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# Environmental Assessment and Hydrochemical Formula of groundwater wells for selected areas of Maysan province Southern Iraq for 2014

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# Environmental Assessment and Hydrochemical Formula of groundwater wells for selected areas of Maysan province Southern Iraq for 2014

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**Abstract** Water was selected for (22) blisters dug in selected areas of Maysan province to study the physical properties where acidity was studied and found that the water tends towards light acidity as for the study of electrical conductivity found there was an increase in the biting of wells due to various factors such as wastewater as for the study of self-solids was observed to increase the concentration of this substance due to the presence of human pollution from sewage and soil washing. As for the study of chemical properties included the study of positive and negative ions, including calcium, magnesium and sodium ions, which exist from different sources between natural and between the various human activities as well as the presence of negative ions such as sulfates, chlorine and sodium also different sources. The hydrochemical formula of most groundwater wells (Ca - SO4) was observed due to the high concentrations of these ions in water. As for the use of water for drinking purposes is not suitable for drinking water because of high salinity, while it is suitable for drinking animals because all elements and dissolved solids fall within the limits of comparative tables. The water was found to be unsuitable for industrial, construction and irrigation purposes, as crops with high salinity could be grown. When comparing the results of this water with universal scales.

## 1. Introduction

Groundwater is the second major source of water around the world. The composition of groundwater is subject to the influence of many climatic factors, topography and the nature of the hydrographic network however, the main effect on groundwater quality is played by the chemical composition of the water-bearing rocks as well as the deeper chemical composition of the water which is involved in feeding the water-bearing levels above received through the weak permeability layers [1] this variety of factors and processes affecting the chemical composition of groundwater makes each aquifer has its own chemical properties For all these reasons, detailed chemical analyzes are carried out, which is a basic tool and instrument that helps to interpret and understand the prevailing hydrogeological situation, considering that the chemical composition of groundwater is formed by the influence of different natural conditions.

Which accurately identify the sources of this structure and the physico-chemical processes by which materials are transported and redistributed in the hydrogeological system, and chemical analyzes identify everything related to different water use concepts [2, 3, 4]. Therefore, one of the main objectives of this research is to study the prevailing hydrochemical situation in the study area and its physical and chemical properties The chemical composition and the study of water quality and different uses have been selected 22 underground wells in the province of Maysan were drilled and took the results of the General Establishment of groundwater and this happened in 2014.

## 2. Study area

Maysan province is located in southeastern Iraq between two latitudes (6, .31$^0$-6, .32) north and longitude (15, 46$^0$ - 50, 47$^0$) To the east and bordered to the north and northwest by the province of Wasit and to the west by the province of Dhi Qar and to the south bordered by the province of Basra and to the east and east there is a political border with Iran and the area of the province (16072 km 2), which represents (3.7%) of the area of Iraq [5].

**Figure 1**. Shows the geographical location of Maysan province

## 3. Geology of the region

The area was influenced by formative land-building activities that permeated all parts of the unstable shelf from the Mesopotamian plain Sedimentary The effects and severity of these activities on the region varied depending on the proximity or distance from the centers of those activities during successive geological ages [6] Most of these surface geological formations date back to the fourth geological time Which is represented by the flood deposits brought by the Tigris River and its streams in the region as well as the river valleys coming from the east in the flood season brings sediment a narrow strip along the northeastern part of the province dates back to the late third millennium They are elevated areas representing the ends of the Zacros Mountains, interspersed with valleys of varying breadth [7].

## 4. Materials and working methods

Samples were taken from multiple water wells to determine the quality of groundwater in the study area where 22 wells were selected to study the water system of groundwater these samples were taken from wells drilled by the General Groundwater Facility of the Ministry of Water Resources in 2014. Particular analyzes included electrical conductivity, pH, total dissolved salts, positive ions ($Ca^{+2}$, $Mg^{+2}$, $Na^{+}$, $K^{+}$) and negative ions ($Cl^{-}$, $SO_4^{-}$,$H CO_3^{-}$) The analysis took place at the General Authority for Drilling Wells and Groundwater of the Ministry of Water Resources manual has been used Mireoxide, Aerocrom Black T (E) and Flame Photometer were used to measure sodium and potassium. And chloride in a way corrected with (AgNO3) and total dissolved salts using the gravimetric method by drying and electrical conductivity device (Electrical conductivity) and acid function by (PH- Meter)

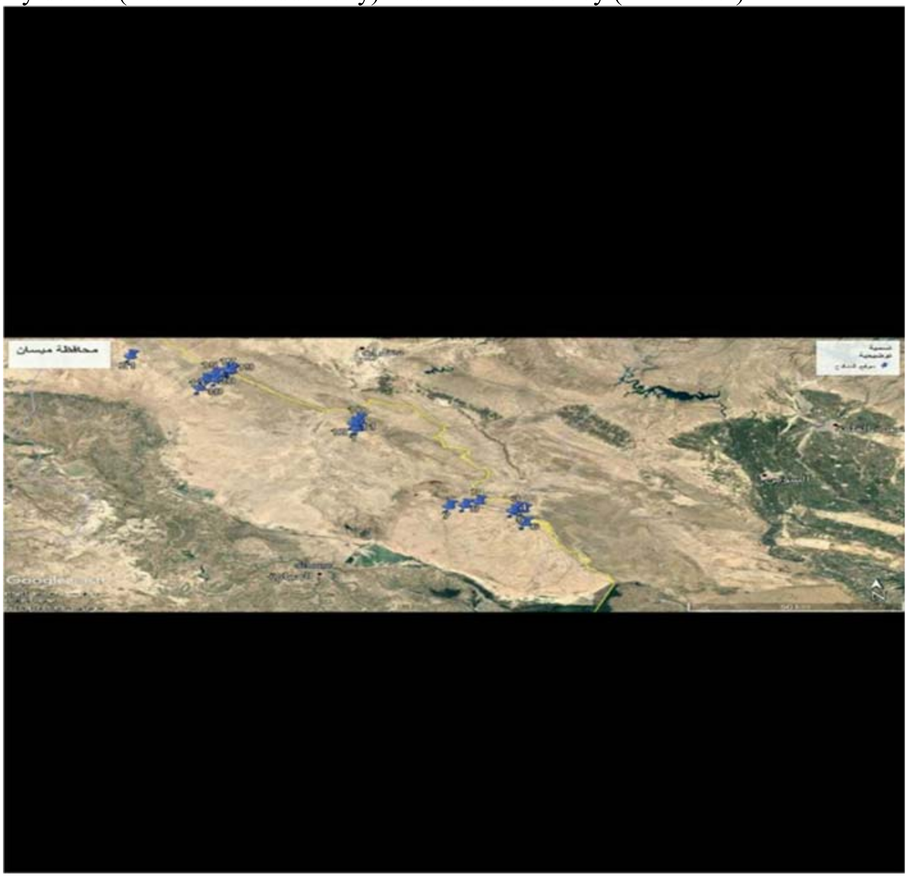


**Figure 2.** Shows the locations of the modeling

## 5. Results and Discussions

### *5.1. Physical properties*

**Acid function (pH):** Sweats as the negative logarithm of the concentration of hydrogen ion. It is a measure of acidity and basal temperature and pressure and is the dominant factor in most of the reaction for gas - water - rock systems such as hydrolysis, polymerization, adsorption, complex formation and oxidation - reduction reactions (8) This function is influenced by the concentration of carbonate ions and bicarbonate dissolved in water(9) It also affects the pattern and behavior of chemical reactions that occur in different environments (10) The change in this function affects the transition of some elements as most of the metal elements are highly soluble in acid solutions Increased pH values are deposited as oxides or hydroxides alkaline elements are deposited if pH values are higher than normal (11). Note that the lowest value of the acidity function was (4.3) in the well (22) Maysan province and the highest value (7) in eight wells belonging to different sites of the province of Maysan and the rate (5.65) that the water tends towards light acidity and table 1 shows this.

**Electrical Connection (EC):** It is capable of conducting (1) cm3 of water to the electric current at a temperature of (25) ° C and measured in microsimens / cm. he electrical connection depends on the temperature of the water as the increase in water temperature of one degree Celsius causes an increase in the electrical connection (2%) (12) Electrical conductivity is a good guide for determining the degree of mineralization of water (13) The highest value was found in the well (1) where it reached (ms / cm15900) and the lowest value (731 ms / cm) in the well (18) and the rate (ms / cm33262). Table (1) shows this

**Soluble Solids (T.D.S.):** It is defined as all dissolved solids in water, whether ionized or non-ionized, and does not include dissolved gases, suspended matter and colloidal substances (14). Salinity is defined as the concentration of dissolved salts in water in ppm when the material is organic oxidants and carbonates converted to oxides and replace chlorine to replace bromine and iodine and the amount of dissolved salts is called the concentration or mineralization or salt content (15) The highest value reached (7950) in the well (6) and the lowest value (510) in the well (21) and the average (4230) The high concentration of dissolved solids (TDS) in most of the study area water is due to its evaporation because it is low in depth as well as human contamination as the dissolved ions are released through wastewater into the groundwater as well as the soil washing operations as a result of watering the home gardens. 16. Table 1 shows this.

**Table 1.** Physical characteristics of groundwater wells of the study area

| No. | pH | E.C (Ms\cm) | T.D.S. (mg/ L) |
|---|---|---|---|
| 1 | 7 | 15900 | 7950 |
| 2 | 7 | 9310 | 4610 |
| 3 | 7 | 5420 | 2890 |
| 4 | 7 | 6330 | 3150 |
| 5 | 7 | 6350 | 3180 |
| 6 | 6.5 | 9760 | 4950 |
| 7 | 6.8 | 12081 | 7290 |
| 8 | 7 | 12330 | 7800 |
| 9 | 7 | 9423 | 5520 |
| 10 | 6.5 | 9550 | 5820 |
| 11 | 7 | 5920 | 3620 |
| 12 | 6.5 | 10640 | 7438 |
| 13 | 6.3 | 9070 | 6580 |
| 14 | 6.5 | 4443 | 2466 |
| 15 | 6.2 | 5050 | 2878 |
| 16 | 6.5 | 816 | 610 |
| 17 | 6.5 | 5620 | 3242 |
| 18 | 7 | 731 | 568 |
| 19 | 6.5 | 7010 | 4494 |
| 20 | 6 | 758 | 530 |
| *21* | 6 | 792 | 510 |
| 22 | 4.3 | 7130 | 4790 |

### *5.2. Chemical Properties*

#### *5.2.1. Positive ions(Cations)*

**Calcium ($Ca^{2+}$)**

It is one of the most prevalent alkaline elements and is an essential element for plants and animals. It comes from the chemical weathering of rocks and minerals containing this ion represented in igneous rock minerals such as pyroxene, amphibole, feldspar and sedimentary rock minerals such as calcite, dolomite, aragonite, fluorite and gypsum.(12) Human activities and some other processes may contribute to the release and increase of calcium ion (8) This ion also comes from:

Concentration of carbon dioxide ($CO_2$), which increases with increasing ($Ca^{+2}$ )due to the formation of carbonic acid and the dissolution of limestone rocks

Photosynthesis, aerobic decomposition and respiration where $CO_2$ increases and then increases

Severe evaporation leads to the deposition of ($CaCO_3$)

Temperature Increases temperature decreases solubility of calcium-containing minerals

The mixing process changes the concentration of $Ca^{+2}$. A clear example is the mixing of groundwater with sewage in urban areas because sewage contains large amounts of organic matter.

When oxidized, it releases amounts of $CO_2$ and increases it

The highest percentage of this ion in well water was (1440) in well No. (7) and the lowest value (80) in well (20). The rate is 760 and Table( 2) shows that

**Magnesium $Mg^{+2}$**

This mineral is found in dolmite, which is the second most important carbonate minerals is calcite and also found in igneous rocks Ferro magnesia and in the minerals of olefin, pyroxin and amphiole, as clay minerals are also a source of magnesium ion in water (9) Increased magnesium concentration affects human health, especially intestinal safety, but is necessary for the chlorophyll needed for plant growth (17) The results showed that the highest percentage of water wells was (800) in well (7) and the lowest value was (5) in well (18) and the average was (402.5). The high concentration of magnesium ion in the water of these areas is due to the effect of ion exchange process and the effect of evaporation processes. (18)

**Sodium $Na^{+1}$**

Sodium ion is found in groundwater as a result of solubility of plagioclase minerals and evaporators such as halite as well as clay minerals (14) Human activities also have an impact on the concentration of sodium in water such as the use of salts in household needs and the reuse of wastewater for irrigation(19) Chemical water treatment such as the use of sodium fluoride and sodium bicarbonate sodium hypochlorite increases the concentration of sodium to 30 mg / L in water (20) The highest concentration of sodium (400) in well (8) and the lowest concentration (11.5) in well (18) and the average (205.75) The high concentration of sodium in water is due to the dissolution of sodium salts concentrated in the soil as a result of watering operations in the home gardens, where it works to dissolve the sodium ion. Aspiration (21)

**Potassium $k^+$**

It is considered an alkali metal with the least abundance of sodium and comes from chemical weathering of potassium-containing minerals such as feldspar, orthoclase and microcline. It is also found in evaporative rocks such as sulphite (12) Potassium concentration in groundwater increases as a result of the use of chemical fertilizers (22) It was found that the highest concentration of potassium ion was (67) in well (8) and the lowest concentration (0.5) in well (18) was the average (38.25) The increase in potassium ion concentration in groundwater is due to the use of chemical fertilizers.

**Table 2.** Concentrations of positive ions for ground wells in the study area

| No. | | $Ca^{+2}$ | $Mg^{+2}$ | $Na^+$ | $K^+$ | Cations$\sum$ |
|---|---|---|---|---|---|---|
| 1 | Ppm | 800 | 600 | 204 | 17.8 | 1621.8 |
| | Epm | 22.22 | 16.66 | 5.66 | 0.49 | 45.03 |
| | Epm% | 49.34 | 36.99 | 12.56 | 1.08 | 100 |
| | Ppm | 600 | 425 | 132 | 13.3 | 1170.3 |
| 2 | Epm | 16.66 | 11.80 | 3.66 | 0.36 | 32.48 |
| | Epm% | 51.29 | 36.33 | 11.26 | 1.10 | 100 |
| 3 | Ppm | 840 | 25 | 136 | 5.7 | 1006.7 |
| | Epm | 13.33 | 1.44 | 3.77 | 14.08 | 32.62 |
| | Epm% | 40.86 | 4.41 | 11.56 | 43.16 | 100 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Ppm | 1120 | 50 | 128 | 1.7 | 1299.7 |
| 4 | Epm | 13.11 | 1.38 | 3.55 | 0.04 | 18.08 |
| | Epm% | 72.51 | 7.63 | 19.63 | 0.22 | 100 |
| | Ppm | 640 | 275 | 98 | 3.8 | 1016.8 |
| 5 | Epm | 17.77 | 7.63 | 2.72 | 0.10 | 28.22 |
| | Epm% | 62.96 | 27.35 | 8.63 | 0.35 | 100 |
| | Ppm | 800 | 500 | 219 | 34 | 1553 |
| 6 | Epm | 22.22 | 13.88 | 6.08 | 0.94 | 43.12 |
| | Epm% | 51.53 | 32.18 | 14.10 | 2.17 | 100 |
| | Ppm | 1440 | 800 | 270 | 36 | 2546 |
| 7 | Epm | 40 | 22.22 | 7.5 | 1 | 70.72 |
| | Epm% | 56.56 | 31.41 | 10.72 | 1.41 | 100 |
| | Ppm | 1200 | 650 | 400 | 67 | 2317 |
| 8 | Epm | 33.33 | 18.05 | 11.11 | 1.86 | 64.35 |
| | Epm% | 51.79 | 28.04 | 17.26 | 2.89 | 100 |
| | Ppm | 960 | 200 | 264 | 32 | 1456 |
| 9 | Epm | 26.66 | 5.55 | 7.33 | 0.88 | 40.42 |
| | Epm% | 65.95 | 13.73 | 18.13 | 2.17 | 100 |
| | Ppm | 960 | 650 | 234 | 30 | 1874 |
| 10 | Epm | 26.66 | 18.05 | 6.5 | 0.83 | 52.04 |
| | Epm% | 51.22 | 34.68 | 12.49 | 1.59 | 100 |
| | Ppm | 720 | 450 | 123 | 12.3 | 1305.3 |
| 11 | Epm | 20 | 12.5 | 3.41 | 0.34 | 36.25 |
| | Epm% | 55.17 | 34.48 | 9.40 | 0.93 | 100 |
| | Ppm | 926 | 825 | 174 | 34 | 1959 |
| 12 | Epm | 25.72 | 22.91 | 4.83 | 0.94 | 54.4 |
| | Epm% | 47.27 | 42.11 | 8.87 | 1.72 | 100 |
| 13 | Ppm | 640 | 600 | 168 | 37 | 1445 |
| | Epm | 17.77 | 16.66 | 4.66 | 1.02 | 40.11 |
| | Epm% | 44.30 | 41.53 | 11.61 | 2.54 | 100 |
| | Ppm | 600 | 37.5 | 48 | 2.4 | 687.9 |
| 14 | Epm | 16.66 | 2.04 | 1.33 | 0.06 | 20.09 |
| | Epm% | 82.92 | 10.15 | 6.62 | 0,29 | 100 |
| | Ppm | 600 | 50 | 34 | 1.6 | 685.6 |
| 15 | Epm | 16.66 | 1.38 | 0.94 | 0.04 | 19.02 |
| | Epm% | 87.59 | 7.25 | 4.94 | 0.21 | 100 |
| | Pm | 120 | 150 | 21 | 1 | 292 |
| 16 | Epm | 3.33 | 4.16 | 0.58 | 0.02 | 8.09 |
| | Epm% | 41.16 | 51.42 | 7.16 | 0.24 | 100 |
| | Ppm | 520 | 50 | 129 | 2.2 | 701.2 |
| *17* | Epm | 14.44 | 1.38 | 3.58 | 0.06 | 19.46 |
| | Epm% | 74.20 | 7.09 | 18.39 | 0.30 | 100 |
| | Ppm | 96 | 5 | 11.5 | 0.5 | 113 |
| 18 | Epm | 2.66 | 0.13 | 0.31 | 0.01 | 3.11 |
| | Epm% | 85.53 | 4.18 | 9.96 | 0.32 | 100 |
| | Ppm | 560 | 87.5 | 153 | 2.1 | 802.6 |
| 19 | Epm | 15.55 | 2.43 | 4.25 | 0.05 | 22.28 |
| | Epm% | 69.79 | 10.90 | 19.07 | 0.22 | 100 |
| 20 | Ppm | 80 | 20 | 70 | 6.8 | 176.8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Epm | 2.22 | 0.55 | 1.94 | 0.18 | 4.89 |
| | Epm% | 45.39 | 11.24 | 39.67 | 3.68 | 100 |
| | Ppm | 104 | 10 | 88 | 4.8 | 206.8 |
| 21 | Epm | 2.88 | 0.27 | 2.44 | 0.13 | 5.74 |
| | Epm% | 49.31 | 4.70 | 43.50 | 2.26 | 100 |
| | Ppm | 480 | 200 | 200 | 2.9 | 882.9 |
| 22 | Epm | 13.33 | 5.55 | 5.55 | 0.08 | 24.51 |
| | Epm% | 55.19 | 22.64 | 22.55 | 0.32 | 100 |

*5.2.2. Negative ions (Anions)*

**Sulfates $SO_4$:**

This ion is present in the water as a result of the melting of the rocks of particles (particles, anhydrite) and is also produced from the oxidation of the pyrite and marxite minerals in the rocks (Shale) and mud (23) It also consists of the decomposition of organic materials and the use of chemical fertilizers in agriculture as it is a nutrient of the plant (19) Its concentration in groundwater is influenced by the presence of Sulfate Reducing Bacteria (Sulfate Reduction Bacteria) The amount of sulfate dissolved in water is affected by the activity of these bacteria, causing the reduction of sulphates to sulphides and use in breathing and is( $H_2S$) (by-product) (24) As a result of increasing the concentration of sulphates in the groundwater and the presence of reducing bacteria and organic materials amounts of ($CO_2$) and ($H_2S$), which in turn leads to the deposition of minerals sulphates and carbonates and then cause reduced porosity (25) The highest percentage in the well (1) reached (2500) and the least forgotten in the well (20) where it reached (150) has reached the rate (1325) Table (3) shows this and the reason for the increase of sulfate ion ($SO_2$) due to the impact of construction materials containing sulfur salts, chemical fertilizers and cleaning materials in addition to the presence of sulfur salts in the soil (21) The sources of this ion in water vary between magmatic water and ancient marine waters found in the pores of sedimentary rocks and the dissolution of halite and evaporation

**Chloride ($Cl^-$) :**

The sources of this ion vary in water between the magmatic water and the old marine water found in the pores of sedimentary rocks and the dissolution of metal halite and evaporation process (24) has reached the highest proportion in the well (8) where it reached (5000) and the lowest rate was in Well (20 and 18) reached (20) and the rate (2510) and table (3) shows that the increase in the concentration of chloride ion is derived from contaminated sources such as household products and sewage drilling (22)

**Bicarbonate (HCO3-) :**

This ion is a source of alkalinity, which means the water's ability to react with (H +). Most of the carbonates in the water turn to bicarbonate (14) and the highest rate in the wells (6) and (7) and in the two sites has reached (240) and the lowest ratio in the well (14) has reached (40) The rate was (140) Table (3) shows that the increase in its concentration is due to the dissolution of sodium bicarbonate in the soil due to irrigation as well as the effect of wastewater through Sewerage for sewer systems in these regions (2).

**Table 3.** Concentrations of positive ions for ground wells in the study area

| No. | | $SO_4^{-2}$ | $Cl^-$ | $HCO_3^-$ | Cations$\sum$ |
|---|---|---|---|---|---|
| 1 | Ppm | *2500* | *2000* | 180 | 4680 |
| | Epm | 69.44 | 55.55 | 5 | 129.99 |
| | Epm% | 53.41 | 42.73 | 3.84 | 100 |
| 2 | Ppm | *1000* | *350* | 160 | 1510 |
| | Epm | 27.77 | 9.72 | 4.44 | 41.93 |
| | Epm% | 66.22 | 23.18 | 10.58 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| | Ppm | *800* | *1100* | 180 | 2080 |
| 3 | Epm | 22.22 | 30.55 | 5 | 57.77 |
| | Epm% | 38.77 | 52.88 | 8.65 | 100 |
| | Ppm | *1920* | *1350* | 192 | 3462 |
| 4 | Epm | 53.33 | 37.5 | 5.33 | 96.16 |
| | Epm% | 55.45 | 38.99 | 5.54 | 100 |
| | Ppm | *1688* | 1550 | 184 | 3422 |
| 5 | Epm | 46.88 | 43.05 | 5.11 | 95.04 |
| | Epm% | 49.33 | 45.29 | 5.37 | 100 |
| | Ppm | *920* | 2200 | 240 | 3360 |
| 6 | Epm | 25.55 | 61.11 | 6.66 | 93.32 |
| | Epm% | 27.34 | 65.48 | 7.13 | 100 |
| | Ppm | *300* | 4100 | 240 | 4640 |
| 7 | Epm | 8.33 | 113.88 | 6.66 | 188.81 |
| | Epm% | 4.41 | 70.90 | 3.52 | 100 |
| | Ppm | *540* | *5000* | 220 | 5760 |
| 8 | Epm | 15 | 138.88 | 6.11 | 159.99 |
| | Epm% | 9.37 | 86.80 | 3.81 | 100 |
| 9 | Ppm | *660* | *2300* | 160 | 3120 |
| | Epm | 18.33 | 63.88 | 4.44 | 86.65 |
| | Epm% | 21.15 | 73.72 | 5.12 | 100 |
| 10 | Ppm | *1050* | 2900 | 180 | 4130 |
| | Epm | 29.16 | 80.55 | 5 | 114.71 |
| | Epm% | 25.42 | 70.22 | 4.35 | 100 |
| | Ppm | *416* | *1000* | 160 | 1576 |
| 11 | Epm | 11.55 | 27.77 | 4.44 | 43.76 |
| | Epm% | 26.39 | 63.45 | 10.14 | 100 |
| | Ppm | *459* | *2100* | 200 | 2759 |
| 12 | Epm | 12.75 | 58.33 | 5.55 | 76.63 |
| | Epm% | 16.63 | 76.63 | 7.24 | 100 |
| 13 | Ppm | *442* | *3000* | 190 | 3632 |
| | Epm | 12.27 | 83.33 | 5.27 | 100.87 |
| | Epm% | 12.16 | 82.61 | 5.22 | 100 |
| | Ppm | *378* | *30* | 40 | 488 |
| 14 | Epm | 10.5 | 0.83 | 1.11 | 12.44 |
| | Epm% | 84.40 | 6.67 | 8,92 | 100 |
| 15 | Ppm | *300* | *170* | 50 | 520 |
| | Epm | 8.33 | 4.72 | 1.38 | 14.43 |
| | Epm% | 57.72 | 32.70 | 9.56 | 100 |
| | Ppm | *290* | *30* | 70 | 390 |
| 16 | Epm | 8.05 | 0.83 | 1.94 | 10.82 |
| | Epm% | 74.39 | 7.67 | 17.92 | 100 |
| | Ppm | *270* | *180* | 60 | 510 |
| 17 | Epm | 7.5 | 5 | 1.66 | 14.16 |
| | Epm% | 52.96 | 35.31 | 11.72 | 100 |
| 18 | Ppm | *260* | *20* | 80 | 360 |

| | | | | | |
|---|---|---|---|---|---|
| | Epm | 7.22 | 0.55 | 2.22 | 9.99 |
| | Epm% | 72.27 | 5.50 | 22.22 | 100 |
| | Ppm | *435* | *550* | 100 | 1085 |
| 19 | Epm | 12.08 | 15.27 | 2.77 | 30.12 |
| | Epm% | 40.10 | 50.69 | 9.19 | 100 |
| | Ppm | *150* | *20* | 70 | 240 |
| 20 | Epm | 4.16 | 0.55 | 1.94 | 6.65 |
| | Epm% | 62.55 | 8.27 | 29.17 | 100 |
| | Ppm | 20 | 30 | 70 | 120 |
| 21 | Epm | 0.55 | 0.83 | 1.94 | 3.32 |
| | Epm% | 16.56 | 25 | 58.43 | 100 |
| | Ppm | *420* | 360 | 80 | 860 |
| 22 | Epm | 11.66 | 10 | 2.22 | 23.88 |
| | Epm% | 48.82 | 41.87 | 9.29 | 100 |

### *5.3. Hydrochemical formula and type of water*

We mean the hydrochemical formula of water by the main positive and negative ions in units (equivalents par million%) and abbreviation (epm) whose concentrations are more than (15%) and arranged in descending proportions of all ions, where negative ions are placed in the numerator and positive ions in addition to the concentrations of dissolved solids Total (TDS) units (mg / L) and pH value (27) It was noted from Table (4) that most of the areas from which the water models are (Ca - SO4) and there are areas of water quality in which Ca –Cl and due to the presence Large amounts of dissolved ions of( Ca $^{++}$ ion) and sulphate compound due to melting melt And t is a source of these materials.

**Table 4.** Hydro chemical formula for groundwater wells in the study area

| Samples | Formula kurlov | Type water |
|---|---|---|
| 1 | $7\,7950\,\frac{SO4(53.14)Cl(42.73\,)}{Ca(49.34)Mg(36.99)}$ | Ca – $SO_4$ |
| 2 | $\frac{SO4(66.22)Cl(23.18)}{Ca(51.0)Mg(36.99)}\,7\;9310$ | Ca –$SO_4$ |
| 3 | $7\frac{Cl(52.88)SO4(38.77)}{Ca(40.86)K(43.16)}5420$ | Ca – Cl |
| 4 | $7\frac{SO4(35.45)Cl(38.99)}{Ca(72.51)Na(19.63)}6330$ | Ca – $SO_4$ |
| 5 | $6350\;7\frac{SO4(49.33)Cl(45.29)}{Ca(62.96)Mg(27.35)}$ | Ca – SO4 |
| 6 | $\frac{Cl(65.48)SO4(27.34))}{Ca(51.53)Mg(32.18)}\,6.5\;9760$ | Ca – Cl |
| 7 | $6.8\qquad 12081\frac{Cl(70.90)}{Ca(56.56)Mg(31.41)}$ | Ca – Cl |
| 8 | $12330\frac{Cl(86.80)}{Ca(51.79)Mg(28.04)Na(17.26)}7$ | Ca – Cl |
| 9 | $9423\frac{Cl(73.72)SO4(21.15)}{Ca(65.95)Na(35.18)}7$ | Ca – Cl |

| | | |
|---|---|---|
| 10 | 6.5 $9550\frac{Cl(70.22)SO4(25.4))}{Ca(43.69)\ Na(31.76)}$ | Ca – Cl |
| 11 | $5920\frac{Cl(63.45)SO4(26.39)}{Ca(49.34)Na(18.13)}7$ | Ca – Cl |
| 12 | $10640\frac{Cl(63.45)SO4(16.63))}{Ca(74.27)Mg(42.11)}6.5$ | Ca – Cl |
| 13 | $9070\frac{Cl(82.61)}{Ca(44.30)Mg(41.53)}6.5$ | Ca – Cl |
| 14 | $4443\frac{SO4(48.40)}{Ca(82.92)}\ 6.5$ | Ca – $SO_4$ |
| 15 | $5050\frac{SO4(57.72)Cl(32.70)}{Ca(87.59)}\ 6.2$ | Ca – $SO_4$ |
| 16 | $6.5\frac{SO4(74.39)HCO3(17.92)}{Mg(51.45)Ca(41.16)}\ 816$ | Mg – $SO_4$ |
| 17 | $\frac{SO4(52.96)Cl(35.31)}{Ca(51.55)Na(38.12)}6.5\ 5620$ | Ca – SO4 |
| 18 | $\frac{SO4(72.27)HCO3(22.22)}{Ca(74.20)Na(18.39)}7\ 731$ | Ca – $SO_4$ |
| 19 | $\frac{Cl(50.69SO4(40.10))}{Ca(69.79)Na(19.09)}\ 6.5\ 7010$ | Ca – Cl |
| 20 | $\frac{SO4(62.55)HCO3(29.17)}{Ca(45.39)Na(39.67)}\ 6\ 758$ | Ca – $SO_4$ |
| 21 | $\frac{HCO3(58.43)SO4(16.56)}{Ca(49.31)Na(43.50)}\ 6\ 792$ | Ca – $HCO_3$ |
| 22 | $\frac{SO4(48.82)Cl(41.87)}{Ca(55.19)Na(22.64)Mg(22.55)}\ 4.3\ 713$ | Ca – $SO_4$ |

**Validity of groundwater wells**: River water is used for various purposes depending on the concentrations of ions left in it to:

To drink the human: - To assess the validity of the water of the study area to drink human content was compared with Iraqi standards for 2009 and international standards for 2006 and table No. (5) shows that.

| Rate of variables in water wells of the study area | International specifications )WHO 2006( | Iraqi Standards(2009) | Variables |
|---|---|---|---|
| 5.65 | 9.5 – 6.5 | 8.5 – 6.5 | PH |
| *33262* | 1530 | 1530 | EC ms/cm |
| *4230* | 1000 | 1000 | T.D.S. (ppm) |
| *760* | 75 | 150 | (ppm) $Ca^{+2}$ |
| 402.5 | 100 | 100 | $Mg^{+2}$ (ppm) |
| 205.75 | 200 | 200 | $Na^{+}$ (ppm) |
| 38.25 | 12 | 12 | K+ (ppm) |
| *1325* | 250 | 400 | $SO_4^{-2}$ (ppm) |
| *2510* | 250 | 350 | $Cl^{-}$ (ppm) |
| *140* | 400 | 400 | $HCO_3^{-}$ (ppm) |

We note from the above table that the groundwater in the study area is not suitable for drinking human because of the high salinity and all the positive elements exceeded the permissible limits as well as the negative ions such as sulfates and chloride. Water is not suitable for human drinking

**To drink animals:**

To determine the validity of groundwater used for drinking animals for animal husbandry, the results of chemical analyzes of well water models in the study area were compared with the specifications proposed by Altoviski, 1962 and Table (5) shows this.

**Table 5.** Water Specifications for Animal Drinking (Altoviski, 1962)

| Rate of elements in the wells of the study area | the highest rate | Can be used | Water allowed to be used | good water | Very good water | Elements )ppm( |
|---|---|---|---|---|---|---|
| 205.75 | 400 | 2500 | 2000 | 1500 | 800 | $Na^{+}$ |
| *760* | 1000 | 900 | 800 | 700 | 350 | $Ca^{+2}$ |
| 402.5 | 700 | 600 | 500 | 350 | 150 | $Mg^{+2}$ |
| *2510* | 6000 | 4000 | 3000 | 2000 | 900 | $Cl^{-}$ |
| *1325* | 6000 | 3000 | 3000 | 2500 | 1000 | $SO_4^{-2}$ |
| *4230* | 15000 | 10000 | 7000 | 5000 | 3000 | T.D.S |

It is concluded from the above table that the groundwater wells in the study area are suitable for drinking animals for breeding purposes, since all elements as well as dissolved solids did not exceed the permissible limits for drinking animals (Altoviski, 1962).

**For industry purposes:**

To determine the validity of groundwater for industrial purposes, the results of chemical analyzes of well water models in the study area were compared with the standard specifications of water used in different industries (Hem, 1985) and Table (6) shows this.

**Table 6.** Proposed Limits of Water Used for Some Industrial Purposes (Hem, 1985)

| Rate of variables in water wells of the study area | Paper Industry | Textile Industries | Oil products | Fruit industry | Type of Industry<br>Variable (ppm |
|---|---|---|---|---|---|
| *760* | 20 | 100 | 75 | - | $Ca^{+2}$ |
| 402.5 | 12 | 50 | 30 | - | $Mg^{+2}$ |
| *2510* | 200 | 500 | 300 | 250 | $Cl^{-}$ |
| *140* | - | 250 | - | - | $HCO_3^{-}$ |
| *1325* | - | 100 | - | 250 | $SO_4^{-2}$ |
| *4230* | - | 1000 | 1000 | 500 | T.D.S |
| 5.65 | 10 – 6 | 8 -6.5 | 9 -6 | 6.8 – 6.5 | Ph |

Note from the above table that the groundwater in the study area is not suitable for industrial purposes and its quality can be improved by putting some chemical conditioners

**For the purposes of construction:**

In order to study the suitability of groundwater in the area of the study for the purposes of building and construction were compared the water models of the study area with the classification (Altoviski, 1962) and Table No. (7) shows that.

| Rate of variables in water wells of the study area | Limit | Ions |
|---|---|---|
| 205.75 | 1160 | $Na^{+}$ |
| *760* | 437 | $Ca^{+2}$ |

| | | |
|---|---|---|
| 402.5 | 271 | $Mg^{+2}$ |
| *2510* | 2187 | $Cl^{-}$ |
| *1325* | 1460 | $SO_4^{-2}$ |
| 140 | 350 | $HCO_3^{-}$ |

We note from the table above that the groundwater in the study area is not suitable for construction purposes because some of the elements are higher than the allowable limit, namely calcium and magnesium

**For irrigation purposes:** To study the suitability of groundwater in the study area, the standard specifications for irrigation water (Ayres & West Cot, 1989) and Table (8) shows that

| Rate of variables in water wells of the study area | Normal range | Unit | Variable | Groups |
|---|---|---|---|---|
| *33262* | 3000 – 0 | s/cm$\mu$ | E.C. | Salinity |
| *4230* | 2000 – 0 | Ppm | T.D.S. | |
| 21.97 | 5 – 0 | Epm | $Mg^{+2}$ | |
| 21.11 | 20 – 0 | Epm | $Ca^{+2}$ | Positive ions |
| 3.90 | 40 – 0 | Epm | $Na^{+}$ | |
| 38.25 | 2 – 0 | Ppm | $K^{+}$ | Nutrients |
| 3.88 | 10 -0 | Epm | $HCO_3^{-}$ | |
| 34.99 | 20-0 | Epm | $SO_4^{-2}$ | Negative ions |
| 69.71 | 30 -0 | Epm | $Cl^{-}$ | |
| *5.65* | 8.5 -6 | (14 - 1) | Ph | Acid function |

We note from the above table that the groundwater wells in the study area are not suitable for irrigation of plants due to high salinity and many positive elements exceeded the permissible limits as well as negative ions.

## 6. Conclusion

1. Most of the water in the study area is acidic.
2. The underground water in the study area is not suitable for human drinking because of the high salinity and all the positive elements exceed the permissible limits as well as the negative ions such as sulphates and chloride. Bicarbonate is within the permissible limits as well as the acidic function pH. The electrical conductivity has exceeded the permissible limits. Valid for human drinking
3. Groundwater wells in the study area are suitable for drinking animals for breeding purposes, since all elements as well as dissolved solids did not exceed the permissible limits for drinking animals.
4. Groundwater wells in the study area is not suitable for industrial purposes and its quality can be improved by the development of some chemical conditioners
5. The lack of validity of groundwater in the study area for construction purposes because some of the elements are higher than the allowable limit, namely calcium and magnesium
6. The lack of validity of groundwater wells in the study area for the purposes of irrigation of plants because of high salinity and many positive elements exceeded the permissible limits as well as negative ions and can be planted plants tolerant to high salinity

## 7. Recommendations

1. Conduct periodic water well analyzes to determine their quality and to ensure that they are free from various pollutants and to take the necessary measures when sudden pollution occurs.

2. Special attention to the environmental conditions of groundwater and develop the necessary measures to protect them from chemical pollution
3. Study the impact of climatic factors of the study area and know their impact on groundwater
4. Planting suitable trees for groundwater in the study area
5. Raise awareness of the people of the region not to use groundwater wells for human purposes and not to throw waste near residential areas so as not to affect the contamination of wells

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