Boron concentration in water samples of Dhi - Qar Governorate (in Iraq) Using Carmine method

Thaer M. Salman, Teghreed A. Shaker

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, $^{10}_{5}B$, concentration in water samples in Dhi-Qar governorate in Iraq. The measurements were performed by analyzing the water samples collected from 45 location using Carmine method.The Boron concentrations which is obtained ranged from 0.25151 ppm in Al-Fhued-al-amaira (1) to 1.05782 ppm in AL-Garma - Center (1) in water samples. 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 water quality standards by concerned authorities to maintain radioactive contamination-free drinking water supplies for the people. The study further reveals that 45 surface water samples have boron below detection limit. The presence of boron in drinking water sources in this territory is of of natural origin. Thus, there is possibility of severe pollution problem with boron in near future.**

Keywords:Boron, Carmine, water samples, Spectrophotometer, Dhi-Qar 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 comm- on 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 [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]. Boric acid is a weak acid with a 9.2 pK_A and exists primarily as the undissociated acid (H_3BO_3) in aqueous solution at physiological pH [2].

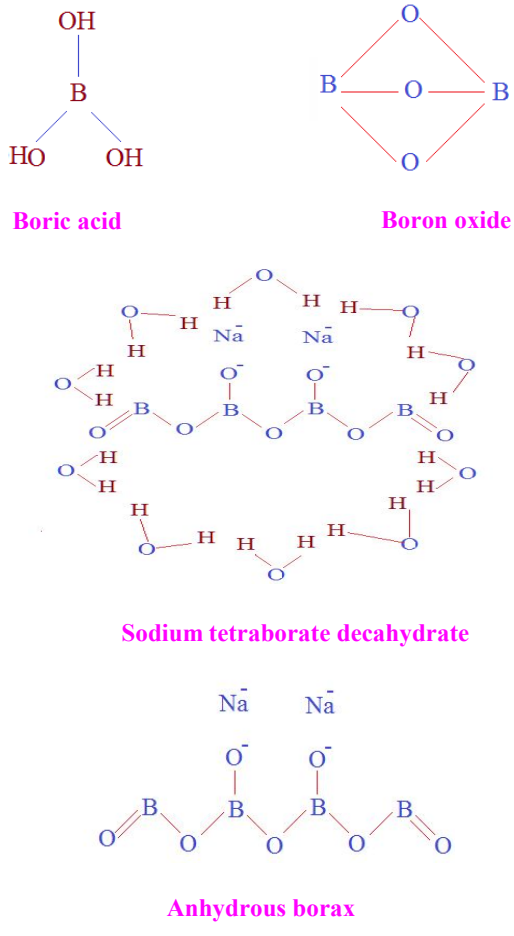

Fig. 1. Chemical Structures of some boron compounds [12]

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(Chemfinder.com, 2006)

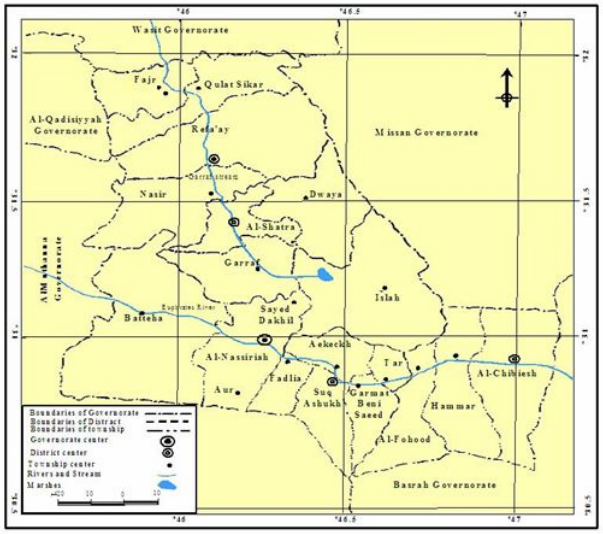

Fig. 2. Administrative units in Dhi-Qar Governorate [15]

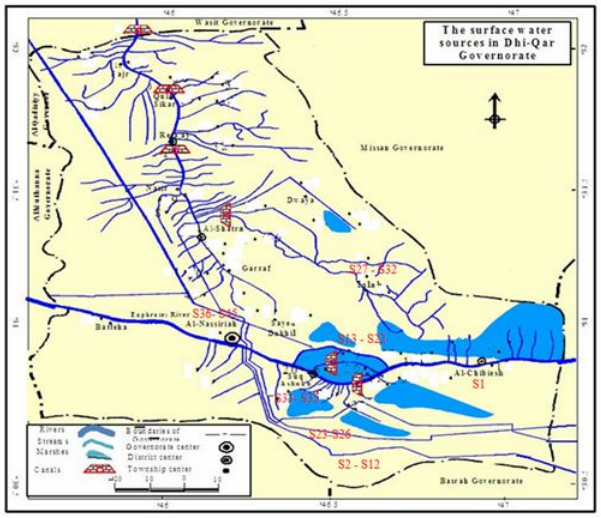

Fig.3. Surface water resources in Dhi-Qar Governorate [16]

This work describes the preliminary findings from Boron concentration measurement data collected from different areas spans across Dhi-Qar Governorate stretching for over (12900) km^2, southern Iraq [16]. The latitude and longitude of Dhi-Qar Governorate are $30^0.33^1$ - 32^1 N $45^0.37^1$ - $47^0.12^1$ E [17]. The area surveyed in the present investigations is shown in Figure 3.

II. MATERIALS AND METHODS

A. Analytical method:

The Boron concentration can be determined by using Carmine method, which involve combina- tion with carmine or carminic acid in sulphuric acid are followed by photometric measurement. The carmine method is optimum for determination of boron level in the range of 1-10 mg/l [18].

B. Boron contend in water

A total of 45 water samples were sampled during August to September, 2014 from area of Dhi-Qar Governorate, Iraq. Boron in water and samples were estimated by spectrophotometrically using carmine method.

Absorbance was recorded at 585 nm in the UV Spectrophotometer (CECIL-CE2021, England). Regression equation: C_1= -0.397 +2.33C_2; divided by,2,the number of,2. is represent the number of milliliter from the water samples. C_1 is the Boron concentration and the C_2 represent the value of absorption; R^2= 94.3% .The Statistical analysis was performed using MINITAB11.

II. 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 Dhi-Qar Governorate, southern Iraq.

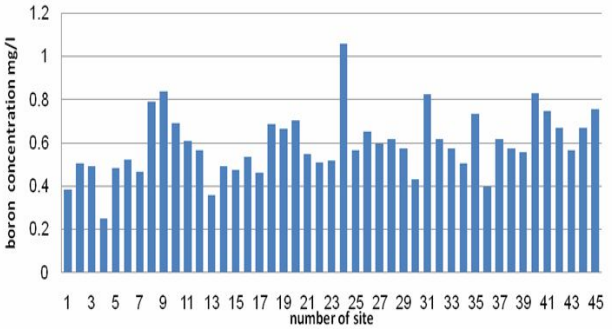

Fig.4 . Boron concentrations in water in Dhi –Qar Governorate, southern Iraq.

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 45 locations, from s1 to s45, shown in Fig. 4. Boron content found maximum (1.05782 ppm) in AL--Garma- center(1) belt and minimum (0.25251ppm) was recorded in AL- Fhued-al-amaira belt. Out of the 45 water samples 8 samples recorded higher which are beginning from 0.70489 to 0.83602 ppm while the 9 water samples are beginning from 0.61003 to 0.68954 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 [19,20].The European Union establishhhed a value of 1.0 mg/L for Boron in 1998 for the quality of water intended for human consumption [21,22]. New Zealand has established a drinking water standard for Boron of 1.4 mg/L [23,24].

Table 1. Values of boron concentration in water samples from different areas of Dhi-Qar Governora

No.	No. of site	Name of site	Absorption At 585 nm	Boron concentration Carmine method) (ppm)
1	S1	Cheapaish	0.234	0.38543
2	S2	-Seed Hanash AL-Fhued	0.319	0.50401
3	S3	AL-Machree(1) AL-Fhued-	0.312	0.49424
4	S4	AL-Amaira(1) -AL-Fhued	0.138	0.25151
5	S5	AL-Machree(2)- AL-Fhued	0.305	0.48448
6	S6	AL-Amaira(2) -AL-Fhued	0.331	0.52075
7	S7	-Hai AL-Asrah AL-Fhued	0.292	0.46634
8	S8	AL- Rwathea AL-Fhued-	0.524	0.78998
9	S9	AL-Amaira(3)- AL-Fhued	0.557	0.83602
10	S10	AL-Amaira(4) - AL-Fhued	0.452	0.68954
11	S11	AL-Fhued - farmer	0.395	0.61003
12	S12	Center - AL-Fhued	0.363	0.56539
13	S13	Center – AL-Tar	0.216	0.36032
14	S14	Bu kaleefa (1)- AL-Tar	0.311	0.49285
15	S15	AL-Jweeber(1) - AL-Tar	0.298	0.47471
16	S16	AIsarah(1) – AL-Tar	0.340	0.53330
17	S17	AL-Asmaelea -AL-Tar	0.288	0.46076
18	S18	AL-Abrat (1) –AL-Tar	0.450	0.68675
19	S19	AL-Jweeber(2) - AL-Tar	0.435	0.66583
20	S20	AL-Abrat (2) –AL-Tar	0.463	0.70489
21	S21	Bu kaleefa (2)- AL-Tar	0.352	0.55004
22	S22	AIsarah(2) – AL-Tar	0.322	0.50819
23	S23	AmmChach - AL-Garma	0.330	0.51935
24	S24	Center(1) -AL-Garma	0.716	1.05782
25	S25	AL-Kubaes -AL-Garma	0.364	0.56678
26	S26	Center(2) -AL-Garma	0.426	0.65327
27	S27	Seed Ushea - AL-Asllh	0.384	0.59468
28	S28	AL-Arethem(1) - AL-Asllh	0.400	0.61700
29	S29	AL-Hssan - AL-Asllh	0.370	0.57515
30	S30	Botuman – AL-Asllh	0.266	0.430070
31	S31	AL-Arethem(2) - AL-Asllh	0.558	0.82625
32	S32	AL-Kwaf – AL-Asllh	0.400	0.61700
33	S33	Akeka – Suk AL-Ashuk	0.368	0.57236
34	S34	AL-Zead -Suk AL-Ashuk	0.319	0.50401
35	S35	Center - Suk AL-Ashuk	0.484	0.73418
36	S36	HaiALfaeda - Nasria	0.243	0.39799
37	S37	AL-Bu-Athem(1)– Nasria	0.399	0.61561
38	S38	Hussainat(1) – Nasria	0.368	0.57236
39	S39	Hai-Ouer -Nasria	0.356	0.55562
40	S40	Hai-AL-Shuda(1) - Nasria	0.553	0.83044
41	S41	Hai-AL-Shuda(2) - Nasria	0.493	0.74674
42	S42	AL Amhana (1) - AL Fthalia – Nasria	0.437	0.66862
43	S43	AL-Bu-Athem(2)– Nasria	0.364	0.56678
44	S44	Hussainat(2) – Nasria	0.436	0.66722
45	S45	AL Amhana (2) - AL Fthalia – Nasria	0.500	0.75650

CONCLUSION

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

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