



An analytical study on the specification of city of Kirkuk's water and compare it with the water areas of Alton-kopry and Daquq for human use.

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Received date: 11 / 9 / 2014

Accepted date: 8 / 3 / 2015

ABSTRACT

Chemical and physical properties of underground water samples were investigated from Kirkuk city and its regional neighborhood such as Alto Kopry and Daquq. These samples were collected from nineteen different locations in these zones including drinking water network of Kirkuk city.

These samples that were tested quality of North Gas Company (NGC). The tests carried out were the determination of PH value, dissolved solids, hardness, ion concentrations and electrical conductivity.

The results showed that the collected samples were free from bacterial contamination, as well as some properties exceeded the permissible limits and others were within limits. As a general conclusion, Kirkuk network water was better than its surrounding regions. Some wells in Alton Kopry and Daquq were acceptable for human use whereas others required chemical treatment.

Keywords: groundwater ,Kirkuk's water network ,civil use .

دراسة تحليلية لمواصفات مياه مدينة كركوك ومقارنتها مع مياه منطقتي التون كوبري وداقوق للاستخدام البشري

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تاريخ قبول البحث: 2015 / 3 / 8

تاريخ استلام البحث: 2014 / 9 / 11

الملخص

تم اختبار الخواص الكيميائية والفيزيائية لعينات المياه في مدينة كركوك وناحية التون كوبري وقضاء داقوق حيث ان الاخيرتين تعتمد على المياه الجوفية، حيث تم جمع 19 عينة من كل مناطق شملت التون كوبري وداقوق وشبكة مياه مدينة كركوك. وان الاختبارات شملت جودة المياه في شركة غاز الشمال (NGC) كل من معامل التوصيل الكهربائي ، قيمة الرقم الهيدروجيني والمواد الصلبة الذائبة ، والصلابة بالإضافة الى تحديد تركيز ايونات. كشفت النتائج ان عينات المياه كانت خالية من الملوثات البكتيرية. وان مياه شبكة كركوك هي الافضل فيما يتعلق بمناطق ابار مياه التون كوبري وداقوق كان بعضها مقبول للاستخدام البشري والبعض الاخر بحاجة الى علاج كيميائي. الكلمات الدالة: المياه الجوفية ، شبكة مياه كركوك ، الاستخدام البشري للمياه.

1.INTRODUCTION

Because of the severe shortage and the growing need for drinking water for human use and drought in some cases, or the lack of surface water sources, there was a need to drill several wells in order to satisfy domestic needs. Water is essential to sustain life and the importance given to the subject in terms of health has been focused to work in this field to provide water free of microorganisms that can cause infectious diseases, as well as the harmful metal ions. Therefore, this analytical research aims to study the qualitative characteristics of groundwater for the regions of Daquq, Alton-Kopry and Kirkuk's network water to check its suitability for



domestic use. The wells that increase from deep inside 35m can be considered free from bacterial contamination [1], except that it must check the qualities and characteristics of those water samples collected from wells implementing the standard methods for the analysis through the use of accurate laboratory devices and compare the results of the investigation and analysis with the global specifications or local health code to determine the acceptability of the water or not.

There are lot of studies that have been performed for the purpose of assessing the validity of groundwater for human use based on a specification of physical, chemical and bacteriological aspects. In a study of the qualitative characteristics of groundwater to the Sinjar area and its suitability for civilian use Shehu[2] explained that the study of groundwater in that region was free of bacterial contamination, and that the focus of some of the properties are located within the permissible limits, while exceeding the concentration of some of the properties of the limits of the required specifications, and also showed that the water of all the wells in the area was acceptable for human use, and in the study of Jamil and Louay [3] to assess the qualitative characteristics of some from groundwater sources for the city of Kirkuk and its suitability for civil and industrial uses results showed a high rate of sulfate and total hardness and electrical conductivity for most of the wells investigated exceeded the permissible limits of civil and industrial uses.

The study, conducted by Shok and Saadi [4] to assess the validity of the water some artesian wells south of Baghdad for domestic use and irrigation study has shown that the water of those wells was unfit for human consumption and irrigation because they exceed the limit by the World Health Organization and U.S. salinity Laboratory. And the study showed Mashhadani.et.al [5] high concentrations of the components of water wells stretching between the city of Mosul and Ba'shiqah to higher limits allowed for drinking purposes and due to the nature of the geological formations of the area.

And shown that the study, conducted by Ani [6] that the groundwater zone Alhamdania tend to contain high and very high salinity and low too high in sodium with a concentration of chloride ion is therefore advisable to choose crops resistant to salinity. The study showed AL-Rawi and his group [7] that the groundwater of some of the wells in the city of Mosul, a predominantly with high salinity and the presence of concentrations of some dangerous elements that affect the agricultural crops.



2.MATERIALS AND EXPERIMENTAL WORK

Samples of water were collected from (19) wells etched and compared with Kirkuk network water used for civilian purposes in different locations of Daquq and Alton-Kopry and some surrounding villages, Daquq region ranging depths of wells between (80-135)m, Alton-Kopry where ranging between (100-170)m, where our samples after running well for enough time more than 30 minutes so that in order to obtain representative samples[2],and given to the laboratory tests in the laboratory the North Gas Company to evaluate the quality of the water by studying the characteristics of human use based on the standard specifications of the Iraqi and global[8,9,10]. Function were measured (PH value) by device (PH meter) type (Enolab-wtw) and electrical conductivity (Conductivity meter) and measure the ratio of the concentrations of calcium and magnesium calibration solution (EDTA and sodium to a gentle flame (Flame Photometer)) and sulphates using (UV) (Thermo visible light) and chlorides manual way using silver nitrate in addition to the measurement of turbidity using (Orbeco - Hellige Turbidity meter).

3.RESULTS AND DISCUSSION

The results of all measurements and laboratory tests that have been conducted for the purpose of determining the qualities of groundwater for the area has been the adoption of elements of the ruling only and compare them with the specifications of the Iraqi standard [9] and specifications of the World Health Organization (WHO) [10] and Euro-zone specifications for drinking water (European com.)[11] and specifications of Central Asia (Middle Asia Class)[12] as described in **Tables (1) and (2)** .

Table (1): The standard specifications of the Iraqi and specifications of the World Health Organization(WHO) and the specifications of the European region of the water.

Limiting	Standard Specifications of the Iraqi	World Health Organization (WHO)		Specifications of the European region of the water.	
		Mini. value	Max. value	Min. value.	Max. value.
mg/L					
Cl	200	200	600	25	200
Mg	50	-	150	30	50
NO ₃	20	6	11	-	-
Na	-	-	-	20	175
SO ₄	200	200	400	25	250
T.D.S	1500	500	1500	-	1500
T.H	500	100	500	-	-
Ca	200	-	-	-	-

Table (2): Specification Central Asia (Middle Asia Class).

Quality of water	Ions concentration(mg/L)						
	T.D.S	Na ⁺¹	Ca ⁺²	Mg	Cl ₁	SO ₄ ₂ ⁻	T.H
Good	1500	600	600	75	150	400	30
agreed	2000	800	700	100	250	500	45
Acceptable	2500	900	800	125	300	700	60
Not acceptable	3000	1000	900	150	350	800	80

Figure (1) range from the depths of the area between Alton-Kopry (100-170)m at a rate of 135m, while the area Daquq ranging between the depths of the wells(80-135)m and an average of 107.5m.

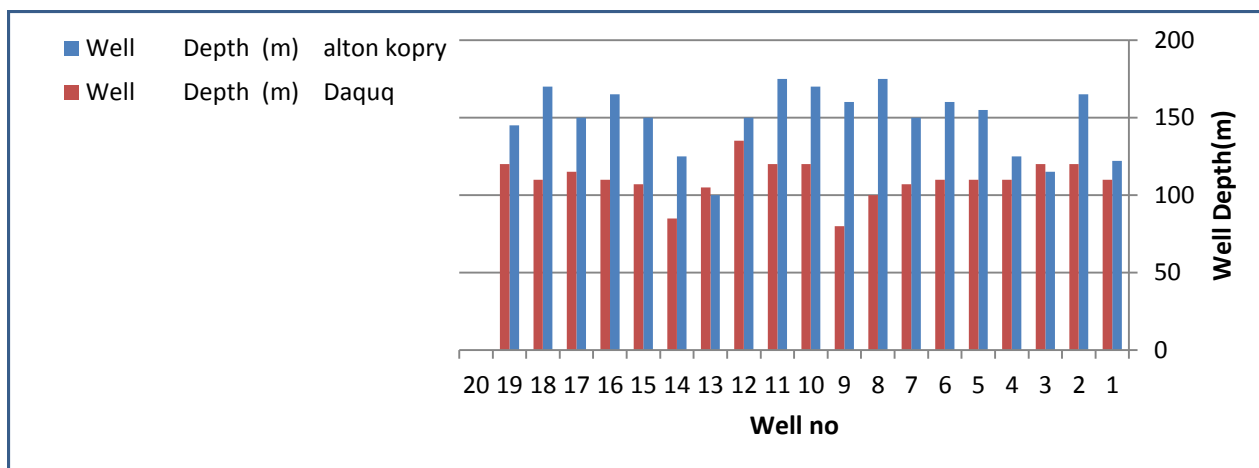


Figure (1): Wells depth (m) and well no. for Daquq and Alton-kopry.

PH:

Values ranged hydrogen ion concentration of the water wells tested values between (7-8) for the Daquq,(7.91-7.24) for the Alton-Kopry and Kirkuk's water ranged between(7.4-7.56)these values can be considered within the limits appropriate for different uses Figure (2).

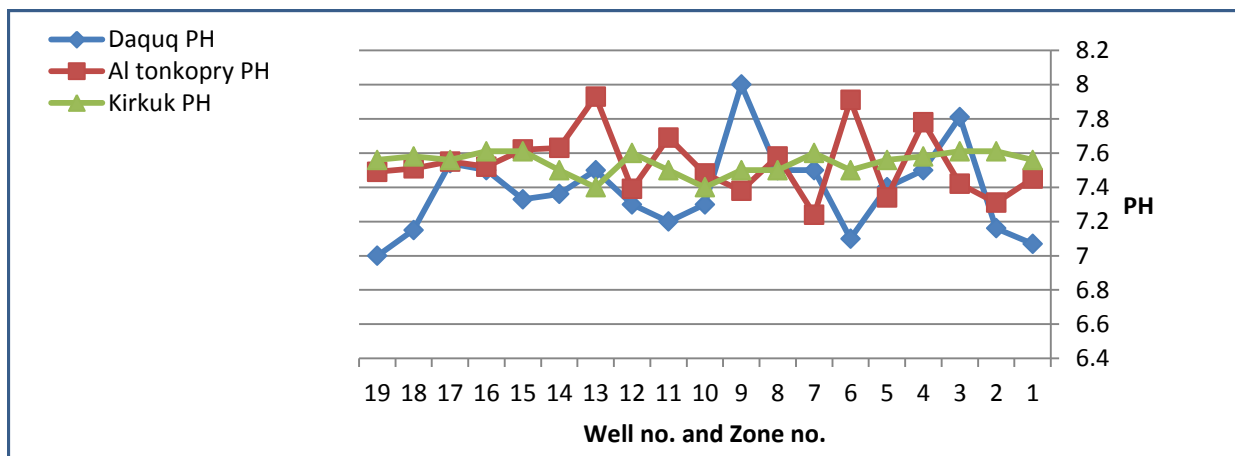


Figure (2): PH values for Daquq, Alton-kopry regions and Kirkuk zones.

Total Dissolved Solids (TDS):

Concentrations mean values of total dissolved solids to water wells for the Daquq area (389-1714)mg/L and when comparing these results with the specifications in the Table (1) it was found that (89%) of the wells were located within the limits of the maximum allowable and (11%) which exceeded the limits and are wells (2 and 5) either when compared to the results in Table (2) the proportion (89%) considered good for home use and (11%) of the wells is considered acceptable as only the concentrations of dissolved solids for all wells border suitable for domestic use.

As for Alton-Kopry area values ranged of TDS (217-1091) mg/L. The results of this can be seen with the specifications in Table (1) all the water wells located within the permissible limits, either when compared to the results in Table (2), all wells are considered good for domestic use did not exceed the concentrations of dissolved solids for all wells appropriate limits to use.

Lastly for Kirkuk's zones the total dissolved solids ranged (230-269) mg/L so when compare with the specifications in Table (1) the proportion is 100% because of all values were acceptable.

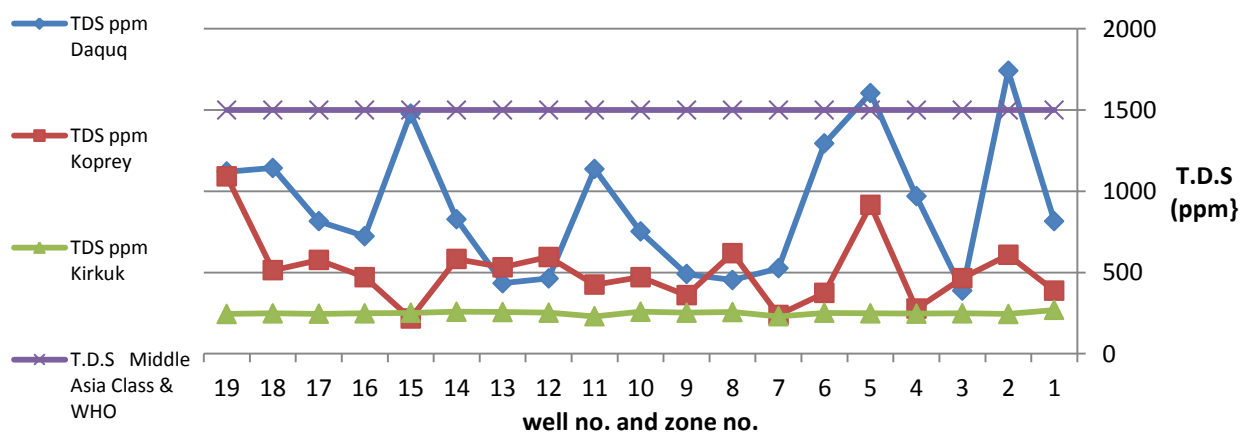


Figure (3): TDS values for Daquq, Alton-kopry regions and Kirkuk's water.

Total Hardness (T.H):

The total hardness of groundwater vary significantly and that depending on the geology of the region and attributed hardness to the abundance of the presence of ions bilateral parity of the elements, especially calcium and magnesium, which are located largely in the

groundwater, and that the presence of hardness makes the water consumer soap where cause for hardness excess water deposition and prevent soap foam [2].

The results showed that the values of total hardness Daquq area **Figure (4)** average between (213-1057)mg/L and depending on the Iraqi standards and (WHO) in **Table (1)**, (47%) of the wells and are (16,14,13,12,10,9,8,7,3) fall within the permissible limits (500 mg/L) the rest of the wells must address its waters for the purpose of reducing the concentration of salts before being used for domestic purposes , either according to the specifications of Central Asia **Table (3)**, all wells unsuitable for home use and Alton-Kopry area **Figure (4)** the values of the top ten college ranged between(151-712)mg/L depending on the Iraqi standards and (WHO) in **Table (1)**, the(90%) of the wells fall within the permissible limits (500mg/L) the rest of the wells, number (5,19) must treats the water for the purpose of reducing the concentration of total hardness before being used for domestic purposes, either according to the specifications of the Central Asian **Table (2)**, all wells unsuitable for home use.

Kirkuk's network water ranged between (116-198) mg/L which is represent the lower values compared with Alton-kopry and Daquq.

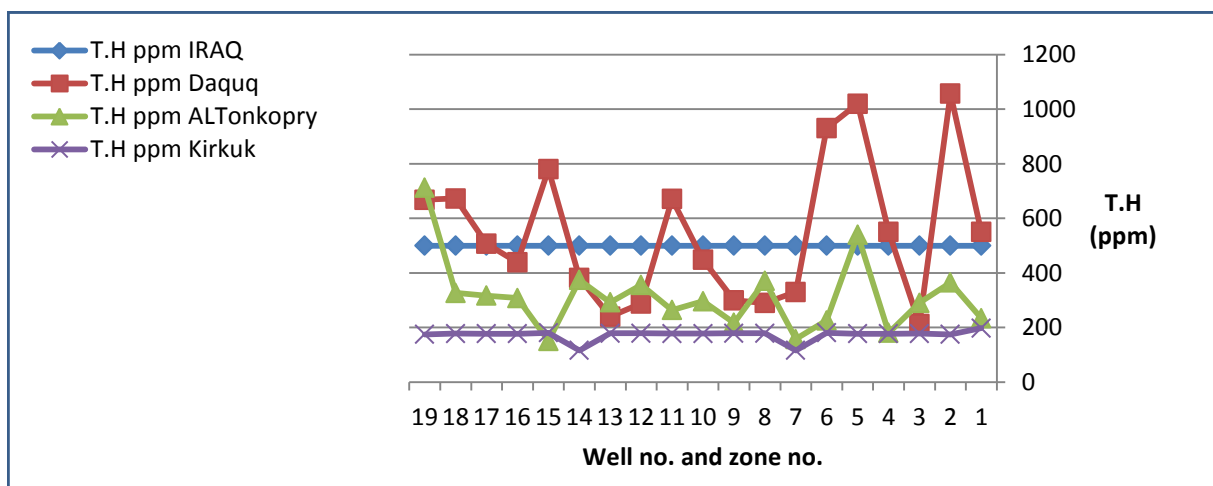


Figure (4): T.H values for Daquq, Alton-kopry regions and Kirkuk's water.

Magnesium(Mg²⁺);

The rock gypsum and dolomite considered the main source for the existence of magnesium ion in groundwater When analyzing the results of the modeling of Daquq area **Figure (5)** tested, it was found that the concentrations of Magnesium ions ranged between(79-607)mg/L

and when comparing results with European specifications[11] and that gave value accepted for ion Magnesium (30mg/L) and the highest value allowed (50)mg/L, as well as Iraqi standards as in Figure (5), which gave (50)mg/L, according to this, all of the wells exceeded the permissible limits But when compared with the results with the specification (WHO), the (26%) of all wells was located within the permissible limits.

Alton-Kopry area Figure (5) found that the concentration of ions of magnesium varying from (53-386)mg/L and when comparing results with European specifications[11] which gave the accepted value for the ion magnesium (30)mg/L and the highest value allowed (50)mg/L as well as Iraqi standards as in Figure (5), which gave (50)mg/L, according to this, all of the wells exceeded the permissible limits, either when comparing the results with the specification(WHO), the (42%) only from wells located within the permissible limits Figure (5).

Kirkuk's water limits between (18.8-27)mg/L which is a good value compared with each Alton-kopry and Daquq as seen in Figure (5).

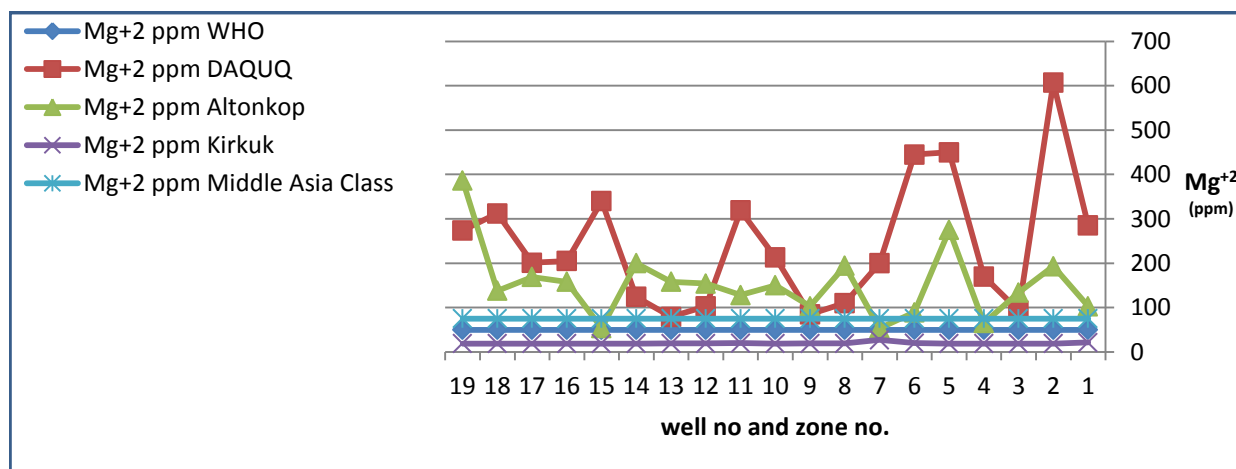


Figure (5): Mg²⁺ ion values for Daquq,Alton-kopry regions and Kirkuk's water.

Sodium(Na⁺):

That the concentration of sodium in the water of great significance in terms increase in the water cause poisoning aquatic and when to contain the water a large amount of it is not fit for drinking and irrigation, sodium ions values of concentrations average to the Daquq area (9.0-197) mg/L and when compared with the specifications Euro-zone for drinking water[11] as in Figure (6) observed that all the values within the boundaries of good except for the well no.2.

Alton-Kopry area values ranged concentrations of sodium ions between (2.7-77.95) mg/Land when compared with the specifications of the European region for drinking water [11] as in **Figure (6)** observed that all the values fall within the good boundaries.

Kirkuk's water limits (7-11) mg/L it is the best boundaries compared with the two other regions.

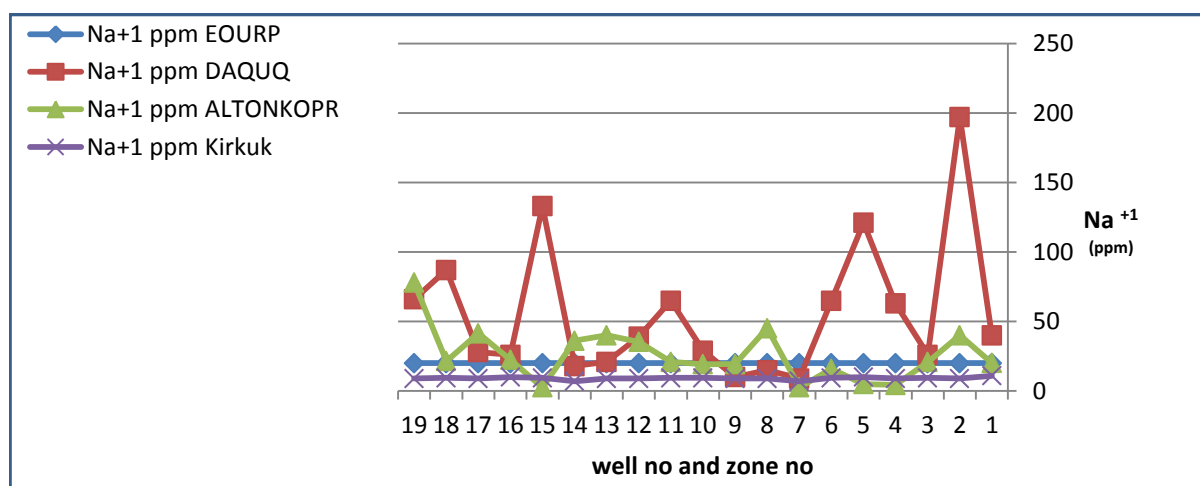


Figure (6): Na⁺¹ ion values for Daquq, Alton-kopry regions and Kirkuk's water.

Chloride(CL⁻¹):

The presence of chloride salts at high rates in drinking water may indicate contamination of the water remnants of animal and human [2] and especially in the case of an increase in water and other materials and the adjacent land, located ratios salts of chloride usually in groundwater more than surface water and that increase its concentration in the water salty taste to it. And when comparing the results of tests for the chloride concentration , which ranged between (24.9-128)mg/ L for the Daquq area and (12-51)mg/L for the Alton-Kopry area that are consistent with the specifications in each of the **Tables (2,3)** and agreed that all values fall within the permissible limits as shown in **Figure (7)**.

Kirkuk's water chloride salts limit between (16-20) mg/L as see in **Figure (7)**.

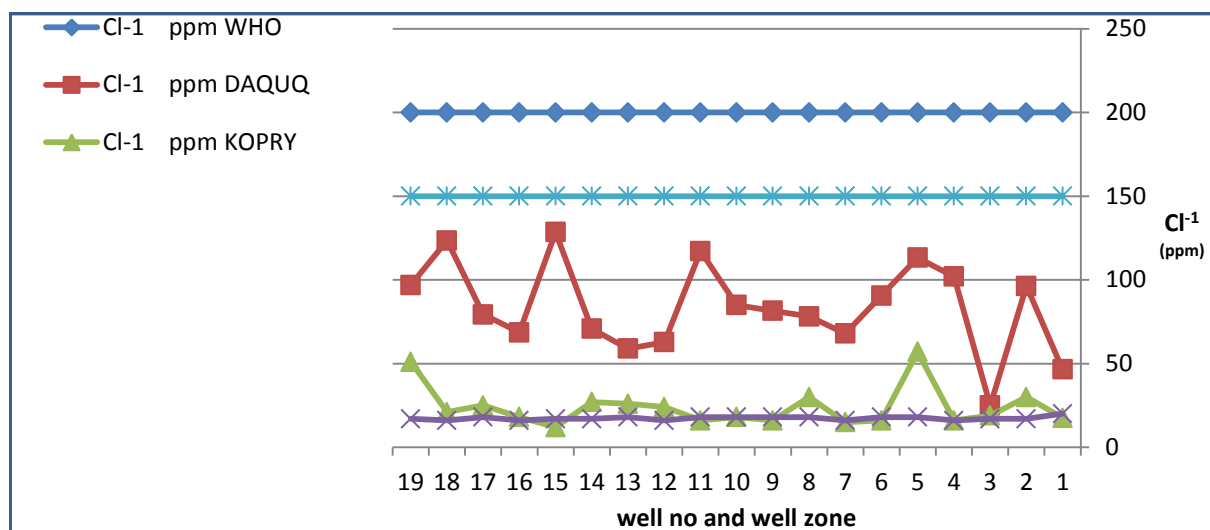


Figure (7): Cl⁻¹ ion values for Daquq, Alton-kopry regions and Kirkuk's water.

Sulphates(SO₄⁻²):

In Daquq area the increase in the concentration of sulfate ion in drinking water presents rights of diarrhea[2], the results indicate to contain water on the concentration of sulfate ion ratios ranged between (101)mg/L of the well (No.3) and (1250)mg/L of the well (No.5) and this difference may be due to differences in geological structure of the area and noticed that (36%) of the wells has exceeded the upper limit allowed for drinking water and are (400)mg/L[10] according to specifications the World Health Organization (WHO), while more than (68%) of the wells limits by Iraqi standards as shown in Figure (8), which gives the upper limit of the sulfate ion concentration (200)mg/L[9].

As for Alton-Kopry area ion concentration of sulfur ranged between (14.7)mg/L for wells number(4,7) and (412.2)mg/L of the well number(5) and this difference in concentration may be attributed to the difference in the geological structure of the area, it was noted that the well number(5) only exceeded the upper limit of the sulfur limit for drinking water, which is(400)mg/L[10] according to World Health Organization standards (WHO), while the note wells (5,19) exceeded the proportion of sulfates where the permissible limits as in Iraqi standards as in Figure (8) which gives the upper limit of the sulfate ion concentration of (200)mg/L[9].

Kirkuk's water the limit of sulfate ion concentration (38-48) mg/L Figure (8).

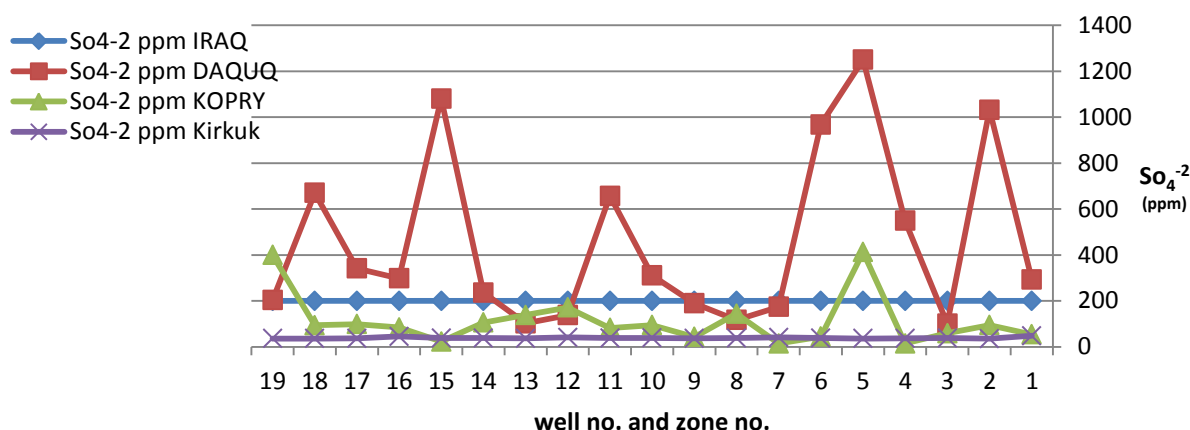


Figure (8): So_4^{-2} ion values for Daquq, Alton-kopry regions and Kirkuk's water.

Nitrate(No_3^{-1}):

The presence of nitrates in drinking water for the Daquq area indicated old contamination water in organic matter as nitrates produced from the oxidation of salts, nitrites and exist naturally and at high rates in the deep groundwater[2], ranged concentrations of nitrate ions for wells tested (22-98)mg/L, and when comparing the results with the specification of the Iraqi standards as in Figure (9) all the water wells had exceeded the permissible limits. As for bacterial contamination, it is during regular check-ups ongoing by laboratories of health in Kirkuk, there was no sign of any contamination of bacterial add to the fact that the wells deep (80-135) m, and that the presence of microbiology limited in the groundwater of the nature of the geological terms of working the soil as a candidate for the revival of the microstructure and water to get rid of them [2].

Alton-Kopry area ranged ion concentration of nitrate for wells tested(4.82-135.8)mg/L and when comparing the results with the specification of the Iraqi as in Figure (9), the percentage of wells that exceeded the permissible limits of (37.7%) as except wells (2,3,4,11,15) which accounted (26.3%), the concentrations were within the permissible limits. Kirkuk's water nitrate limits between (6-8.5) mg/L.

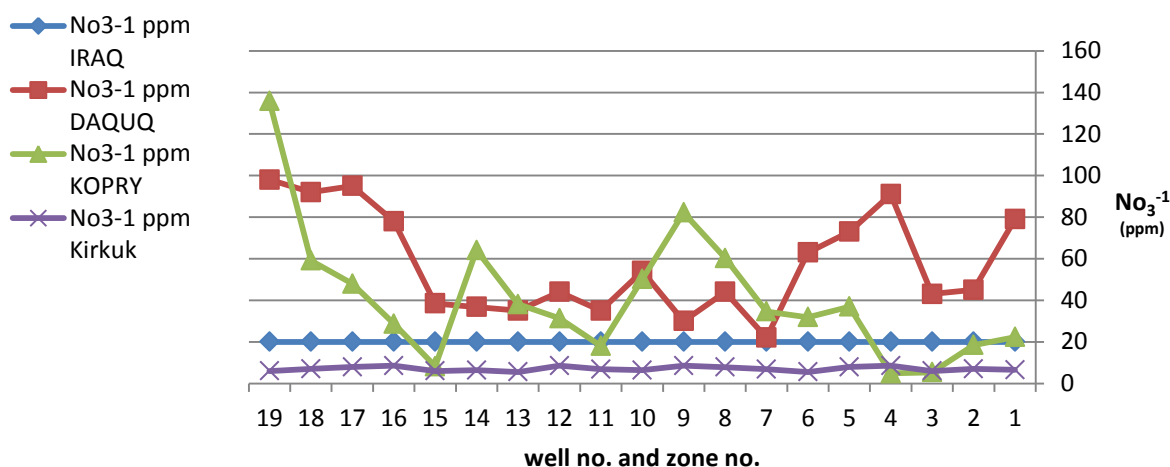


Figure (9): NO_3^{-1} ion values for Daquq, Alton-kopry regions and Kirkuk's water.

Calcium(Ca^{+2}):

There is calcium in the water depending on the installation of the geological Daquq area where there in the rocks of dolomite and gypsum and limestone [2] and the results showed the samples tested the concentration of calcium ions ranged between (120-570)mg/L, and when comparing the results with the standard specifications of the Iraqi **Figure (10)**, the (26%) of the wells are located only within the permissible limits (200)mg/L.

Alton-Kopry area and the concentration of calcium ions ranged between(97-326)mg/L and when comparing the results with standard specifications in Iraq as in **Figure (10)**, all of the wells are located within the permissible limits 200mg/L, except for wells no.(5,19). As for bacterial contamination, it is during regular check-ups ongoing by laboratories health Kirkuk, there was no sign of any contamination of bacterial as well as the fact that the wells deep (100-170)m, and the presence of microorganisms is limited in the groundwater of the nature of the geological terms of working the soil as a candidate microbiology and disposal water them[2].

Calcium ion for Kirkuk's water ranged (39-44) mg/L.

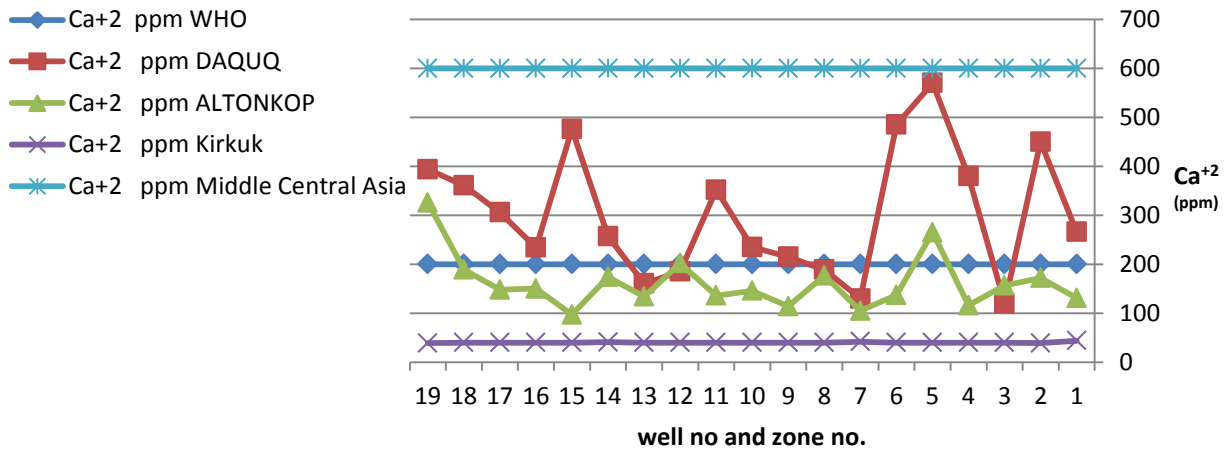


Figure (10): Ca⁺²ion values for Daquq, Alton-kopy regions and Kirkuk's water.

Electrical conductivity (E.C(μ/cm)):

The electrical conductivity for Daquq,Alton-kopy and Kirkuk’s water are acceptable only without 3 wells numbers(2,5,and 15) in Daquq region where in need of treatment Figure (11) .[13].

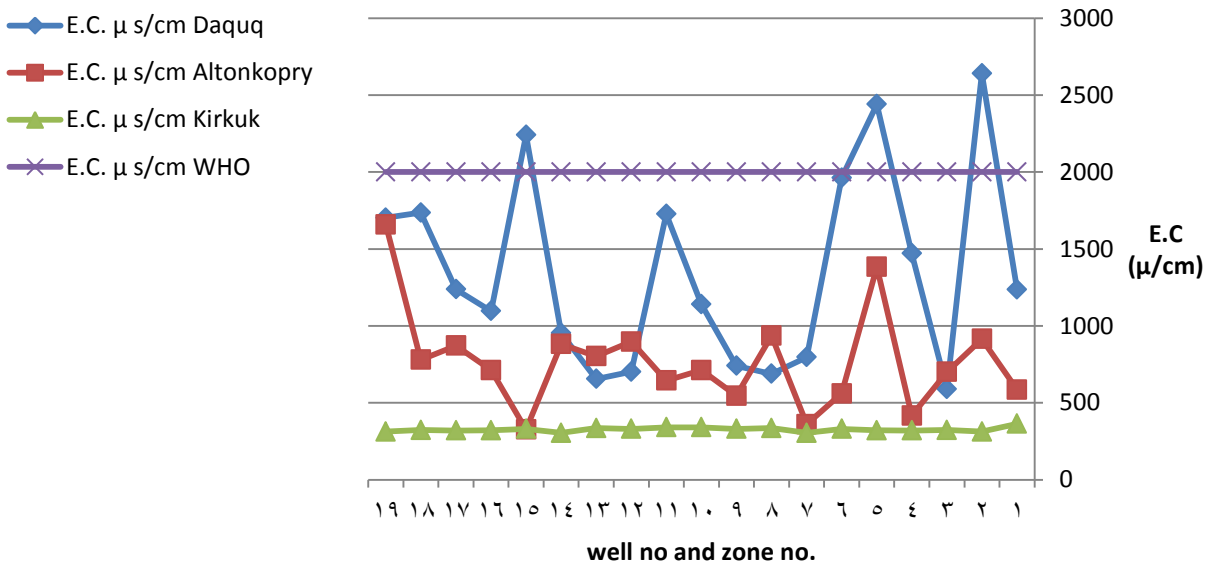


Figure (11): E.Cμ/cm values for Daquq, Alton-kopy regions and Kirkuk's water

4.RECOMMENDATION AND CONCLUSIONS

1. The optimum water quality is Kirkuk's water because city has a good large unit for water treatment.
2. Concentrations of total soluble solids to all wells for Daquq and Alton-Kopry did not exceed the permissible limits according to the specifications of Iraqi standards and(WHO).
3. The concentration of total hardness in water Daquq area is (47%) of the wells and are located within the permissible limits, while the rest of the water wells must treat its waters for the purpose of reducing the total hardness before being used for domestic purposes. For Alton-Kopry area the concentration of (90%) of wells located within the permissible limits, either wells no.(5,19) must be treated for the purpose of reducing the total hardness before use for domestic purposes.
4. Daquq area that the concentrations of sulfates in (68%) of the wells had exceeded the permissible limits as in Iraqi standards and that gives the upper limit for the concentration of sulfate ion (200)mg/L and which may cause adverse health effects when used for drinking purposes. Alton-Kopry area and that the concentrations of (90%) of the wells are located within the limits permitted by Iraqi standards, while wells no (5, 19) exceeded the proportion of sulfates where the permissible limits, which may cause damage to health when used for drinking purposes.
5. The concentrations of nitrates in water Daquq area compared with Iraqi standards and that gives (20)mg/L, all of the wells are located out of the limits because of the ratio of nitrates which limits so it is advisable to avoid the use of water wells for drinking purposes the possibility of adverse health effects when used. Alton-Kopry area and the concentration of nitrates in water wells (2,3,4,11,15) compared to Iraqi standards which gives (20)mg/L are within allowable limits so it is advisable to avoid the use of those water wells for drinking purposes for the possibility of occurrence of damage to health when used.
6. The concentration of sodium ions and chloride within the permissible limits and all wells that it does not cause any danger when used for domestic use.

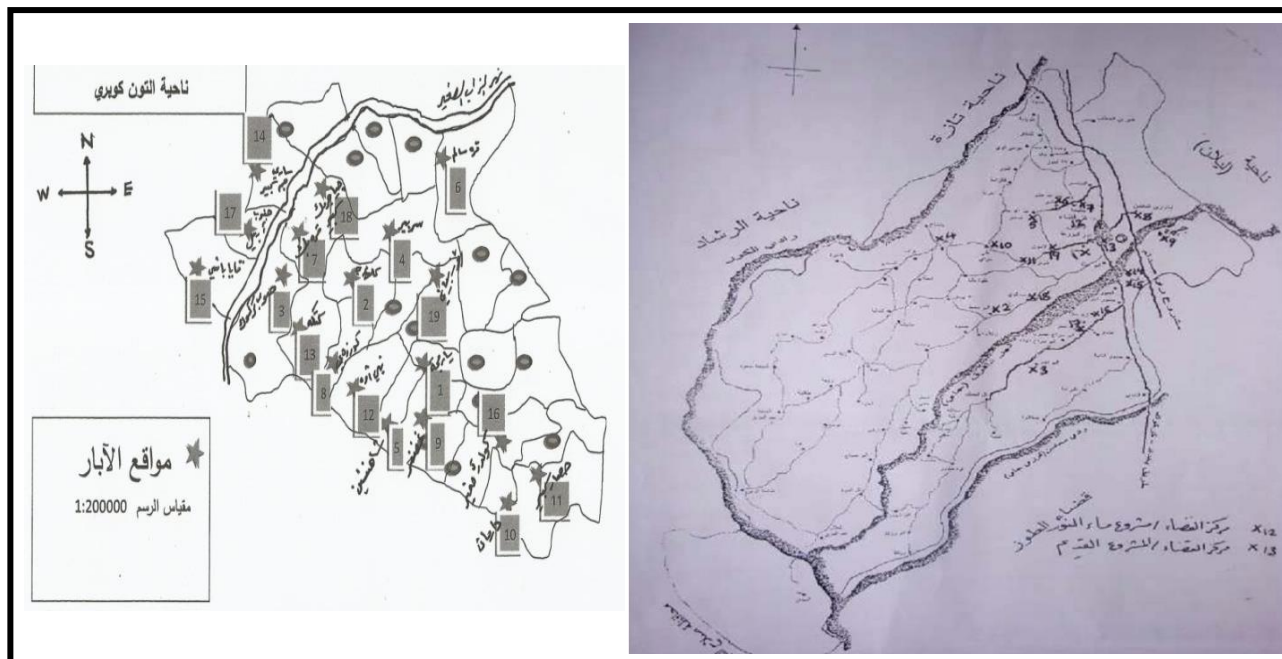


Figure (A): Wells located in Daquq regio

Figure (B):Wells located in Alton-kopery region.

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