

The measurements of boron concentration rate in soil samples of Basrah Governorate (in Iraq) using ICP/OES Techniques

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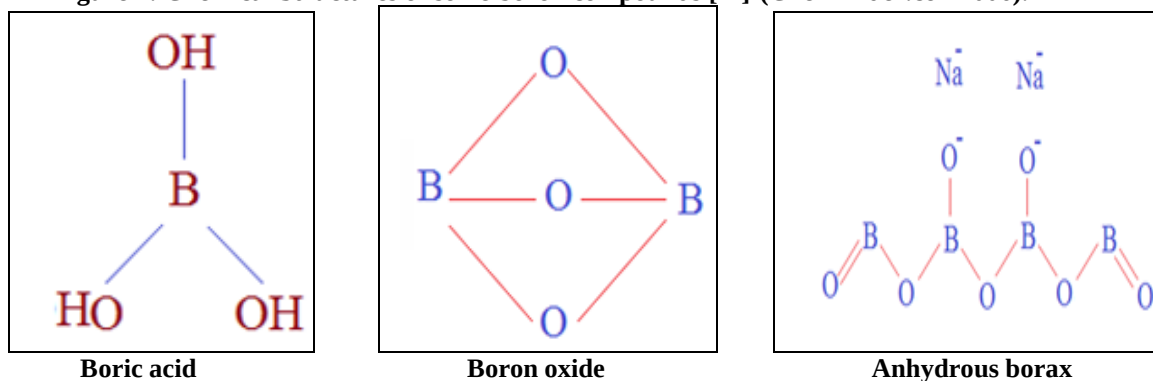
Abstract: Boron is none uniformly distributed, ubiquitous essential micronutrient element for plant as well as human beings. The aim of this study is to measure the Boron, $^{10}_5\text{B}$, concentration in soil in Basrah governorate in Iraq. The measurements were performed by analyzing the soil samples collected from 75 location using ICP/OES Techniques. The Boron concentration which is obtained ranged from 0.38192 ppm in Al-leheise1 to 5.139 ppm in Almaeber in soils. The results are presented and compared with other studies. The results could be utilized to make distinctive supplementary contributions when contamination event occurs and to implement soil quality standards by concerned authorities to maintain radioactive contamination-free soils samples which are needing for the people. The study further reveals that 75 surface soil samples have boron more than detection limit. It may be due to higher leaching of boron during monsoon rains from surface soils beyond the root zone. Thus, there is possibility of severe pollution problem with boron in near future.

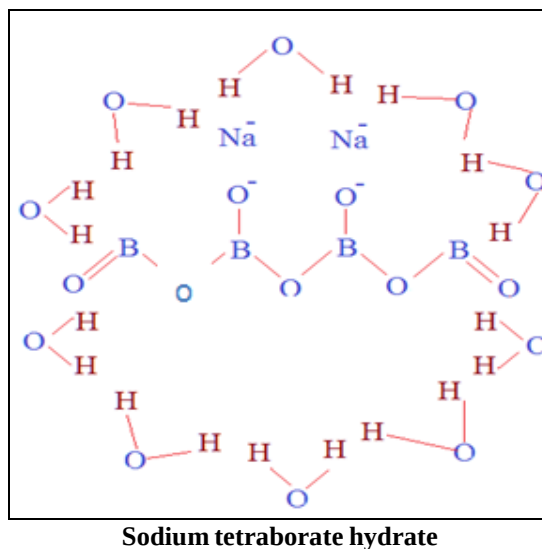
Keywords: Boron, Soil samples, Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), Basrah Governorate

I. Introduction

Boron is a nonmetallic element that belongs to Group IIIA of the periodic table and has an oxidation state of +3. It has an atomic number of 5 and atomic weight of 10.81. Boron is actually a mixture of two stable isotopes, ^{10}B (19.8%) and ^{11}B (80.2%) [1]. Boron is a naturally-occurring element found in rocks, soil, and water. The concentration of boron in the earth's crust has been estimated to be <10 ppm, but concentrations as high as 100 ppm can be found in boron-rich areas [2]. It does not appear on the earth in elemental form but is found in combined state as borax, boric acid, tourmaline, colemanite, kernite, ulexite and borates [3-6]. Boron deficiency is much more common in crops that are grown in soil that have higher amount of free carbonates, low organic matter, and high pH [7]. Boric acid, borates and per borates can introduced to environment as these have been used in mild antiseptics, cosmetics, pharmaceuticals [8]. Boric acid and borates are used in glass manufacture, soaps and detergents, flame retardants, and neutron absorbers for nuclear installations can cause boron toxicity in environment. Borates have various agricultural uses as fertilizer, insecticide and herbicide because they are not carcinogenic to mammalian and lack of insect resistance compared with organic insecticides [9,10]. Boron occurs as borosilicate in igneous, metamorphic, sedimentary rocks which are resistant to weathering and not readily available to plants. The chemical structure of some boron compounds is found in Figure 1.

Figure 1: Chemical Structures of some boron compounds [11] (Chemfinder.com2006).





Elemental boron is insoluble in water [12]. Borax (decahydrate) does not have a boiling point. Borax decomposes at 75°C, and loses 5H₂O at 100°C, 9H₂O at 150°C, and becomes anhydrous at 320°C. The melting point for anhydrous borax is above 700°C and it decomposes at 1575°C [11]. The purpose of this study is to investigate the complex interactions and exchanges with flow of soils, and to estimate how much hazards brought with soil samples. In fact, the study area is located inside Basra Governorate which is located in the extreme southern part of Iraq, see Fig. 2.

Figure 2 Basra Governorate, dots represent the places where samples taken from, numbering in station number (S) (Basra map is from Google earth).



II. Materials and Methods

In Basra governorate, the samples from 75 stations and locations were collected during April 2014. The measurements of Boron concentration soil samples were carried out by using ICP/OES method [13]: Inductively coupled plasma/optical emission spectrometry (ICP/OES) is a powerful tool for the determination of metals in a variety of different sample matrices. With this technique, liquid 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 viewed in either a radial or axial configuration, collected with a lens or mirror, and imaged on to the entrance slit of a wavelength selection device. Single element measurements can be performed cost-

effectively with a simple monochromator/photomultiplier tube (PMT) combination, and simultaneous multielement determinations are performed for up to 70 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, especially with regards to sample throughput and sensitivity.

Soil Sampling and Analysis:

Surface soil of 75 samples (0-15 cm) are collected from the different locations in Basrah Governorate .Soil samples are air dried and any clods and crumbs are removed, crushed and homogenized to pass through a 75 μ m mesh sieve and stored in plastic container until analysis.

Extraction of Boron from Soil:

The samples of soils have been sampled which were estimated by ICP/OES method. For the calibration graph a stock solution of borate was used of which a calibration Solution was prepared by ICP/OES devices at 249.772 nm . A linear calibration was observed, followed by the calculation of the slope factor. The results are experimented in mg B/l. Regression equation $Y=2465.14x + 323.941$: $R^2 = 0.999986$, Boron concentration was read directly from the standard curve (see figure 2),but the Regression equation $Y= 2314.18x + 201.258$: $R^2 =0.999976$ which is obtain from the slop factor, Boron concentration was read directly from the standard curve (see figure 3).

Figure 2: Calibration curve for boron concentration in Al-zubair soil (ppm) vs Emission intensity (c/s).

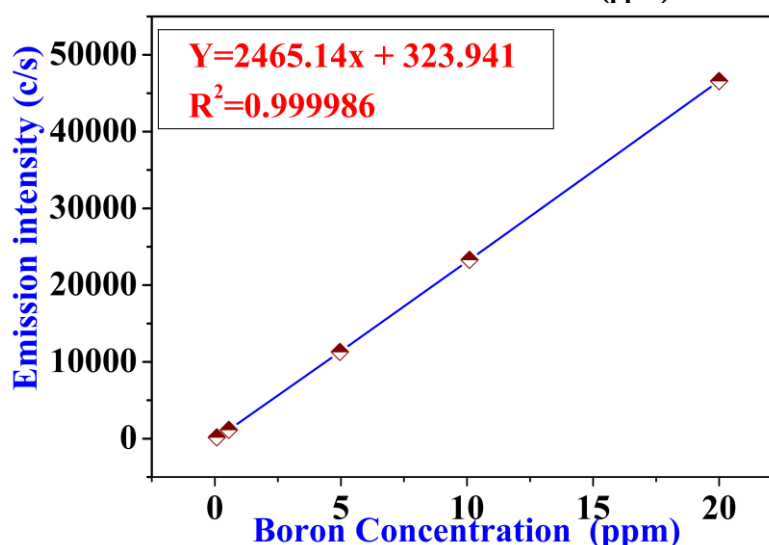
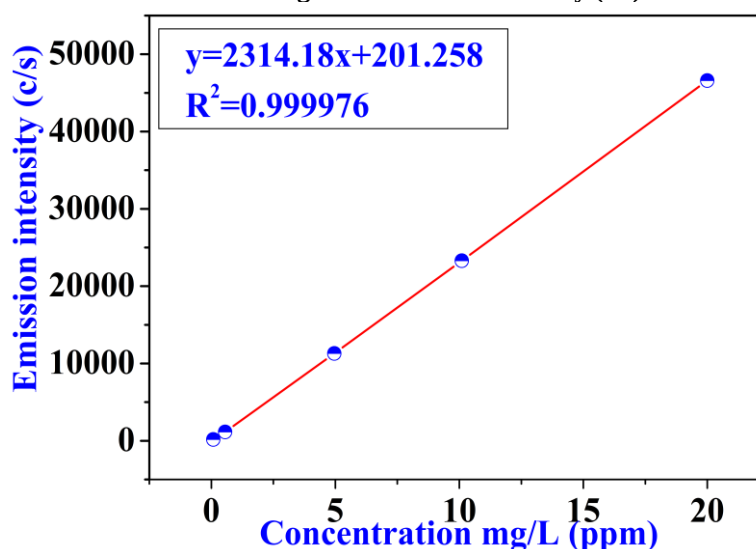


Figure 3: Calibration curve for boron concentration in Shat Alarab,Almaina, Gurna and Abu- Alkhaseb soil mg/L vs Emission intensity (c/s)



III . Results and Discussions

The results for Boron concentration in Soil samples determined in the present study are presented in Table 2 and Table 3 which are collected from some areas in Basrah Governorate, southern Iraq .For the measurement of boron concentration level soils, Table 1,Table 2 and Fig.4, Fig.5 reflect the fact that, there was some high level of boron concentration in this soil water higher than the most of public tap and washing surface water in the governorate. The results for these 33 samples categorized into 33 locations, in al-zubair region from s1 to s33, shown in Fig. 4. Boron content found maximum (3.9478 ppm) in Eastern star /alzubair/safwan street17 and minimum (0.38192 ppm) was recorded in Allihise1 belt. Out of the 33 soil samples 8 samples recorded higher which are beginning from 2.1291ppm to 3.9478 ppm while the 16 soil samples are beginning from 1.1091 ppm to 1.9818 ppm while the 6 samples soils are beginning from 0.38192 ppm to 0.92949 ppm than the prescribed WHO limit (0.5 ppm). With respect to the table 2 , The results for these 41 samples categorized into 41 locations, in Abu AL khaseb ,Shatt Al-Arab Almdiana and Gurna soil analysis by ICP-OES from s34 to s75, shown in Fig. 5. Boron content found maximum (5.139 ppm) in Al-emaber and minimum (0.04844 ppm) was recorded in Gekor belt. Out of the 41 soil samples 3 samples recorded higher which are beginning from 4.0409ppm to 5.139 ppm and the 9 soil samples are beginning from 2.0288 ppm to 3.9493 ppm but we find the 14 samples soils are beginning from 1.084 ppm to 1.9424 while the 6 soil samples are beginning from 0.04844 ppm to 0.9829 than the prescribed WHO limit (0.5 ppm). the result The World Health Organization (WHO) in 1993 the WHO established a health-based Guideline of 0.3 mg/L for boron. This value was raised to 0.5 mg/L in 1998 primarily. Furthermore, in 2000 it was decided to leave the guideline at 0.5 mg/L until data from ongoing research becomes available that may change the current view of boron toxicity or boron treatment technology [14,15].The European Union established a value of 1.0 mg/L for boron in 1998 for the quality of water intended for human consumption [16,17]. New Zealand has established a drinking water standard for boron of 1.4 mg/L [18,19]. Higher amount of Boron in soil samples may be due to leaching of soil boron as maximum amount of mobile boron is present in the acidic soil in the study area. Moreover 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 soil water.

NO	No of site	Location of samples	Concentration of boron in soil by ICP- OES (ppm)
1	S ₁	Allhis1	0.38192
2	S ₂	Al-zubair/Al-hadama	0.44569
3	S ₃	Al-zubair/Safwan- Umm-Qasr road 17/eastern star	0.72981
4	S ₄	Allhis2	0.75851
5	S ₅	Alzubair / southren star	0.88745
6	S ₆	Safwan - Umm-Qasr road17 / southren star	0.92949
7	S ₇	Allhis3	1.1091
8	S ₈	Al-zubair/southren star	1.3239
9	S ₉	Allhis4	1.36
10	S ₁₀	Al-Zubair/Rafidya	1.466
11	S ₁₁	Al-zubair /Alhadama	1.4922
12	S ₁₂	Khor Al-Zubair / against the iron and steel	1.5101
13	S ₁₃	Allhis5	1.5611
14	S ₁₄	Al-zubair/eastern star/Safwan -Umm-Qasr road17	1.6263
15	S ₁₅	Almoilhat/Alnagme/safwan _ Umm-Qasr road 17	1.6968
16	S ₁₆	southren star /behined liquid gaz plant/Safwan- Umm-Qasr roade 17	1.7152
17	S ₁₇	Allhis6	1.7423
18	S ₁₈	Safwan-Al-zubair road 17 /southern star/Besides liquid gas plant	1.7556
19	S ₁₉	Safwan - Qasr road 17 /southren star /behined liquid gaz plant	1.7637
20	S ₂₀	Allhis7	1.8119
21	S ₂₁	Almoilhat/Alnagme/safwan _ Qasr road 17	1.9084
22	S ₂₂	Allhis8	1.9778
23	S ₂₃	Al-zubair/Al-hadama	1.9818
24	S ₂₄	safwan_ Amm Qaer road 17/Al-hadama	2.0085
25	S ₂₅	safwan_ Amm Qaer road 17/Eastren star	2.0962
26	S ₂₆	Umm_Qaser	2.1291
27	S ₂₇	Almoilhat/Alnagme/ safwan_ Amm Qaer road 17	2.2847
28	S ₂₈	safwan_ Amm Qaer road 17/Al-zubair	2.4967
29	S ₂₉	Allhis9	2.6737
30	S ₃₀	Allhis10	2.9902
31	S ₃₁	safwan_ Amm Qaer road 17/Al-zubair	2.9979
32	S ₃₂	southren star/ safwan_ Amm Qaer road 17	3.2544
33	S ₃₃	Eastm star/Al-zubair /safwan street17	3.9478

Table 1: Measurments of Boron concentration in soil samples from different areas in Alzubair of Basrah Governorate by using ICP-OES.

Table 2. Measurements of Boron concentration in soil samples from different areas in Abu Alkhaseb, Shatt Arab, Almdiana and Gurna of Basrah Governorate by using ICP-OES.

No	No of site	Location of sample	ncentration of Boron (ppm)
1	S ₃₄	Gekor	0.04844
2	S ₃₅	Alsarage	0.57204
3	S ₃₆	Bab twel	0.60458
4	S ₃₇	Alabara	0.67798
5	S ₃₈	Hamdan	0.73545
6	S ₃₉	Albhadria	0.9602
7	S ₄₀	Abu Alkhasib center	0.9829
8	S ₄₁	Koz rever	1.084
9	S ₄₂	Mhala	1.1236
10	S ₄₃	Talha/Area of Al-emam Al-sadeq	1.1972
11	S ₄₄	Alhwer/Area Ezzeldine salem	1.2274
12	S ₄₅	end of Almdiana bowndary	1.3594
13	S ₄₆	Mhegran	1.3689
14	S ₄₇	Alfathai/Almdiana	1.4023
15	S ₄₈	Sahel Abu flus	1.4139
16	S ₄₉	Abu flos near water progect	1.4261
17	S ₅₀	Autba	1.427
18	S ₅₁	Doad	1.4834
19	S ₅₂	Fao	1.5273
20	S ₅₃	Bab sliaman	1.5334
21	S ₅₄	Qurna center	1.6616
22	S ₅₅	Abu magera	1.7703
23	S ₅₆	Alkta/near Abu flus bridge	1.8331
24	S ₅₇	Riverbank Ezz1	1.8606
25	S ₅₈	Hor Alkhuwayt/Mdaina	1.8651
26	S ₅₉	Center of Amdiana	1.9424
27	S ₆₀	Near Abu flus port	2.0288
28	S ₆₁	Alsebelait	2.2226
29	S ₆₂	Salehia	2.3509
30	S ₆₃	Alshafe	2.378
31	S ₆₄	Aldear	2.6482
32	S ₆₅	Alsobais street/between hor chabaish and hor Almdiana	2.6955
33	S ₆₆	Grdlnd	2.8467
34	S ₆₇	Shatt Al-Arab /ktaban	2.8625
35	S ₆₈	Hor akab/end of hwair	3.0102
36	S ₆₉	Cote Algoa / Altnomp	3.09
37	S ₇₀	Hartha	3.1467
38	S ₇₁	Jassim river	3.9493
39	S ₇₂	Aldear /Algalal	4.0409
40	S ₇₃	Cliff Qurna	4.391
41	S ₇₄	Alknazeria	4.5956
42	S ₇₅	Al-emaber	5.139

Figure 4: Distribution of the results of the boron concentration in Al-zobair soil analysis by ICP-OES.

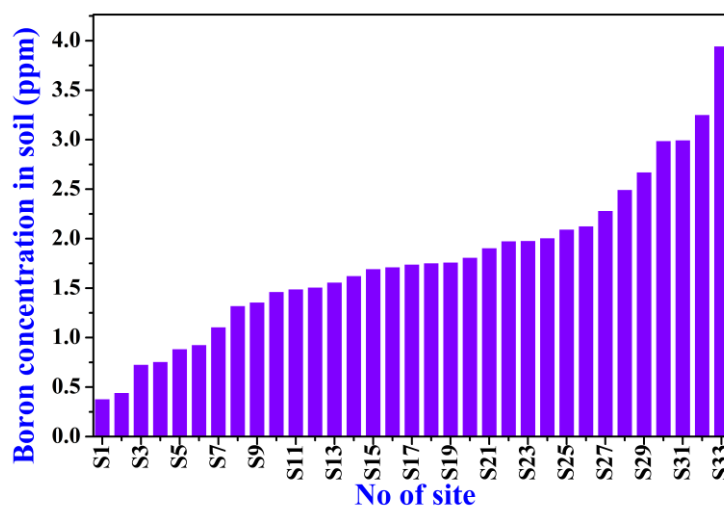
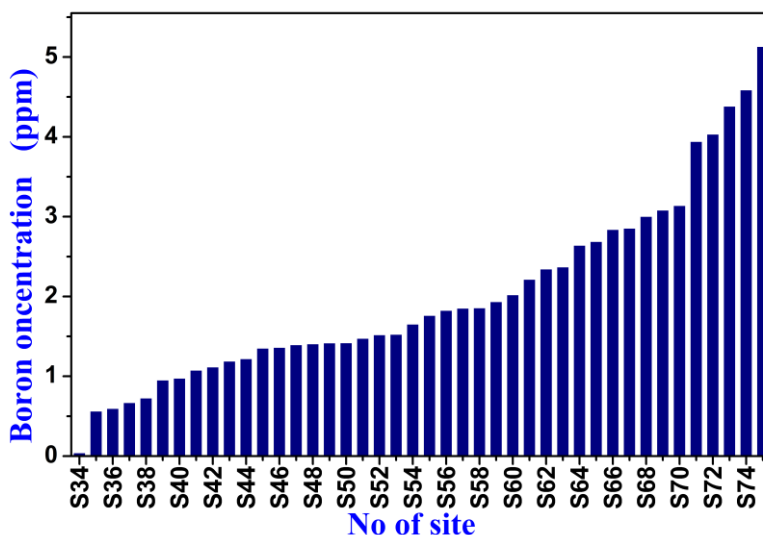


Figure 5: Distribution of the results of the boron concentration in Abu AL khaseb ,Shatt Al-Arab Almdiana and Gurna soil analysis by ICP-OES.



V. Conclusion

This study is the first boron concentration measurement in soil sources that is performed in the area of Basra Governorate (Iraq). In general, well soil samples within the investigated areas, are highly mineralized. The correlation analysis revealed the strong positive association between boron and some chemical compounds in soil samples. Access to safe soil samples is essential to human well being and is a key public health issue. The maintenance of good quality o f soil samples were achieved both by protecting the raw soil samples supply and soil water treatment. It is possible to protect the raw soil waters supply by means of pollution control measures that prevent undesirable constituents from entering the soil water and by good watershed management practices.

VI. References

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