Boron Concentration Measurements in the Samples of Water wells Collected from Al-Diwaniya Governorate -Iraq Using ICP/OES Techniques.

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Abstract. Boron is not uniformly dispersed, ubiquitous crucial micronutrient component for vegetation as well as for man. The aim of this research is to measure Boron, $^{10}\text{B}_3$, concentration in the water of the wells in Al-Diwaniya governorate in Iraq. The measurements done through analysing the soil samples of wells collected from 30 different locations using ICP/OES Techniques. The Boron concentration, which is obtained from the study, ranged from 0.64 ppm in (Eastern Hamza 4) to 3.81 ppm in (Alsuniya 2) in water wells. The findings of the study are introduced and compared with other papers. The findings could be employed to introduce unique supplemental contributions in case a contamination incident happens and to achieve wells water quality standards by related entities to preserve radioactive contamination-free water wells samples, which are needing for the people. More further, the study discovered that 30 samples of the surface water wells had boron more than detected levels. It is because the higher leaching of boron through monsoon rains from surface water wells beyond the root level. Therefore, in the close future, there will be probability of acute contamination problem with boron.

Keywords: Boron, samples of water wells, (ICP-OES) and Diwaniya Governorate.

1. Introduction:

Boron is a non-metallic component, which relates to Group IIIA of the periodic table. It had an oxidation situation of $+3$. It has an atomic number of 5 and atomic weight of 10.81. Actually, it is a combination of two constant isotopes, $^{10}\text{B}$ (19.8%) and $^{11}\text{B}$ (80.2%) [1]. It is a natural component which exist in rocks, soil, and water. The concentration in the earth’s crust is estimated about <10 ppm, while high concentrations as 100 ppm is existed in boron-rich parts [2]. It is not existed on the earth in elemental shape but it is exit in a united condition as borax, boric acid, tourmaline, colemanite, kernite, unexcited and borates [3-6]. The deficiency of Boron is more found in crops cultivated in soil that has higher quantity of free carbonates, low organic matter, and high pH [7].
Boric acid, borates and per borates can be presented to environment that are used in moderate disinfectants, makeups, pharmaceuticals [8]. Boric acid and borates are employed in manufacturing glass, soaps and cleaning powder, flame retardants, and neutron absorbers for nuclear installations may lead to boron toxicity in environment. Fertilizer are among the uses of borates in agriculture, pesticide and herbicide because they are not carcinogenic to mammalian and they do not have insect resistance in comparsion with organic pesticides [9,10]. Boron is found as borosilicate in igneous, metamorphic, sedimentary rocks that are resistant to withstanding but not available to vegetation. Some chemical structure compounds of boron is in figure 1.

**Figure 1.** Some boron chemical structure compounds [11]

Primary boron can not be dissolved in water [12]. Borax (dehydrate) has no boiling point. Borax decays at 75°C. It misses 5H₂O at 100°C, 9H₂O at 150°C. It turns anhydrous at 320°C. The melting point for anhydrous borax is higher than 700°C and it decays at 1575°C [11]. The purpose of this study is to examine the complicated reactions and interactions with movement of soils, and to assess the risks brought with soil samples. Actually, water and soil samples under this study were taken from areas within Diwaniyah Governorate, situated in the south of Iraq, see Figure 2.

**Figure 2.** Al- Diwaniyah Governorate, dots are the locations samples taken from are numbered in station number (S).
2. Material and Method

In Al-Diwaniya governorate, the water wells samples are taken from 30 stations and collected during September 2018. The Boron concentration measurements of wells water samples were conducted through using ICP/OES method[13]: The (ICP/OES) is a powerful tool to determine the existence of metals in a variety of different sample matrices. Based on this technique, samples are injected into a radiofrequency (RF)-induced argon plasma using one of a variety of nebulizers or sample introduction techniques. The sample mist reaching the plasma is quickly dried, vaporized, and energized through collisional excitation at high temperature. The atomic emission emanating from the plasma is seen in either a radial or axial configuration, gathered with a lens or mirror, and imaged on to the entrance slit of a wavelength selection tool. One elemental measurements can be achieved cost-effectively with a simple monochromator/photomultiplier tube (PMT) combination, and simultaneous multi element determinations are performed for up to 30 elements with the combination of a polychromator and an array detector. The analytical performance of such systems is competitive with most other inorganic analysis techniques, particularly in respect to sample quantity and sensitivity.

The water wells samples have been sampled and estimated by ICP/OES method. For the calibration graph a stock solution of borate was used of which a calibration Solution was prepared by (O. Neil, M. J. Smith) ICP/OES devices at 249.772 nm . A linear calibration was noticed, followed by the calculation of the slope factor. The results are tested in mg B/l. Regression equation:

\[
Y = 6793x + 286.62; R^2 = 0.9995.
\]

Boron concentration was read directly from the standard curve see figure 2.

![calibration curve for boron for the ICP-OES](image)

**Figure 3.** Calibration curve for boron concentration in Al-Diwaniya water wells (ppm) vs Emission intensity (c/s).

3. Findings and Discussions:

The water wells samples findings for Boron concentration are defined in this study are introduced in Table 1, which is gathered from some parts in Al-Diwaniya Governorate water wells, south of Iraq. To measure the level of boron concentration in waters, Table 1 in addition to figure 4 reveal that there was some high rates of boron concentrations in the wells water higher than the most of public tap and washing surface water wells in the governorate. The results of 30 samples are sorted out into 30 sites, in Al-Diwaniya Governorate region from S1 to S30, shown in figure 4. The results showed that the maximum concentration of boron (3.81ppm) in the (Alsuniya 2) city and the minimum concentration of boron was found in the Eastern Hamzah region (0.64ppm). Out of 30 water wells samples 6 samples recorded higher which start from (2ppm) to (3.81ppm) while the 19 water wells samples start from 1 ppm to (1.99) ppm. While the other 5 water wells samples start from( 0.64) ppm to (0.96) ppm than the recommended WHO limit (0.5 ppm).
In 1993, WHO management of the boron value of (0.5-0.3) mg/L, and it ranked first in 1998. In addition to that, in 2000, it is agreed to leave the parameter at 0.5 mg/L till information of continuous studies becomes obtainable that could alter the present opinion of boron toxicity or technology of boron treatment [14,15]. In 1998, the European Union stated that boron value must be of 1.0 mg/L for the quality of water used for drinking [16,17]. Higher amount of Boron in water wells samples may be due to leaching of water wells boron as maximum amount of mobile boron is present in the acidic water wells in the studied areas [18,19]. Moreover, the use of boron compounds as fertilizer, insecticide and herbicides at regular intervals are subjected to wastewater irrigation disposal. Hence possibility of boron leaching in under water.

**Table 1.** Boron Concentration in the water wells in Diwaniya Governorate wells by using ICP-OES.

| No of site | Location of samples | Concentration of boron in water wells |
|-----------|---------------------|-------------------------------------|
| S1        | Alshanaafia 1       | 1.01                                |
| S2        | Alshanaafia 2       | 0.88                                |
| S3        | Alshanaafia 3       | 1.91                                |
| S4        | Alshaamia 1         | 2.17                                |
| S5        | Alshaamia 2         | 2.33                                |
| S6        | Alshaamia 3         | 1.99                                |
| S7        | Alshaamia 4         | 1.07                                |
| S8        | Alshaamia 5         | 1                                   |
| S9        | Alsuniya 1          | 1.04                                |
| S10       | Alsuniya 2          | 3.81                                |
| S11       | Alsuniya 3          | 1.77                                |
| S12       | Afak 1              | 1.95                                |
| S13       | Afak 2              | 1.93                                |
| S14       | Afak 3              | 1.02                                |
| S15       | Nufer 1             | 2                                   |
| S16       | Nufer 2             | 1.8                                 |
| S17       | Nufer 3             | 1.91                                |
| S18       | Al Badair1          | 0.75                                |
| S19       | Al Badair2          | 0.96                                |
| S20       | Al Badair3          | 2.66                                |
| S21       | aldighara 1         | 1.72                                |
| S22       | aldighara 2         | 2.87                                |
| S23       | aldighara 3         | 1.55                                |
| S24       | Sumer 1             | 1.79                                |
| S25       | Sumer 2             | 1.74                                |
| S26       | Sumer 3             | 1.84                                |
| S27       | Eastern Hamza 1     | 1                                   |
| S28       | Eastern Hamza 2     | 1.44                                |
| S29       | Eastern Hamza 3     | 0.86                                |
| S30       | Eastern Hamza 4     | 0.64                                |
4. Conclusions
The paper is considered the first one which is performed in the area of Al-Diwaniya Governorate (Iraq) for boron concentration measurement of water wells sources. In general, the study found that water wells samples within the investigated areas, are highly mineralized. Right to use safe water wells samples is vital for man's health and it is fundamental for public health situation. Good quality samples of well water were preserved by isolating the soil sediments suspended with the well water and then the wells were treated. It is probable to keep the raw water wells resources through measures of pollution control that inhibit adverse elements from inflowing the water wells and by good watershed organizing practices. In recent years, there is much news about the issue of integrity on the water provided by municipalit. People should pay more attention to the water coming of their faucet, especially those who consume water from wells. According to the U.S. Geological Survey (USGS), nearly 20 percent of private wells encompass pollutants, where 23 percent have high levels to be a possible health concern. Private wells are excepted from Environmental Protection Agency (EPA) potable water regulations that enforce legal restrictions on more than 90 pollutants. (Some states and local governments establish their own potable water regulations.) It means that it is the the well’s owner responsibility to guarantee the safety and quality of water before it reaches the tap. The Centers for Disease Control and Prevention (CDC) acclaims that owners examine well water one time a year. Finally, boron concentration of examined samples of water wells diversified from to 1.01 ppm mg/l. The majority of the high level concentrations are estimated from 2.66 mg/l to 3.81 mg/l. The current studied values are lower than most of the values stated for other countries of the world. The perceived estimations are below the IMAC recommended limit of 5 mg/l. Therefore, health risks associated with boron in water wells of the Al-Diwaniya Governorates are some what insignificant. Boron can be exist in many countries around the globe, in Itlay and spain studies ranged the level of it from 0.5 to 1.5mg/l. Other EU countries like Netherlands and UK are ranged at the level of 0.6mg/l. This high concentration of the boron is due to the nature of grounds especially those which is mineralized or carbonated ground water.

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