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The Estimated of Boron Concentration in Water Samples of the north of Basrah Governorates Using AAS Techniques

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***Abstract*— Significant risks for human health may results from exposure to non pathogenic toxic contaminants that are often globally ubiquitous in waters from which drinking water is derived to measure the Boron, 105B concentration in water samples in Basra governorate in north of Iraq. The measurements were performed by analyzing the water samples collected from 55 location using AAS Technique. The Boron concentrations which are obtained ranged from 0.1185 ppm in Alhwair - Al-Samayd to 1.539 ppm in Hawair- Harde river in water samples. The results are presented and compared with other studies. The results could be utilized to make distinctive supplementary contributions when contam- ination event occurs and to implement water quality standards by concerned authorities to maintain radioactive contamination-free drinking water supplies for the people. The study further reveals that 55 surface water samples have boron below detection limit. The presence of boron in drinking water sources in this territory is of natural origin. Thus, there is possibility of severe pollution problem with boron in near future.**

***Index Terms*— 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. 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]. In aqueous solution at pH < 7, it occurs mainly as un-dissociated boric acid (H_3BO_3) but at higher pH boric acid accepts hydroxyl ions from water thus forming a tetrahedral borate anion [7]. 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 [8]. Boric acid, borates and per borates can introduced to environment as these have been used in mild antiseptics, cosmetics, pharmaceuticals [9]. 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 [10-11]. 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. Elemental boron is insoluble in water [12,13]. 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 [14].

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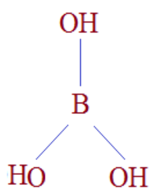
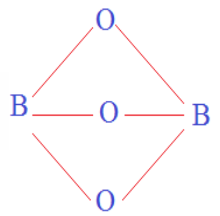
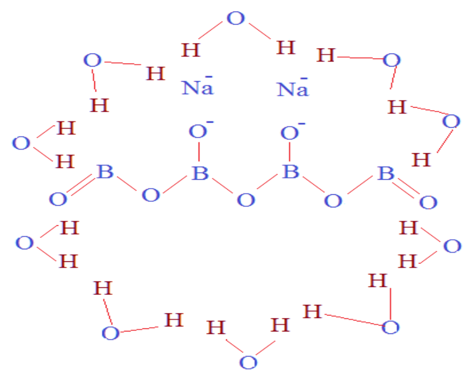


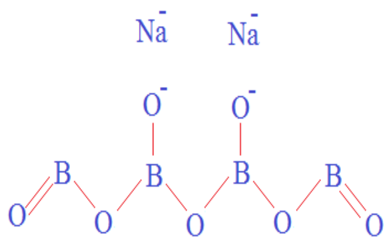
Boric acid



Boron oxide



Sodium tetraborate decahydrate



Anhydrous borax

Fig. 1. Chemical Structures of some boron compounds [12]

This work represents the preliminary findings from Boron concentration measurement data which were collected from different regions in north Basrah city. The general aim is to investigate the complex interactions and exchanges with the flow of water, and estimate how much hazards brought with waters. In fact, the study area is located inside Basra Governorate which is located in the extreme northern part of Iraq, see Fig.2.

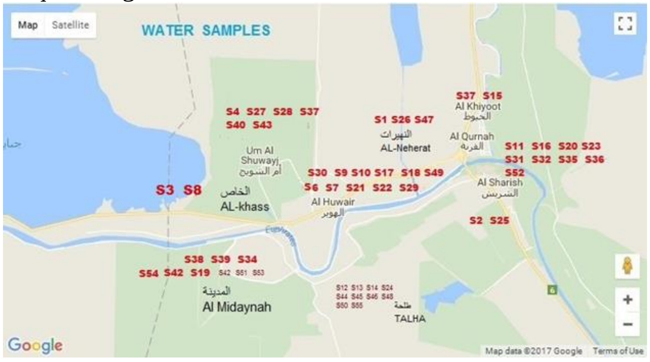


Fig. 2. Basra Governorate, dots represent the places where samples taken from, numbering in station numbers, Basrah map is from Google earth.

The measurements of Boron concentration water samples were carried out by using AAS method 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 Atoms 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).

II. MATERIALS AND METHODS

In Basra governorate, the Samples from 55 stations and locations were collected January 2017. The measurements of Boron concentration in water were carried out by active metheod; we used the Atomic Absorption Spectrometry (AAS) for the measurements of Boron concentration in water samples.

B. Calibration Curve for water sample

The samples of water 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 249 nm. A linear calibration was observed, followed by the calculation of the slope factor. The results are experimented in mg /l. Regression equation Y= 0.000102852 + 0.475059 , R^2 = 1.00 Boron concentration was read directly from the standard curve (see figure 3).

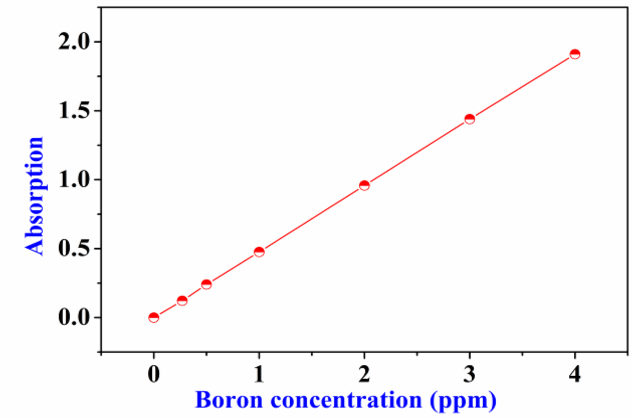


Fig. 3. Absorption vis Boron concentration (ppm) for standard Boron samples.

III. RESULTS AND CONCLUSION

The results for Boron concentration in water samples determined in the present study are presented in Table 1 are collected from some areas in north of Basrah Governorate.

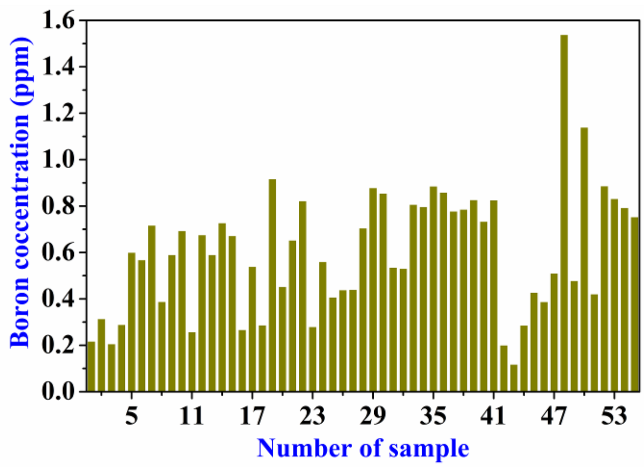


Fig.4. Boron concentrations in water sample as a function of location number.

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 55 samples categorized into 55 locations, from S1 to S55, shown in Fig. 4. Boron content found maximum (1.539 ppm in Hawair - Harde belt and minimum (0.1185 ppm) was recorded in Alhwair - Al-Samayd belt. Out of the 55 water samples 10 samples was recorded higher which are beginning from 0.80870 to 0.8870 ppm while the 9 water samples are beginning from 0 .7054 to 0.7977 ppm and 4 samples are beginning from(0.6006 to 0.6941) ppm wile the 8 samples which were from (0.53110 to 0.5906) ppm and 7 samples are beginning from 0.4078 to 0.4789) 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 [15,17].The European Union established a value of 1.0 mg/L for boron in 1998 for the quality of water intended for human consumption [18,19]. New Zealand has established a drinking water standard for boron of 1.4 mg/L [20,21]. The interim maximum acceptable concentration (IMAC) for boron in Canada is 5 mg/L. The Canadians have established this value on the basis of practical treatment technology. They believe available technologies are inadequate to reduce boron concentrations to less than 5mg/L. They will review this IMAC periodically as new data becomes available [22,23]

Table 1. Boron Concentration in the water samples of the north of Basrah Governorate using AAS method.

Sequenced location	location Name	Absorption	Boron Concentration (mg/l)
S1	Al Qurna - Al Nahairat (1)	0.1035	0.2178
S2	Al Qurna - Al Sharash	0.1495	0.3146
S3	Hawair – Sheikha	0.0983	0.2067
S4	Al-Huwair - Al-Saddah	0.1377	0.2898
S5	Al-Qurna – AL- thger	0.2854	0.6006
S6	Al-Huwair – Huwair Al-sada(1)	0.2702	0.5687
S7	Al Hawair - Al Aweeja	0.341	0.7177
S8	Alhwair – Khamesa	0.1847	0.3887
S9	Hawair – Aujan	0.2806	0.5905
S10	Al Huwair - Center (1)	0.3298	0.6941
S11	Qurna - Hay -AL- Salam	0.1228	0.2583
S12	Al-Huwair – Huwair Al-sada(2)	0.3213	0.6761
S13	Al-Hawair - Al-Alwa	0.2806	0.5906
S14	Al Huwair - River of Ezz (4)	0.346	0.7281
S15	Al Hawair - Company Street	0.3195	0.6724
S16	Qurnah – Humayun	0.1272	0.2676
S17	AL-Huwair – AL-Ardainea	0.2565	0.5398
S18	Al Huwair - River of Ezz (5)	0.1368	0.2878
S19	AL-Midena - Al Sura (2)	0.436	0.9176
S20	Qurna – Nasir	0.2155	0.4534
S21	Al Huwair - River of Ezz (1)	0.3104	0.6532
S22	Al Huwair - River of Ezz (2)	0.3909	0.8227
S23	Al Qurna - Center (2)	0.1333	0.2805
S24	Al Huwair - River of Ezz (3)	0.2664	0.5607
S25	Qurna – Shaheen	0.1938	0.4078
S26	Al Qurna - Al Nahairat (2)	0.2087	0.4392
S27	Alhwair – Al-Mhayit	0.2095	0.4408
S28	Hawair - Oil Street	0.3352	0.7054
S29	Al Huwair - Center (2)	0.4177	0.8791
S30	Alhwair - Haj al-Dakhil	0.4065	0.8555
S31	Al Qurna - Mazra'a (1)	0.2547	0.5361
S32	Al Qurna - Center (1)	0.2525	0.5314
S33	City - Al Sura (1)	0.3835	0.8072
S34	– Fethiy AL-Midena	0.379	0.7977
S35	Al Qurna - Maziraa (3)	0.421	0.8861
S36	Al Qurna - Maziraa (2)	0.4083	0.8594
S37	Hawair – AL-kutae	0.37	0.7787
S38	AL-Midena – AL-Sada	0.3737	0.7864
S39	AL-Midena - Al-Awaji (1)	0.393	0.8272
S40	Alhwair - Al Bayeb	0.349	0.7344
S41	– Market AL-Midena	0.3928	0.8267
S42	- Al-Awaji (2) AL-Midena	0.0957	0.2013
S43	Alhwair - Al-Samayd	0.0563	0.1185
S44	Hawair – Triangle	0.1363	0.2868
S45	Talha – Center	0.2034	0.4281
S46	Talha – Rahmaniyah	0.1846	0.3884
S47	Al Qurna - Al Nahirat (3)	0.2428	0.511
S48	Hawair - Harde	0.7312	1.539
S49	AL- Hawair Asala	0.2276	0.4789
S50	Al-Huwair – AL-Trabia	0.5416	1.14
S51	Asala AL-Midena	0.2004	0.4217
S52	Asala Qurna	0.4214	0.887
S53	- River Saleh AL-Midena	0.3954	0.8322
S54	AMidena - Antar River	0.3771	0.7937
S55	Talha - Ahmed bin Ali	0.3581	0.7537

IV. CONCLUSION

Well water is in many rural localities in rural areas and which were existent in the Basra Governorate Iraq. The analytical results of chemical soils analysis revealed the presence of Boron in the limit of New Zealand 1.4 ppm and IMAC 5 ppm, with a variation between 0.1185 to 1.539ppm.

The values of Boron concentration are small and within the natural limits in most of the sample of the water samples of the rivers. The correlation factor, 99.97%, between the boron concentration of standard samples and the absorption of the samples in water samples of the rivers are very good correlation. Access to safe water of the rivers is essential to human well-being and is a key public health issue.

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