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MEASUREMENT OF BORON CONCENTRATION IN PARTS OF THE IRAQI MARINE ENVIRONMENT USING ICP-OES TECHNIQUE

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Abstract

This research aims to evaluation the concentration of boron in the samples collected from parts of the Iraqi marine environment starting from Umm Qasr port to the deep oil port within the Arabian Gulf, where the study included 18 samples. Laboratory examination was done by inductively coupled plasma optical emission spectrometry technology. The obtained boron concentrations ranged between 3.3846ppm at The waterway of Khor Al-Zubair 1 and 7.3956ppm at the waterway of Khor Al-Zubair 3 within the Iraqi marine environment. The results can be utilized to provide distinct complementary contributions when a pollution event occurs and to implement water quality standards by the relevant authorities to maintain water samples free of radioactive contamination that people need. The study also revealed that 18 samples of surface water contained more boron than the detection limit.

Keywords: Boron, Marine Environment, ICP-OES.

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1. Introduction

Boron is actually a mixture of two stable isotopes, 10B (19.8%) and 11B (80.2%)[1]. Boron is an element found in water, soil and rocks naturally. High concentrations of this element can be found in the areas rich in boron up to 100 parts per million. As for the boron concentration in the earth's crust, it was estimated at <10 ppm[2]. Boron compounds are used during manufacturing processes, such as glass production, fiberglass, borosilicate glass, agricultural fertilizers and herbicides, flame retardants, soaps, laundry bleach, detergents, and more [3].

Mostly, these compounds are found in natural water and wastewater, where their concentration may reach tens to hundreds of milligrams per 1dm3. [4], and therefore the contents of borate in ground and surface water may increase as a result of wastewater discharge[5].

Depending on the source of drinking water, the concentration of boron varies greatly, but with regard to most of the world, the belief is that the concentration range ranges between 0.1 and 0.3mg /L [4]. As for sea water, the concentration of boron ranges between 0.5 and 9.6. mg/L, Average concentration of this element was found between 4.5 ppm and 4.6mg/L [6-8]. High boron concentrations are a common characteristic of geothermal water sources[3,9,10,11], especially when Total dissolved solids (TDS) is greater than 1 g/L[12]. In different parts of the world, the presence of boron is prohibited Direct use of water as drinking water or for irrigation, and causes chemical pollution and environmental problems for groundwater and surface water [3].

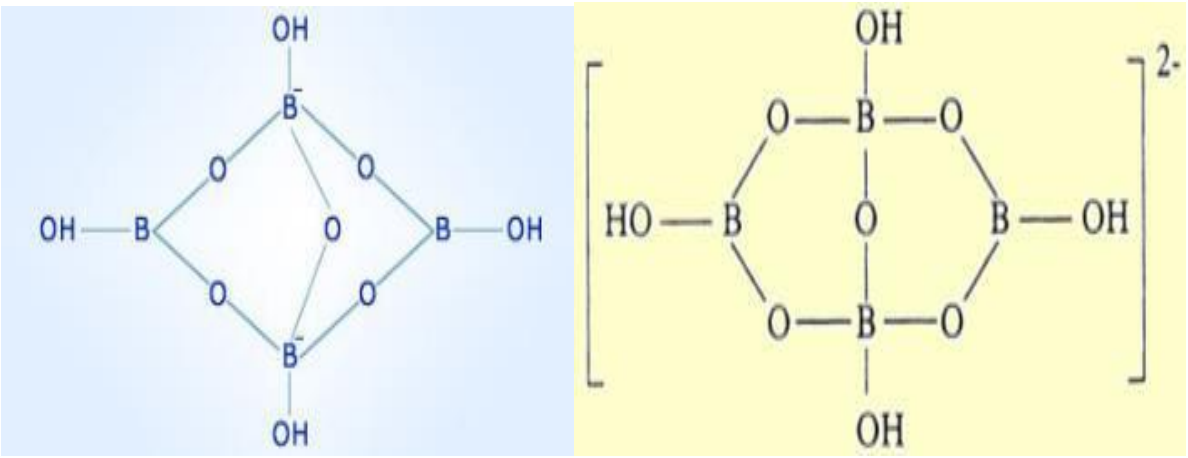

Figure 1. Some boron chemical structure compounds [13]

This research includes the results obtained from the measurements of boron concentration in samples from the Iraqi marine environment. The goal is to estimate the risks that result from high boron ratios for use in future business. The study area is located in the Arabian Gulf in southern Iraq within the Iraqi territorial waters, starting from Umm Qasr Naval Base, which is affiliated with the leadership of the Iraqi Naval Force, near the Iraqi-Kuwaiti border, passing by waters near the port of Umm Qasr, Khour Al-Zubayr and Khor Abdullah, all the way to the port of Faw, as well as the ports of Basra and the deep Oilers.

Figure 2. The area of Al-Faw Port, Khor Abdullah Canal and Khor Al-Zubair Canal from which the studied samples were taken

Materials and Methods

An ICP technique was developed for optical emission spectrometry measurement by Fassel et al. At Iowa State University in the United States and by Greenfield et al. At Albright & Wilson, Ltd. In the United Kingdom in the mid-1960s[15-17].

The measurements were made using inductively coupled plasma - optical emission spectrometry (ICP-OES). ICP-OES is a powerful technology used to identify minerals in a variety of sample arrays. With this technique, liquid samples are injected into the radiofrequency-induced argon plasma using one of a variety of nebulizers or sample introduction techniques. The mist sample reaching the plasma is dried, evaporated, and rapidly activated by shock excitation at high temperature. The atomic emission emitted by the plasma is viewed in either a radial or an axial configuration, collected with a mirror or a lens, and imaged on to the entrance slit of a wavelength selection device. Single-element measurements can be made cost-effectively with a simple monochromatic / photomultiplier tube (PMT) combination, and simultaneous multi-element determinations are performed for up to 70 elements with a combination of a polychrome-ator 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[14].

Results and Discussions

The samples are located in the marine waters of the Iraqi regional waters within the Arabian Gulf in southern Iraq. It was noted through the results that the boron concentrations in seawater are very high compared to the freshwater indicated by other research, but compared to the concentrations of seawater they are within the range. Through the table(1) it is clear that the lowest concentration of boron is 3.3846ppm in the waterway of Khor Al-Zubair 1, while the highest concentration recorded is in the waterway of Khor Al-Zubair 3 Which reaches 7.3956ppm. It was also noted that 5 samples have a concentration of less than 5ppm, ranging from 3.3846ppm to 4.8405ppm, while there are 7 samples with a concentration range between 5.2952ppm and 5.9861ppm. Also, there are 6 samples containing boron concentration ranging between 6.0579ppm and 6.5940ppm, and there are two samples include boron concentration with 7.2720ppm and 7.3956ppm.

The boron standard is established all over the world in drinking water,Irrigation water and wastewater, but the level of boron content varies in different regions. The recommended content of the World Health Organization guidelines in drinking water is 0.5 mg / L In 1998, which is revised to 2.4 mg / L in 2011. However, there are few countries follow it. In fact, the value of 2.4 mg / L is below the human tolerant level, But, it exceeds the required concentration of several types of the crops sensitive to boron. Therefore, many countries still implement their own standards[18]. Table 1 and Figure3 illustrate the boron concentration in the studied samples.

Table 1. Measurments of Boron concentration in water samples from the Iraqi marine environment by using ICP-OES.

No of site	Location of samples	Concentration of boron
S1	Umm Qasr	6.4766
S2	Buoy 31	6.4054
S3	Buoy29	5.9861
S4	Buoy27	5.7974
S5	Buoy25	5.5934
S6	Deep oil port	6.3828
S7	Basrah Oil Port1	5.2952
S8	Basrah Oil Port 2	5.7651
S9	Basrah Oil Port 3	6.1684
S10	The waterway of Khor Al-Zubair 1	3.3846
S11	Near the waterway of Khor Al-Zubair	4.8405
S12	Near berth No. 4 in the Khor Al-Zubair port	4.4682
S13	The waterway of Khor Al-Zubair 2	6.0579
S14	The waterway of Khor Al-Zubair 3	7.3956
S15	Near the port of Umm Qasr	6.5940
S16	Fao naval base 1	4.5327
S17	West Breakwater – FAO 1	5.8973
S18	West Breakwater – FAO 2	7.2720

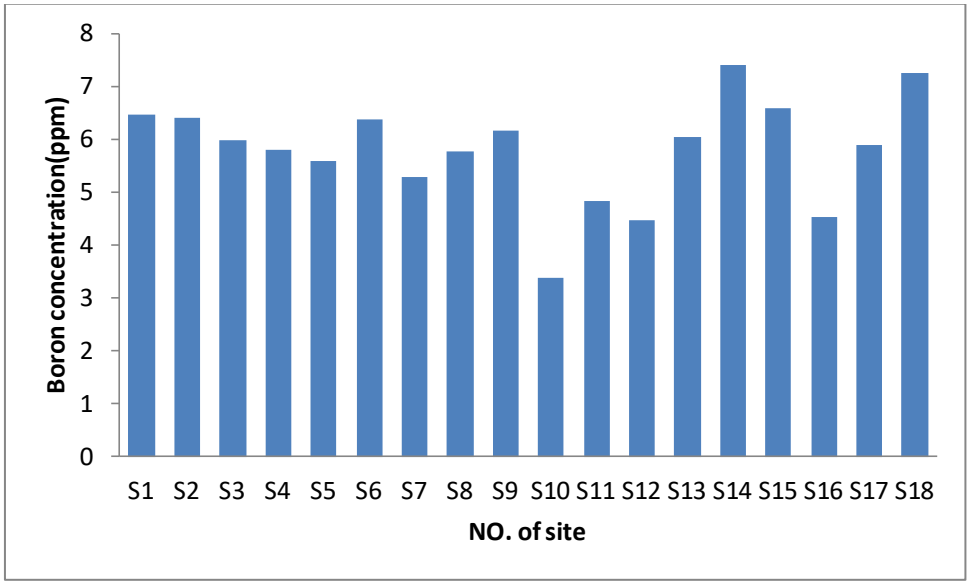

Figure 3. Distribution of the results of the boron concentration in the Iraqi marine environment water analysis by ICP-OES

Conclusion

This study included measuring the concentration of Surface water for parts of the Iraqi marine environment. It is observed from the results that the boron concentrations in the studied marine waters are very high compared to the fresh water, but they are not very high compared to the average concentration of boron in the seas. Therefore, the use of marine waters for any purposes related to human activity may pose a danger to humans. In the event that the competent authorities head to desalinate sea water in the future, desalinated water may still contain high levels of boron, which requires reducing high concentrations of boron to reach less than 0.5ppm.

References

World Health Organization. (1998). Boron Environmental Health Criteria 204. World Health Organization: Geneva, Switzerland.

Woods, W. G. (1994). Environmental health perspectives, 710, 25.

Dill, H. G. (2010). The “chessboard” classification scheme of mineral deposits: Mineralogy and geology from aluminum to zirconium. Earth-Science Reviews, 100(1-4), 1-420.

Öner, Ş. G., Kabay, N., Güler, E., Kitiş, M., & Yüksel, M. (2011). A comparative study for the removal of boron and silica from geothermal water by cross-flow flat sheet reverse osmosis method. Desalination, 283, 10-15.

World Health Organization. (2011), Guidelines for Drinking-water Quality. World Health Organization.

Woods, W. G. (1994). An introduction to boron: history, sources, uses, and chemistry. Environmental health perspectives, 102(suppl 7), 5-11.

Farhat, A., Ahmad, F., & Arafat, H. (2013). Analytical techniques for boron quantification supporting desalination processes: A review. Desalination, 310, 9-17.

Kabay, N., Güler, E., & Bryjak, M. (2010). Boron in seawater and methods for its separation—a review. Desalination, 261(3), 212-217.

Bundschuh, J., Maity, J. P., Nath, B., Baba, A., Gunduz, O., Kulp, T. R., ... & Bhattacharya, P. (2013). Naturally occurring arsenic in terrestrial geothermal systems of western Anatolia, Turkey: potential role in contamination of freshwater resources. Journal of hazardous materials, 262, 951-959.

Tomaszewska, B., & Szczepański, A. (2014). Possibilities for the efficient utilisation of spent geothermal waters. Environmental Science and Pollution Research, 21(19), 11409-11417.

Tomaszewska, B., Pająk, L., & Bodzek, M. (2014). Application of a hybrid UF-RO process to geothermal water desalination. Concentrate disposal and cost analysis. Archives of Environmental Protection, 40(3), 137-151.

Tomaszewska, B., & Bodzek, M. (2013). Desalination of geothermal waters using a hybrid UF-RO process. Part I: Boron removal in pilot-scale tests. Desalination, 319, 99-106.

Altieri, S., Bortolussi, S., Bruschi, P., Chiari, P., Fossati, F., Stella, S., ... & Ferrari, C. (2008). Neutron autoradiography imaging of selective boron uptake in human metastatic tumours. Applied Radiation and Isotopes, 66(12), 1850-1855.

Salman, T.M., & Fleifil, S.S.(2015). The measurements of boron concentration rate in soil samples of Basrah Governorate (in Iraq) using ICP/OES Techniques. International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS),14(2), 157-162.

Charles, B., & Fredeen, K. J. (1997). Concepts, instrumentation and techniques in inductively coupled plasma optical emission spectrometry. Perkin Elmer Corp.

Wendt, R. H., & Fassel, V. A. (1965). Induction-Coupled Plasma Spectrometric Excitation Source. Analytical Chemistry, 37(7), 920-922.

Greenfield, S., I. Ll Jones, and C. T. Berry. "High-pressure plasmas as spectroscopic emission sources." Analyst 89, no. 1064 (1964): 713-720.

Wang, B., Guo, X., & Bai, P. (2014). Removal technology of boron dissolved in aqueous solutions–a review. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 444, 338-344.