

Measuring Total Dissolved Solids (TDS) and Electrical Conductivity (EC) in Domestic Wells Water in some Regions of Mosul City

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Abstract:

The study included some regions within Mosul city. The sample consists of thirty two domestic wells collected for this study. Thirteen wells were taken from left side and the range of well depth was between (25-35m). Also ten wells were selected from the right side of Mosul city, and included different areas, the range of well depth was between (30-54m), as the random sample.

This study concluded that highest variation in some domestic wells water for the studied area in total dissolved solids, and conductivity analysis was found as statistically efficient among variables . The regions in the right side of the city shows the highest percentage as compared with the region in the left side city .

قياس الاملاح الذائبة الكلية والتوصيلية الكهربائية في مياه الابار المنزلية في بعض مناطق مدينة الموصل

الملخص:

اشتملت الدراسة على بعض المناطق داخل مدينة الموصل , وقد تم جمع اثنين وثلاثين بئراً محلياً لهذه الدراسة حيث تم اخذ ثلاثة عشر بئراً من الجانب الايسر وكان مدى عمق البئر بين (25-35) متراً .بالاضافة الى انه تم اختيار عشرة ابار من الجانب الايمن من مدينة الموصل , وتضمنت مناطق مختلفة تتراوح اعماقها ما بين (30-54) متراً كعينة عشوائية .استنتج من الدراسة الحالية ان اعلى تباين في بعض مياه الابار المحلية للمنطقة المدروسة في المواد الصلبة الذائبة الكلية والتوصيلية حيث تم التعرف على التحليل كاحصائية فعالة بين المتغيرات التي تظهر المناطق في الجانب الايمن من المدينة اعلى نسبة مقارنة مع المناطق في مدينة الجانب الايسر .

Introduction

On earth, the water is essential for life. The pattern of human settlement throughout history has often been determined by its availability because of its importance (Reda, 2015) . The water is taken from rivers, lakes, reservoir, spring and wells. Some components of rocks and soil may dissolve and carried to the final consumer during the trip of water over the surface land, The appearance, taste or odors of water from a well or other sources offer on obvious contamination but analysis is needed to detect water contamination (Mahdii *et al* .,2010).One of the important factors that affect water quality is total dissolved solids (TDS) (Mohammed *et al*.,2018). it comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and small amounts of organic matter that are dissolved in water and the concentrations in water vary considerably in different geological regions owing to differences in the solubilities of minerals (WHO, 2017). The allowed range of Total dissolved solids in water: Different governments have various regulations for the level . Guideline criteria for the safe drinking water of the Group of European

States, 1992:TDS (300-1500) mg /L. While the standards of World Health Organization (WHO) is the palatability of drinking water in relation to its TDS level in table (1) (WHO, 2008). The electrical conductivity (EC) is a measure of the water capacity to conduct electrical current; it depends on three factors; the density of ions (increase the density of ions leads to higher electrical conductivity), temperature of the solution (higher temperature leads also to higher electrical conductivity), and finally on the type of the ions (higher specific ability leads to higher electrical conductivity) (Mohammed *et al*.,2018). The present study amid to measuring Total Dissolved Solids (TDS) and electrical conductivity (EC) in domestic wells water in some regions of Mosul city

Materials and Methods

The study included some regions within Mosul city. The samples consist of : Thirty two domestic wells were collected for this study. Thirteen wells were taken from left side and the range of depth well was between(25-35m). Also select ten wells from right side of Mosul city, and included different areas the

range of well depth between (30-54m), as randomly sample.

Sample Collection and Analyses

The study started from 15th October 2017 until 10th march 2018, while the taking samples from domestic wells began from 3rd January 2018 to 1st February 2018. The sample of the water taking from domestics' wells represented take the middle sample after empty the water in electric pump and putting in clean bottle. To measured total dissolved solids by unit mg/L , and electrical conductivity by unit $\mu\text{S}/\text{cm}$ used the using a device (TDS and EC) in figure (1). The statistical analysis includes descriptive statistics by Statistical Package for the Social Science (SPSS, Version 19) , it consist of analysis presented by the mean, standard deviation and Correlation, in addition use

the Arc Map version (10.5),spatial analyst tools, by interpolation kriging. The total dissolved solids and electrical conductivity in bottle water (Brand's Name , life water- type , Bottled Drinking Water), and tap water for Mosul city was (110 mg/L, 217 mg/L) and 220 $\mu\text{S}/\text{cm}$, 227 $\mu\text{S}/\text{cm}$) respectively.

Table (1) The palatability of water in relation to its TDS level (WHO, 2008).

No.	Class	Range
1.	Excellent	Less than 300 mg/L
2.	Good	Between 300 and 600 mg/L
3.	Fair	Between 600 and 900 mg/L
4.	Poor	Between 900 and 1200 mg/L
5.	Unacceptable	Greater than 1200 mg/L



Figure (1) TDS and EC device

The Results

Table (2) Descriptive statistics of domestic wells water in the left side of Mosul city (n=13).

No. well	Region	Well Depth	TDS mg/l	EC μS/cm
1	Al-Samah	35	356	710
2	Al-khadraa	28	407	840
3	Aden	30	500	1038
4	Al – Arkan	45	475	990
5	Al-Tahrir	35	986	1944
6	Al Zahraa	30	1124	2248
7	Al – Arkoub	35	438	900
8	Al – Qadisiyah 1	27	1524	2474
9	Al – Qadisiyah 2	25	1147	2182
10	Al-Bared	25	400	804
11	Al-Kindi	29	677	1402
12	Al seadeek	25	519	1036
13	Al Hadba	28	936	1870
Mean		30.5	729.92	1418.31
Standard Deviation		5.70	373.18	633.98
Minimum		25	356	710
Maximum		45	1524	2474

Table (3) Descriptive statistics of domestic wells water in the right side of Mosul city (n=10)

No. well	Region	Well Depth	TDS mg/l	EC μS/cm
1	Al-Zanjaily	36	1188	2376
2	Mosul algeadedda	33	1255	2510
3	Khazraj	45	1190	2223
4	Oreibi	40	1050	2100
5	Al abar	35	1215	2430
6	Bab al beed	32	1263	2532
7	Ras Al-Jadida	30	1250	2500
8	July 17	54	924	1794
9	Al thoraa	40	1217	2336
10	Al sehaa	45	1154	2280
Mean		39	1170.6	2308.1
Standard Deviation		7.38	106.67	226.96
Minimum		30	924	1794
Maximum		54	1263	2532

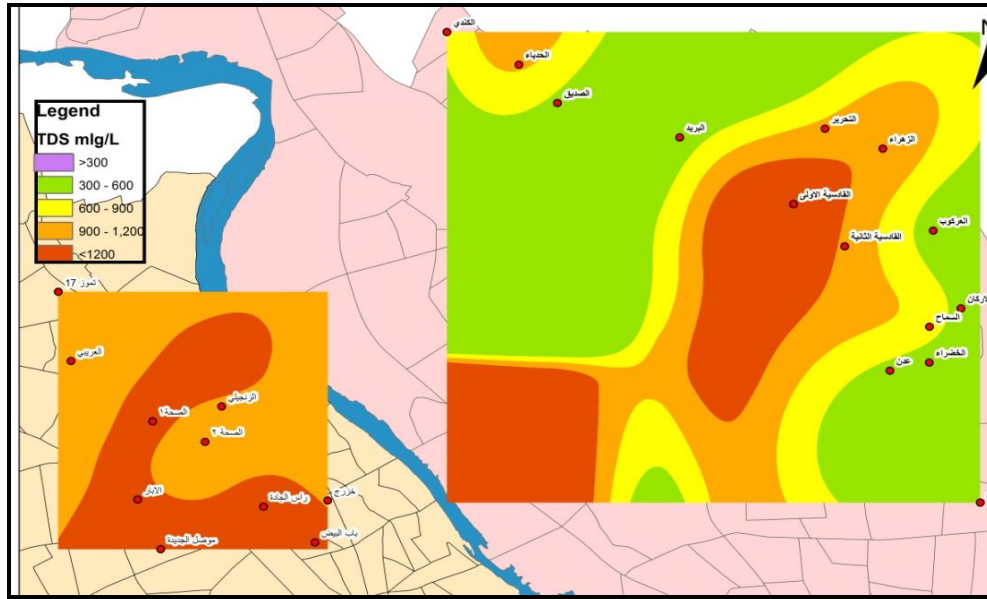


Figure (2) Distribution the total dissolved solids in some region of Mosul city

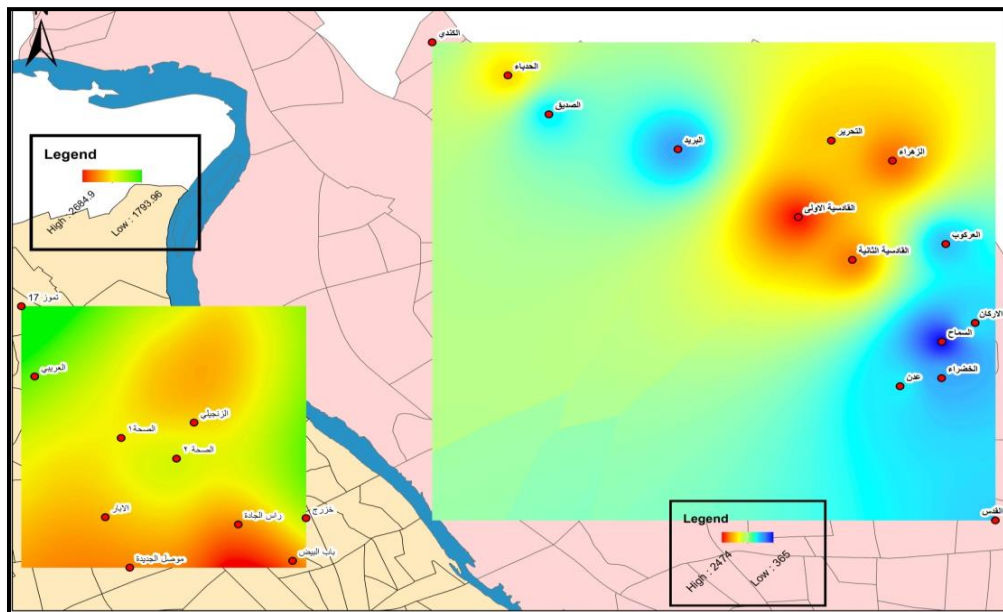


Figure (3) Distribution the electrical conductivity in some region of Mosul city

Table (4) Comparing the total dissolved solids in present study with WHO standard

No.	Class	The left side of city		The right side of city		Total	
		F	%	F	%	F	%
1.	Excellent	0	0	0	0	0	0
2.	Good	7	53.85	0	0	7	30.43
3.	Fair	1	7.69	0	0	1	4.35
4.	Poor	4	30.77	5	50	9	39.13
5.	Unacceptable	1	7.69	5	50	6	26.09
Total		13	100	10	100	23	100

Table (5) Correlations between variables in the study (n=23) .

Variables	Side of city	Region	Wells Depth	TDS	EC
Side of city	1	0.811(**)	0.561(**)	0.618(**)	0.677(**)
Sig.		0.000	0.005	0.002	0.000
Region	0.811(**)	1	0.471(*)	0.575(**)	0.613(**)
Sig.	0.000		0.023	0.004	0.002
Wells Depth	0.561(**)	0.471(*)	1	0.130	0.153
Sig.	0.005	0.023		0.555	0.486
TDS	0.618(**)	0.575(**)	0.130	1	0.987(**)
Sig.	0.002	0.004	0.555		0.000
EC	0.677(**)	0.613(**)	0.153	0.987(**)	1
Sig.	0.000	0.002	0.486	0.000	

**** Correlation is significant at the 0.01 level (2-tailed).**

*** Correlation is significant at the 0.05 level (2-tailed).**

Discussion

Total dissolved solids (TDS) and conductivity or electrical conductivity (EC) are frequently used as water quality. The dissolved ions concentration is usually measured as TDS, while EC is the measure of liquid capacity to conduct an electric charge. Its ability depends on dissolved ion concentrations, ionic strength by study (Rusydi1, 2018). In the current study table (1) show the palatability of water in relation to its TDS level is as follows: Excellent, if TDS less than (300 mg/L), good (between 300 and 600 mg/L), fair (between 600 and 900 mg/L), poor (between 900 and 1200 mg/L), and unacceptable (greater than 1200 mg/L) respectively. In our study table (2) descriptive statistics of domestic wells water for left side of Mosul city ($n=13$), the mean, and standard deviation, for wells depth, total dissolved solids, electrical conductivity were $M = (30.5\text{m})$, (729.92 mg/L), (1418.31 $\mu\text{S/cm}$), $S.D = (5.70\text{m})$, (373.18 mg/L), (633.98 $\mu\text{S/cm}$). Also minimum, and maximum for the following were (25m), (356 mg/L), (710 $\mu\text{S/cm}$) in Al-Samah region, and (45m) (1524 mg/L), (2474 $\mu\text{S/cm}$) in Al – Qadisiyah (1) region. Table (3) explain

descriptive statistics of water for right side of Mosul city ($n=10$), the mean and standard deviation for wells depth, total dissolved solids, electrical conductivity were $M = (39\text{m})$, (1170.6 mg/L), (2308.1 $\mu\text{S/cm}$), and $S.D = (7.38\text{ m})$, (106.67 mg/L), (226.96 $\mu\text{S/cm}$) alternately. While minimum and maximum for the following were (30m), (924 mg/L), (1794 $\mu\text{S/cm}$) in July 17 region, and (54m), (1263 mg/L), and (2532 $\mu\text{S/cm}$) in Bab al beed region. Figure (2) explain some region in left side of city represented high levels of TDS and EC in Mosul city such as al Zahraa, Al – Qadisiyah 1, and Al – Qadisiyah 2 regions, but in right side of Mosul city all area was high levels such as (Al-Zanjaili, Mosul algeadedda, Khazraj, Oreibi, Al abar, Bab al beed, Ras Al-Jadida, Al thora, and Al sehaa egions, except July 17 region have low level of TDS, and EC in figure (3). Table (4) Comparing the total dissolved solids in present study with WHO standard this table shows the various class percentage of domestic wells water (good 53.85%, fair 7.69 %, Poor 30.77 %, finally unacceptable was (7.69 %). But they were not excellent in left side of city. As for the most region involved poor (50%) and Unacceptable (50%)

found in right side of city. Table (5) shows that these variables are significantly correlated with each other used in the present study. The correlation is significant at the 0.01 level (**), and significant at the 0.05 level (*), But not a significant correlation among wells depth with TDS, and EC (0.130), and (0.153). According to (AL-Fatlawy, 2013) the highest value of electrical conductivity was in water the area was (4951 $\mu\text{S}/\text{cm}$), in while the lowest value was (0951 $\mu\text{S}/\text{cm}$), and TDS were found to be in their water concentrations in a region study, with the highest concentration (4206 mg/L) in the Yarmouk area, while the lowest concentration was (531 mg / L) in the Jadiriya area. This is due to the high concentrations of dissolved solids in most of the water of the study area to be affected by operations evaporation because it is low-depth, as well as the presence of pollution humans release dissolved ions through water sewage to groundwater. While the study by (Alwani, 2012) found the highest value of electrical conductivity was recorded in the well water sample and (2350 $\mu\text{S}/\text{cm}$) was the lowest. And show that the values of electrical conductivity values are

greater than local and global determinants suitable for water use Different. If water contains a concentration of less than (500 mg / L), it is considered safe to drink, as well as for many for domestic, industrial and industrial purposes, whether or not a concentration greater than (1000 mg / L) is unacceptable and unsuitable for various environmental uses. (Saeed *et al.*, 2017) showed the results that the depth of the wells did not affect the values of salts and conductivity because they did not notice the direct relationships of depths and values. The current study water is not suitable for drinking to exceed the allowed level locally. In (2016) (Rawdan *et al.*, 2016) demonstrate that (80%) of the wells did not meet the specifications of drinking water due to the level of high TDS of these domestic wells. It is found that (76%) of the well-studied wells fall outside the limits of the standard specifications, while (24%) of the wells did not exceed the limits of these specifications. (Mahdii *et al.*, 2010) in our study which detect the total dissolved solids, and conductivity values fluctuated in the samples, The results of EC were correlated with TDS

values for the analysed samples and the correlation coefficient was unity (Awofolu et al., 2005) total dissolved solids can also be taken as an indicator for the general water quality because it directly affects the aesthetic value of the water, also the concentrations of total dissolved solids in all sampling sites were ranged from (150.76 to 155.54 mg/L). These values were within the standard limits of water quality set by WHO. Thus a low level of TDS contents of the water allows the water for drinking and other domestic uses. Finally, Reda, (2015) mention in our study that the studied properties recorded values since were (TDS= 869.5mg/L, EC= 2230.5 μ S/cm).

Conclusions

1. The highest variation in some domestic wells water for the studied area in total dissolved solids, and conductivity.
2. Analysis was found as an efficient statistical among variables.
3. The regions in right side of city shows the highest percentage comparing with the regions in left side city.

Recommendations

1. The present study recommended investigate other potential water contaminations such as chemicals, microbial and radiological materials for a longer period of time, in order to assess the domestic wells water for drinking.
2. Guideline for use the domestic wells for drinking water and educate the people in the different region about harmful on health.

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