 3 km to the south of the mouth of the Diyala River, where the length between these two points is 58 km and the average slope of the Tigris River at the city of Baghdad is 9.6 cm / km. Between 500-190 meters (Al-Adly, 1998) and the Tigris River is characterized by many twists in the city of Baghdad, especially in the Al-Dawra region, which is preceded by the Jadiriyah torsion, where this torsion is semi-symmetrical and in the form of a longitudinal peninsula (5)

Map. (1) The location of the city of Baghdad (6)

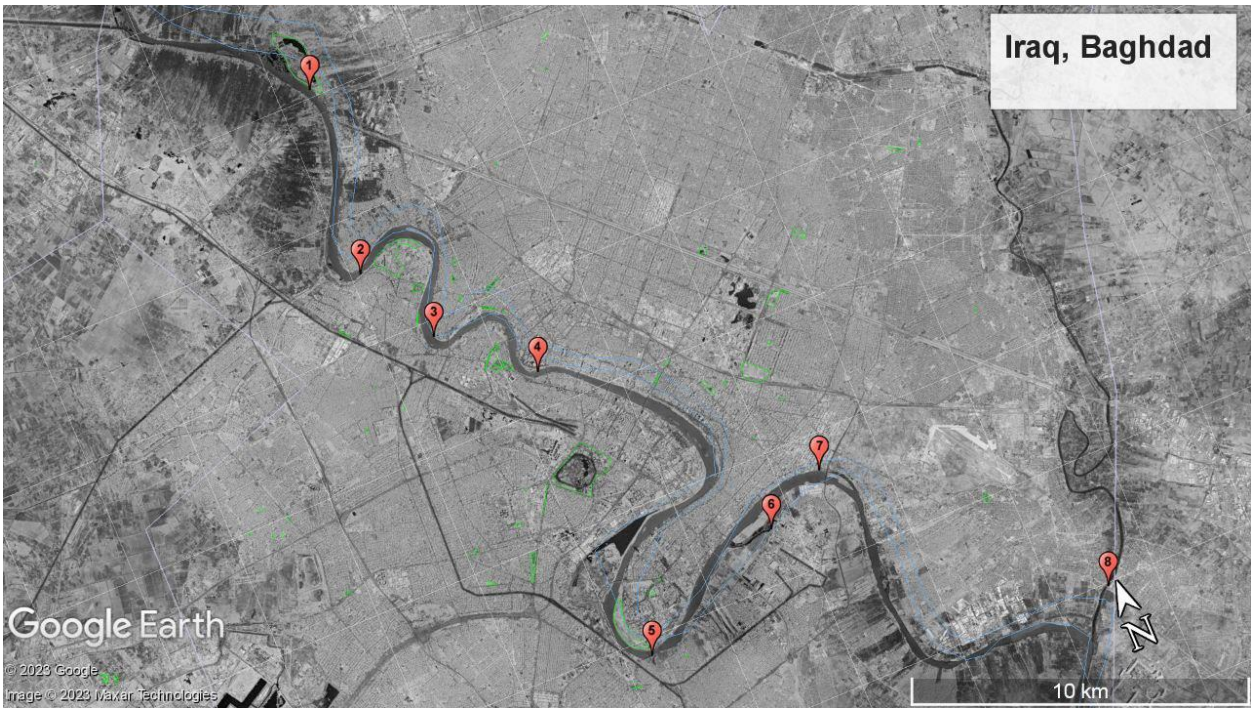
geology of the area:

The study area is located in the plain of Mesopotamia, which represents a floodplain alluvial plain, where the sediments of the Quaternary age appear on the surface, the deposits of the Quaternary age Gypsum in areas far from the Tigris River, while a number of river terraces were identified at different heights from the river course. Some thick gravel layers were also found that formed in the last stages of the Quaternary age. These deposits are located in the study area where they cover large areas of different thickness and consist of eroded sediments. One of the oldest formations and contains gravel sand, silt and clay (7)

Map (2) The geological map of the study area (8)

Materials and working methods:

Water models for determining the main components represented by positive ions and negative ions from the water of the Tigris River were collected in drinking water bottles with a size of (250) cm. Samples from eight areas inside the city of Baghdad during the fourth month on 5- 4- 2022. Eight water samples (The tourist island, Al-Qurayyat pedestrian bridge, Al-Nu'man Hospital, the Medical City Hospital, the Dora electric station, the Dora refinery, the oil factory near Al-Rasheed camp, and the old Diyala Bridge.)These samples were preserved in the laboratory at a degree of 4 ° C and a drop of hydrochloric acid was placed in each model to preserve the elements from decomposition and until chemical analyzes were conducted for them. Laboratory analyzes were conducted for them in the Department of Environment and Water Center Water research in the Ministry of Science and Technology and the researchers obtained the results used in this research**.**



Map (3) the site for taking samples

Results and discussion:

Physical properties:

Acidity function (pH): The pH function is a measure of the hydrogen ion concentration in the anhydrous solution, or it is defined as the negative logarithm of the hydrogen ion concentration in the aqueous medium (9). pH) to less than (6.5), it affects the water supply systems through the erosion of the pipes of the water distribution networks and thus causes water pollution with iron, lead and zinc elements, but when the pH values increase to more than (8.5), the water becomes alkaline and not It has a direct impact on human health, but it causes a change in the taste of water (10)To measure the level of acidity descriptively, the acidity scales are used, which ranges from (1-6) substances are called acidic and from (8-14) are considered alkaline, while substances whose pH reaches (7) are considered neutral substances (11)

14Alkaine 8,7,6 Acids 1

the highest value of the acidity function in sample 3 (7.2), and the lowestvalue in sample 8, and it was (6.7), and Table. (2) shows this and that the reason for the high (pH) near the Al-Numan and Silo hospitals is the presence of an almost high percentage of Ion (Ca^{+2}) of different sources , and the reason for its decrease near the secret of Al-Qurayat is the presence of an almost high concentration of Na^{+1} ion Of different natural and human sources

Electrical conductivity (EC): Electrical conductivity is a measure of water's ability to conduct electric current through it, and it is measured in units (µ/cm) or Mohs) (12) and its values depend on the concentrations of the main positive and negative ions dissolved in the water and on the proportions of

solids Total solubility (13) It is also one of the indicators for determining the percentages of dissolved salts in water (14) The EC values increase by 7% as a result of an increase in temperature by one degree Celsius.anthropogenic such as waste or industrial processes (15)The value of the electrical conductivity depends on the concentration of ions in the water, which is the ability of (1.0) cm3 of water to conduct electric current at (25.0) C^0 (11). its highest value in sample 7 it reached (2070) micro-siemens / cm. The lowest value was in sample (4), reaching (728) micro-siemens / cm. Table No. (2) shows this and the reason is due to the increase in dissolved solids (T). D.S.) in the area near Al-Rasheed camp of various human activities, so we note the high electrical conductivity that is affected by the increase in the concentrations of these substances. As for the low electrical conductivity near the city of Medicine, due to the low concentration of dissolved solids (T.D.S.) in the area Due to the lack of industrial activity in this area

Dissolved Solids (T.D.S.): It includes all the remaining materials resulting from the evaporation of water, whether they are inorganic materials (calcium, magnesium, potassium, sodium, bicarbonate, chlorides, and sulfates) or other materials. Organic and in limited quantities, which can dissolve in water and do not include suspended substances, dissolved gases and colloids (15)The World Health Organization (WHO) classified drinking water according to the concentration of (T.D.S.) into five types and table No. (1) shows this and its highest value was in sample (7) (1051) The reason is due to the presence of human activity and industrial activities, as well as the presence of dissolved compounds such as carbonate salts, bicarbonates, and its lowest value in sample (4), as it reached (377) and Table (2) shows this.

Table (1) World Health Organization (WHO) classification of drinking water according to (T.D.S.) concentration (11)

(Concentration (T.D.S.) (mg. L^{-1})	water classification
less than 300.0	**Excellent water**
300.0- 600.0	**good water**
600.0- 900.0	**acceptable water**
900.0- 1200.0	**clear water**
more than 1200.0	**Unacceptable water**

and its highest value was near Al-Rasheed Station (1051) The reason is due to the presence of human activity and industrial activities, as well as the presence of dissolved compounds such as carbonate salts, bicarbonates, and its lowest value near Medicine City, as it reached (377)and table No. (2) shows this

Table (2) average physical properties of the Tigris River water for year 2022

Sample Name	Ph	E.C (µ S \cm)	T.D.S.
1	7.1	834	439
2	6.7	832	436
3	7.2	788	408
4	7.1	728	377
5	7.0	1083	551
6	7.1	937	478
7	7.1	2070	1051
8	6.9	2030	1030

Chemical properties:

Cations

Calcium Ca^{2+}: The calcium ion is the most abundant element in the earth's crust, and its main source is carbonate sedimentary rocks such as (Limestone and Dolomite) and gypsum rocks (16) Calcium causes collateral damage that negatively affects human health when exposed to high concentrations of them, causing Damage to the cells of the body, and when its concentration in the blood plasma is high, it leads to the disease of hypercalcemia (Hypocalcaemia), which may lead to death (17). As it reached (70) parts of a million, and Table No. (3) shows that

Magnesium Mg^{2+}: The magnesium ion is one of the most prevalent alkali in the earth's crust after the calcium ion, and it is the result of chemical weathering and melting and substitution processes of rocks (Dolomite and Marl). (20) And in the event of exposure to high concentrations of them, it causes nausea and vomiting and lowers blood pressure and sometimes causes death (26) and the highest percentage was at sample (7)(73.0) ppm certainly, because magnesium and calcium have a positive relationship, and the increase is also coming from the various industrial wastes in the region and the lowest in sample (3)As it reached (22.2) parts per millionand –Table (3) shows that

Sodium Na1+: Most soils and rocks contain in their composition the sodium ion, which dissolves easily in water. The source of the sodium ion is the result of precipitation of salt rocks and weathering of rocks, as well as weathering of carbonate rocks (33). Sodium causes health effects that negatively affect human health when exposed to high concentrations of it, such as heart attacks, swelling of the extremities, fluid retention in the kidneys and high blood pressure (26) and the highest percentage was in sample (8), reaching (189.3) parts per million and less. The percentage in sample (4) , as it reached (83.1) parts of a million, Table (3) shows this. The reason for its increase in sample (8) area is the large number of agricultural areas that cause an increase in the use of chemical fertilizers, in addition to the presence of various wastes that are thrown into the river from the Al-Rustumiya area (sewage water) Without complete treatment.

Potassium k+: The presence of potassium ion in water is the result of weathering of sedimentary and metamorphic rocks and clay minerals (2), as well as industrial sources, pesticides and chemical fertilizers used in agricultural lands, which cause an increase in the concentration of potassium in surface water. It is one of the important nutrients for humans. However, the increase in its concentrations causes stomach ulcers and the mucous membrane of the intestines and works to reduce blood pressure and has a direct effect on the cardiovascular system (3). less. The percentage in sample (4) (2.1) , as it reached The highest percentage in sample (7) , reaching (21.1) and Table (3) illustrates this The increase in its concentration in this areais due to it being an area for dumping industrial waste coming from the oil plant, in addition to.

Table (3) Concentration of positive ions in the Tigris River for the year 2022, the fourth month

Sample Name		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	∑Cations
1	PPm	80	22.2	98.3	2.5	**200.5**
	Epm	4	1.85	4.27	0.13	**10.25**
	Epm%	39.02	18.04	41.66	1.27	**100%**
2	Ppm	75	27.3	95.6	2.5	**200.4**
	Epm	3.75	2.28	4.16	0.13	**10.32**
	Epm%	36. 33	22.09	40.31	1.26	**100%**
3	Ppm	78	28.5	91.5	2.0	**200**
	Epm	3.9	2.38	3.98	0.11	**10.37**
	Epm%	37.61	22.95	37.9	1.06	**100%**
4	PPm	70	25.5	83.1	2.1	**180.7**
	Epm	3.5	2.13	3.61	0.11	**9.35**

	Epm%	37.43	22.78	38.61	1.18	**100%**
5	PPm	95	34.7	118.4	6.6	**254.7**
	Epm	4.75	2.89	5.15	0.35	**13.14**
	Epm%	36.14	22	39.19	2.66	**100%**
6	PPm	85	31.0	110.3	2.5	**228.8**
	Epm	4.25	2.58	4.81	0.13	**11.77**
	Epm%	36.11	21.92	40.9	1.1	**100%**
7	PPm	200	73.0	189.2	21.1	**483.3**
	Epm	10	6.01	8.23	1.11	**25.35**
	Epm%	39.45	23.71	32.47	4.38	**100%**
8	PPm	190	69.3	189.3	17.2	**465.8**
	Epm	9.5	5.78	8.22	0.91	**24.41**
	Epm%	38.92	23.68	33.67	3.73	**100%**

Anions

Sulfate SO_4: Sulfate is one of the main negative ions present in abundance in the earth's crust, one of the most important natural and main sources of water resulting from the processes of weathering, decomposition and oxidation of sulfur-containing materials such as fossil fuels, in addition to the melting of sulfur-containing rocks and minerals such as (Pyrite Anhydrite, Gypsum). (15) The high concentration of sulfate works to corrode and damage the water-carrying pipes in the water supply systems in the filtration plants. High concentrations of bicarbonate ions in drinking water cause stomach irritation and diarrhea, meaning that it acts as a laxative, especially when it is associated with calcium and magnesium, as well as changing the taste of foods (19). The highest percentage of sulfate in sample (7) reached (475) parts per million, and the lowest concentration in sample (4), as it reached about (170) parts per million, Table (5). Calcium and Magnesium

Chloride Cl^-: The chloride ion is one of the main negative ions, usually found in the form of chlorine salts, and it is highly soluble in water. One of the most important natural sources of chloride ion are (NaCl, CaCl, MgCl), sedimentary rocks and evaporated minerals, and their presence in water is naturally linked With the washing processes (Leaching) of minerals such as (Gallite, Sylvite) from rocks and salt sediments (13) Chloride is an essential nutrient and necessary for the development of the body's organs, but if its concentration reaches a high level, it causes high blood pressure and an increase in the number of white blood cells (30). According to the American specifications, drinking water was classified according to the chloride ion concentration into four types, and Table (4) shows this. The highest percentage

Table (4) Classification of water according to chloride concentration according to American standards (11)

Cl concentration mg. Liter $^{-1}$	water classification
less than 50.0	Excellent source
50.0- 250.0	good source
250.0- 600.0	Not a good source
More than 600.0	very poor source

(24.79) parts per million and its lowest percentage is near the Medical City Hospital, as it reached (4.2) parts per million, Table No. (5) shows this. The increase is due to water pollution with human waste coming from Al-Rastumiya, in addition to the chemical fertilizers used in the farms.

Nitrate NO3: The nitrate ion is one of the most oxidizing forms of nitrogen in natural waters, and it is a negatively charged compound known to be one of the most soluble salts, but it is less precipitated in

water. Nitrates enter the surface water as a result of human activities represented in the discharge of industrial process water, sewage and agricultural activity through excessive use of chemical fertilizers, in addition to the dissolution of ammonia and nitrogen in the atmosphere and its transfer to surface water when it rains (31). The high absorption of nitrate concentrations in the human body leads to severe poisoning, especially when absorbed by children, causing glaucoma syndrome, as well as heart and thyroid diseases and diabetes (28). The high percentage in sample (7) as it reached(36) parts per million and its lowest percentage near the in sample (4)as it reached (4.9) parts per million and Table (5) shows this due to the increase in its concentration in this area due to it being an area for throwing industrial waste coming from the oil plant in addition to the sewage thrown in same area

BicarbonateHCO_3^-: This ion is a source of alkalinity, which means the ability of water to interact with (H+). As for the total alkalinity, it is a measure of bicarbonates, carbonates, and hydroxyls (OH-) dissolved in water. When the pH is less than (8.2), most of the carbons present In water it turns into bicarbonate (20) The lowest percentage in sample No.(3) reached (128) and high percentage in sample (8) reached (165) and rate is (138.62) Table (5)

Phosphate PO_4: Phosphate is a natural substance, consisting mainly of tri-calcium phosphate, which is slightly soluble in water. Phosphate derivatives are used in the form of phosphate fertilizers, and the quality of phosphates is measured by the percentage of phosphorous pentoxide, and water is considered suitable for human use if the percentage of phosphates in it is low. Phosphate is used in many industries, the most important of which are: mining, military, medical, food, ceramics, textiles and matches. Phosphate is important in the manufacture of fertilizers to increase agricultural crops. High levels of phosphates accelerate the appearance of signs of aging in humans. And that these levels elevated levels of it in the body may increase the prevalence and severity of age-related complications such as chronic kidney disease and calcification or hardening of the tissues of the heart and blood vessels. It can also induce severe atrophy of the skin and muscles (22). The highest percentage was in the waters of the Tigris River in sample (8), reaching (3.6), and the lowest in each of the waters in sample (3) reaching (0.1) The reason for its increase near the old Diyala Bridge area is due to water pollution with chemical fertilizers that come from nearby agricultural areas from the river when sewage water is thrown into the river containing phosphorous

Table (5) Negative ion concentrations in the Tigris River for the year 2022, the fourth month

Sample No.		HCO_3^-	SO_4^{-2}	Cl^-	NO_3^-	$P0_4^{-3}$	∑Cations
1	**PPm**	129	222	5.2	5.1	0.11	**361.41**
	Epm	2.11	2.32	0.15	0.08	0.003	**4.66**
	Epm%	45.27	49.78	3.21	1.71	0.06	**100%**
2	**Ppm**	131	212	7.44	5.1	0.12	**355.66**
	Epm	2.14	2.21	0.21	0.08	0.003	**4.64**
	Epm%	46.12	47.62	4.52	1.72	0.06	**100%**
3	**Ppm**	128	210	6.06	5.2	0.10	**344.36**
	Epm	2.09	2.19	0.17	0.08	0.002	**4.53**
	Epm%	46.13	48.3	3.75	1.76	0.04	**100%**
4	**PPm**	131	170	4.2	4.9	0.15	**310.25**
	Epm	2.14	1.77	0,12	0.07	0.004	**4.1**
	Epm%	52.19	43.17	2,92	1,70	0.09	**100%**
5	**Ppm**	133	275	8.04	6.2	0.51	**422.75**
	Epm	2,18	2.86	0.23	0.1	0.01	**5.38**
	Epm%	40.52	53.15	4.27	1.85	0.18	**100%**
6	**PPm**	132	262	7.40	18.1	0.10	**419.6**

	Epm	2.16	2.73	0.21	0.29	0.002	**5.39**
	Epm%	40.07	50.64	3.89	5.38	0.03	**100%**
7	**Ppm**	160	475	23.7	36	2.1	**536.8**
	Epm	2.62	4.95	0.67	6.53	0.05	**8.87**
	Epm%	29.53	55.80	7.55	9.28	0.5	**100%**
8	**Ppm**	165	470	24.79	15.2	3.6	**513.59**
	Epm	2.70	4.9	0.7	0.24	0.1	**8.64**
	Epm%	31.25	56.17	8.10	2.77	1.15	**100%**

water quality rating: We mean the hydrochemical formula of water by the main positive and negative ions in units (equivalents par million%), and it is abbreviated (epm), whose concentrations are greater than (15%) and whose proportions are arranged in descending order for all ions. Total (T.D.S.) in units (mg/L) and the pH value (26) if it was noted from Table (6) that most of the areas from which the Tigris River water samples were taken are (Ca - SO4) and other areas (Na - SO4) and the reason is due The presence of large quantities of dissolved ions of Ca++ ion) and the sulfate compound due to the presence of these ions from various natural sources, as well as the presence of pollutants resulting from human waste (sewage water) and industrial waste that is directly thrown into the river without treatment

Table (4) The hydrochemical formula of the Tigris River water for the fourth month

Sample Name	Formula kurlov	Type water
1	$439\frac{SO4(49.78)\ HC03(45.27)}{Ca(39.02)\ Na(41.66)Mg(18.04)}7.1$	**Ca – Na – Mg – SO_4 - H Ca – SO_4**
2	$6.7\ 436\frac{SO4(47.62)HC03(46.12)}{Ca(36.33)Na(40.31)Mg(22.09)}$	**Ca – Na – Mg – SO_4- HCO3- Ca – SO_4**
3	$408\frac{SO4(89.75)HC03(45.27)}{Na3(37.9)Ca(37.61)Mg(22.95)}7.2$	**-Ca– Mg – SO_4-HCO3 Na - Na – SO_4**
4	$377\frac{HC03(52.19)SO4(43.17)}{Na(38.61)Ca(37.43)Mg(22.78)}7.1$	**-Ca– Mg – SO_4-HCO3 Na - Na – -HCO3**
5	$551\frac{SO4(53.15)HC03(40.07)}{Na(39.19)Ca(36.14)Mg(22)}\ 7.0$	**-Ca– Mg – SO_4-HCO3 Na - Na-SO_4**
6	$478\frac{SO4(84.52)HC03(40.52)}{Na(40.9)Ca(36.11)Mg(21.92)}7.1$	**-Ca– Mg – SO_4-HCO3 Na - Na – SO_4**
7	$1051\ \frac{SO4(55.80)HC03(29,53)}{Ca(39.45)Na(32.47)Mg(23.71)}7.1$	**Ca – Na – Mg – SO_4- HCO3- Ca – SO_4**
8	$1030\ \frac{SO4(56.17)HC03(31.25)}{Ca(38.92)Na(33.67)Mg(23.68)}6.9$	**Ca – Na – Mg – SO_4- HCO3- Ca – SO_4**

Water validity: The river water is used for various purposes depending on the concentrations of ions left in it to:

1- **For human drinking:** By comparing the values of water models with the Iraqi determinants of corrected drinking water for the year (2009) (28) and the World Health Organization (WHO) for drinking water. Corrected for the year (2017) (29) We note that the quality of the water of the Tigris River during the research period is suitable for human drinking, as all the averages of the elements for all areas of the study did not exceed the permissible percentages within the Iraqi determinants of drinking water and some, so the water is considered safe for drinking and Table No. (7) explain it

Table (7) Comparison of rates from the Tigris River water from 2022 with the Iraqi determinants of drinking water for the year (2009) and the World Health Organization (WHO) for corrected drinking water for the year (2017)

Variables	The average of variables in Water of study area	International specifications WHO 2017)	Iraqi specifications 2009
Ca^{+2} (ppm)	109.2	200	200
Mg^{+2} (ppm)	39	125	100
Na^{+} (ppm)	122.1	200	200
K+ (ppm)	7.1	12	12
SO_4^{-2} (ppm)	287	400	400
Cl^{-} (ppm)	10.85	250	350
NO_3 (ppm)	11.98	50	50
PO_4^{-3} (ppm)	_	_	_

2- **Drinking animals:** The suitability of water for drinking animals varies from its suitability for human drinking, and the minimum amount of human drinking is very good for animal drinking because the animal can drink water within the range of electrical conductivity (1500) to (16000) and from comparing these values with the rate of electrical conduction for areas The study shows that it is suitable for drinking animals in the study area, as it reached (1064.25), and Table No. (8) shows this

Table (8) Validity of using water for drinking animals (30)

Water Salinity EC (µs/cm)	Rating
15oo>	Excellent
1500- 5000	Very Satisfactory
5000 – 8000	Satisfactory for livestock, unfit for poultry
8000 – 11000	Limited use for livestock , unfit for poultry
11000 – 16000	Very Limited use
16000	Not recomuaded

As for the comparison with the other elements present in the water, it indicates the validity of the Tigris River water for drinking animals, and Table No. (9) shows that

Table No. (9) Validity of the Tigris River water for drinking animals (30)

Elements (ppm)	Results of the studied area	the highest rate	Can be used	Permitted water	Good water	Very good water
Na^{+}	200	400	2500	2000	1500	800

Ca^{+2}	109.2		1000	900	800	700	350
Mg^{+2}		122.1	700	600	500	350	150
Cl^{-}		10.85	6000	4000	3000	2000	900
SO_4^{-2}		287	6000	3000	3000	2500	1000
TDS	596.52		15000	10000	7000	5000	3000

3- Use of water for construction purposes: For construction purposes, and by comparison with measurement (31), the water of the study area is valid for construction purposes, and Table No. (10) shows this

Table (9) Limits of validity of water used in construction

Indmstrial	PH	Cl Epm	SO_4 Epm	Ca Epm	Mg Epm	T.D.S PPM
Cement lnd.	6.5-8.5	7.052	5.205	9.9	8.2	1000
Results of the studied area	7.03	0.30	2.99	5.46	3.24	596.52

4- Adequacy of water for irrigation purposes: The use of water for irrigation purposes depends on the extent of the plants' needs for salts and their ability to tolerate concentrations of these salts, as well as the type of soil. Water classification systems for use in irrigation purposes depend on several variables such as (SAR, %Na, T.D.S, E.C.) and due to the fact that the water enjoys good proportions of these variables when comparing the results with the environmental determinants, so the water of the Tigris River is suitable for irrigation purposes in the study area and Table No. (11) shows this

Table No. (11) Proposed limits of water validity for irrigation (32)

Totals	Variable	The average in the studied area	The standard term	Unit
Salinity	EC	1064.25	3000 – 0	s/cmμ
	TDS	596.52	2000 – 0	Ppm
Positive ions	Mg^{+2}	3.24	5 – 0	Epm
	Ca^{+2}	5.46	20 – 0	Epm
	Na^{+}	5.30	40 – 0	Epm
	K^{+}	0.37	2 – 0	Epm
Negative ions	PO_4^{-3}	-	-	Epm
	SO_4^{-2}	2.99	20-0	Epm
	Cl^{-}	0.30	30 -0	Epm
Acidic function	PH	7.03	8.5 -6	(14 - 1)

Conclusion and discussion:

1- Most of the waters of the Tigris River during the study months are lightly acidic and some are close to the neutral state

2- The water of the Tigris River in the study area is of a fresh type when compared with different sources
3- We note a difference in the electrical conductivity rates in the study area due to the rise and fall in the temperature that increases the ionization speed of the salts in the water.
4- The water quality in the study area is of the type (Na-Sulfate) or (Ca-Sulfate) due to the dissolution of some evaporite rocks (gypsum and anhydrite), as well as due to the increase in rainfall rates during this period.
5- The results of chemical analyzes of the water of the Tigris River in the study areas showed that some study areas showed a marked increase in the permissible percentages, especially in the areas near Al-Rasheed camp and the old Diyala bridge area, due to the severe pollution resulting from throwing human and industrial waste without treatment in the area Near Al-Rasheed camp, specifically near the oil plant, where the wastes of this plant are dumped in addition to the sewage water and synchronized with it As for the area of the old Diyala Bridge, which is considered one of the most polluted areas in the Tigris River, as it receives sewage water coming from Al-Rustumiya, in addition to the remnants of chemical fertilizers that come from the agricultural areas that are abundant in these areas. It is (400) in addition to sulfates. It was also noted in these two areas that potassium (k+) also exceeded the permissible limits, as it reached (21.1) near Al-Rasheed Camp.and (17.2) in the area of the old Diyala Bridge. As for the permissible limits, they are (12) for the same reasons mentioned above. This indicates that the waters of the Tigris River in these two areas are not suitable for human consumption as drinking water, as the excess of the percentage of these elements beyond the permissible limits poses a threat to health. It is considered a dangerous indicator of pollution, which calls for concerted
efforts to find quick and feasible solutions to treat or reduce the pollution that affects the Tigris River

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