International Association of Scientific Innovation and Research (IASIR)
(An Association Unifying the Sciences, Engineering, and Applied Research)

ISSN (Print): 2279-0047
ISSN (Online): 2279-0055

International Journal of Emerging Technologies in Computational and Applied Sciences(IJETCAS)
(Open Access, Double Blind Peer-reviewed, Refereed and Indexed Journal)
www.iasir.net

The evaluation of boron concentration rate in soil samples of North Basrah Governorate (in Iraq) using AAS Techniques

Mustafa M. Jafer and Thaer. M. Salman
Department of Physics, College of Education for pure sciences
University of Basrah, Basrah, Iraq

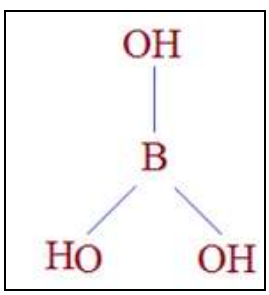
Abstract: *Boron is none uniformly distributed, ubiquitous essential micronutrient element for plant as well as human beings. The aim of this study is to measure the Boron,* ${}^{10}_{5}B$ *, concentration in soil in Basrah governorate in Iraq. The measurements were performed by analyzing the soil samples collected from 43 location using AAS Techniques. The Boron concentrations which is obtained ranged from from* 0.2700 *ppm in Al-Qurna - the thger to 0.933 ppm in Alhwair – Khamesa in 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 43 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, Water samples, Absorption Atomic Spectroscopy , Basrah Governorate.*

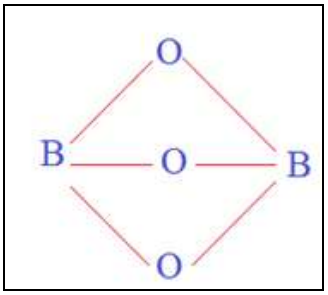
I. Introduction

Boron is a nonmetallic element that belongs to Group IIIA of the periodic table and has an oxidation state of +3. I 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.

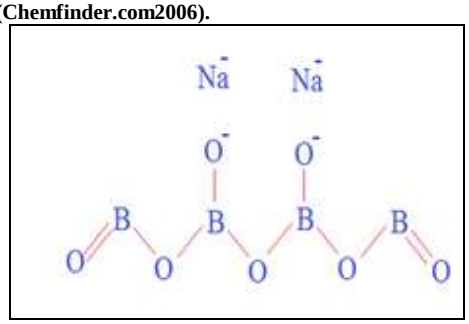
Figure 1 Chemical Structures of some boron compounds [11] (Chemfinder.com2006).



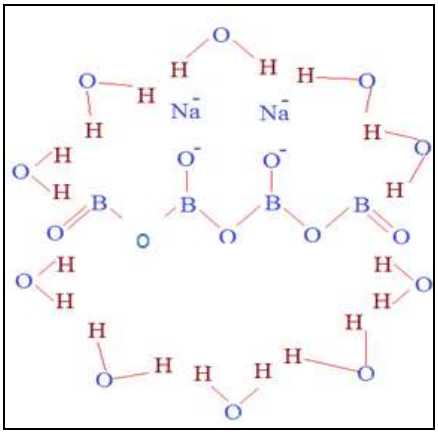
Boric acid



Boron oxide



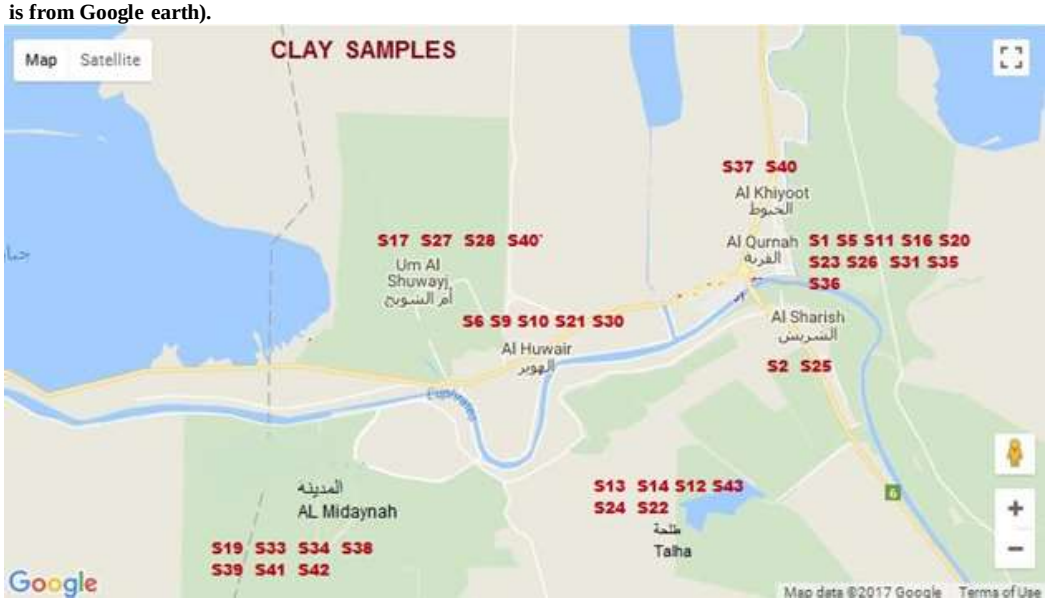
Anhydrous borax



Sodium tetraborate hydrat

Elemental boron is insoluble in water [12]. Borax (decahydrate) does not have a boiling point. Borax decomposes at 75°C, and loses $5H_2O$ at 100°C, $9H_2O$ 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

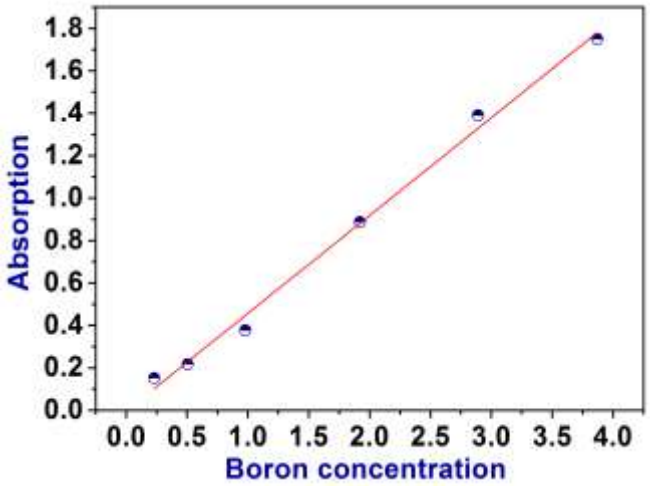
In Basra governorate, the samples from 43 stations and locations were collected during April 2014.The measurements of Boron concentration soil samples were carried out by using AAS method[13]: Atomic Absorption Spectrometry (AAS) is a technique for measuring quantities of chemical elements present in environmental samples by measuring the absorbed radiation by the chemical element of interest. This is done by reading the spectra produced when the sample is excited by radiation. The atoms absorb ultraviolet or visible light and make transitions to higher energy levels. Atomic absorption methods measure the amount of energy in the form of photons of light that are absorbed by the sample. A detector measures the wavelengths of light transmitted by the sample, and compares them to the wavelengths which originally passed through the sample. A signal processor then integrates the changes in wavelength absorbed, which appear in the readout as peaks of energy absorption at discrete wavelengths. The energy required for an electron to leave an atom is known as ionization energy and is specific to each chemical element. When an electron moves from one energy level to another within the atom, a photon is emitted with energy EA toms of an element emit a characteristic spectral line. Every atom has its own distinct pattern of wavelengths at which it will absorb energy, due to the unique

configuration of electrons in its outer shell. This enables the qualitative analysis of a sample. The concentration is calculated based on the Beer-Lambert law. Absorbance is directly proportional to the concentration of the analyte absorbed for the existing set of conditions. The concentration is usually determined from a calibration curve, obtained using standards of known concentration. However, applying the Beer-Lambert law directly in AAS is difficult due to: variations in atomization efficiency from the sample matrix, non-uniformity of concentration and path length of analyte atoms (in graphite furnace AA).

Soil Sampling and Analysis:
Surface soil of 43 samples (0-15cm) 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 2 mm 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 AAS method. For the calibration graph a stock solution of borate was used of which a calibration Solution was prepared by AAS devices at 249nm. A linear calibration was observed, followed by the calculation of the slope factor. The results are experimented in mg B/l. Regression equation Y= - 0.0925 + 0.46726 X: R^2 = 0.9977 Boron concentration was read directly from the standard curve (see figure 2)

Figure 2 Calibration curve for boron concentration in Al-zubair soil (ppm) 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 Table1 which are collected fro m some areas in Basrah Governorate, nortern Iraq. For the measurement of boron concentration level water, table 1 and Fig.4, reflect the fact that, there was some high level of boron concentration in this water higher than the most of public tap and washing surface water in the governorate. The results for these 45 samples categorized into 43 locations, from s1 to s43, shown in Fig. 4. Boron content found maximum 0.0.933 ppm in Alhwair-Khamesa in soils belt and minimum (0.270ppm) was recorded in Al-Qurna-thger belt. Out of the 43 water samples 7. samples recorded higher which are beginning from 0.756-0.884 ppm while the 8 soil samples are beginning from 0.603-0.697 ppm and the 12 soil samples which are beginning from 0.501-0.579 ppm wile the 9 soil samples are beginning from 0.424-0.480 ppm than the prescribed WHO limit (0.5 ppm). 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 [18,20]. 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.

Table 1: Measurements of Boron concentration in soil samples from different areas in north of Basrah Governorate by using AAS

Sequenced location	Name location	Absorption At 249 nm	Boron Concentration (ppm)
S1	Al Qurna - Al Nahairat (1)	0.1470	0.512
S2	Al Qurna - Al Sharash	0.1073	0.4270
S3	Hawair – Sheikiha	0.2335	0.6970
S4	Al-Qurna - the thger	0.0337	0.2700
S5	Al-Huwair – Huwair Al-sada(1)	0.0507	0.3250
S6	Alhwair – Khamesa	0.3439	0.9330
S7	Hawair – Aujan	0.0714	0.3500
S8	Al Huwair - Center (1)	0.1085	0.430
S9	Qurna- Hay Al- Salam	0.2992	0.8380
S10	Tallha – AL-rahmanya	0.0820	0.3730
S11	Tallha- Ahmed bin ali	0.0486	0.3010
S12	Tallha – Bahlah	0.1893	0.6030
S13	Al Hawair - Company Street	0.0891	0.388
S14	Qurnah – Humayun	0.2942	0.8270
S15	AL-Huwair – AL-Ardainea	0.1165	0.4470
S16	Tallha – altumar	0.1487	0.516
S17	AL-Midena - Albadran	0.1297	0.4750
S18	Qurna – Nasir	0.1203	0.4550
S19	Al Huwair - River of Ezz	0.2612	0.7560
S20	Tallha – abo guraib	0.1556	0.530
S21	Al Qurna - Center (2)	0.1057	0.4240
S22	Tallha-Alneayem	0.1431	0.5040
S23	Qurna – Shaheen	0.1527	0.524
S24	Al Qurna - Al Nahairat (2)	0.2644	0.763
S25	Alhwair – Al-Mhayit	0.1260	0.4670
S26	Hawair - Oil Street	0.1318	0.4800
S27	Al Huwair - Center (2)	0.1469	0.5120
S28	Alhwair - Haj al-Dakhil	0.3037	0.8470
S29	Al Qurna - Mazra'a (1)	0.1775	0.577
S30	Al Qurna - Center (1)	0.2026	0.6310
S31	AL-Midaynaa -Hiader	0.2017	0.6290
S32	AL-Midena – Fethiya	0.1435	0.505
S33	Al Qurna - Maziraa (3)	0.2778	0.792
S34	Al Qurna - Maziraa (2)	0.1586	0.537
S35	Hawair – AL-kutae	0.1726	0.567
S36	AL-Midena – AL-haj Hamdy	0.1783	0.579
S37	AL-Midena - AL-wohayyed	0.1418	0.501
S38	Alhwair - Al Bayeb	0.1169	0.448
S39	– Market AL-Midena	0.1933	0.611
S40	AL-midayna – AL-sudan	0.2221	0.673
S41	Alhwair - Al-Samayd	0.2081	0.643
S42	Hawair – Triangle	0.2075	0.624
S43	Talha – Center	0.3209	0.884

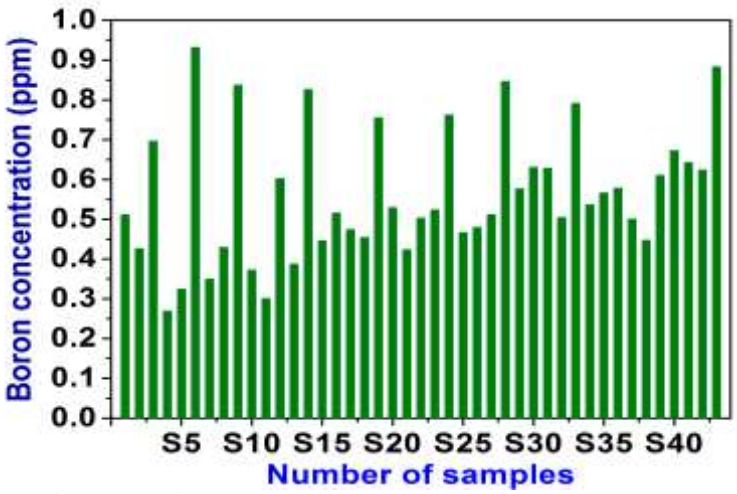


Figure 4: Distribution of the results of the boron concentration in north of basrah governorate soil analysis by AAS

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 qualit y 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

[1] WHO. World Health Organization. Environmental Health Criteria 204: Boron. Geneva, Switzerland: World Health Organization (as cited in U.S. EPA, 2004). 1998.

[2] Woods W.G. , Environ. Health Perspect.**,** , Vol.710, 1994, 25.

[3] W.G., Woods, Environ Health Perspective, 102, Supplement Vol.7, 1994, 5-11.

[4] P. Argust, Biological Trace Element Research, Vol.66 (1-3), 1998**,**131-143.

[5] D.S. Kostick, Mineral Yearbook: Boron, United States Geological Survey, 2006.

[6] S. Goldberg, D.L. Suarez, P.J. Shouse, Soil Science, Vol.173 (6), 2008, 368-374.

[7] W.L. Lindsay, In: J. J. Mortvedt, et al., (Eds), Micronutrients in Agriculture, 2nd Edition, (Soil Science Society of America, Madison, Wisconsin, USA, **1991**), 89-144.

[8] WHO,Guidelines for Drinking Water Quality.3rd Ed.,World Health Organisation. Geneva.2004.

[9] R.J. Weir, R.S. Fisher, Toxicol and Pharmacol, Vol.25, 1972, 251-256.

[10] D. Diaconu, V. Nastase, M.M. Nanau, O. Nechifor, E. Nechifor, J. Preventive Medicine,Vol.16(1-2), 2008,77-84.

[11] Chemfinder. com. 2006. Database and Internet Searching. Available online at http://chemfinder.cambridgesoft.com/

[12] O. Neil, M. J. Smith, P.E.Heclelman.The Merck Index. An Encyclopedia of Chemicals,Drugs and Biologicals.13thedition. Merck & Co.Inc.,Whitehouse Station, NJ,2001,pp 1326 .

[13] Boumans, P.W.J.M. Inductively coupled plasma-emission spectroscopy-Part 1. John Wiley & Sons. New York. 584 pp.

[14] World Health Organization. Guidelines for drinking water quality. Boron, World Health Organization. 2003 .

[15] Vadivel S., Manickam A., Ponnusamy S. Advances in Applied Science Research,3 , 2012, 219

[16] Council of the European Union Council Directive 98/83/EC, November3, 1998 on the quality of water intended for human consumption. 1998**.**

[17] S. Neelesh, D. D. Mishra, P. K. Mishra, Advances in Applied Science Research,Vol.3 2012,335

[18] New Zealand Ministry of Health Drinking-Water Standards for New Zealand 2000. Wellington Ministry of Health. 2000**.**

[19] R.H. S. Abdul, A. A. Master, Advances in Applied Science Research,Vol. 3, 2012, 563.

[20] Thaer M Salman, Alaa Y AL-Ahmad, Hussain A Badran and Chassib A Emshary, Physica Scripta 90 (2015) 085302 (8pp)