

Study the Concentration of Boron the Water Samples South of Maysan Governorate by Using ICP/OES Technique

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ABSTRACT

This project aims to measure the amount of boron (^{10}B) in water samples taken from the rivers and streams of the city of Maysan. It passes through the southern Iraqi province of Maysan. ICP/EPA methods were used to analyse water samples collected from 35 different locations. According to the investigation results, the boron concentration in the water ranged from 2.13 parts per million from the city of Al-Mashrah (S4) to (0.28 parts per million) in the city of Al-Azair. (S27). The results are compared to those reached by previous research. The results can be used to support the relevant authorities in implementing water quality regulations and to give special attention in the event of contamination, enabling them to monitor radiation-free water samples that people need. The study results showed that, apart from a few samples that may indicate potential future contamination threatening both people and the environment, most samples from the study sites exhibited very low concentrations.

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INTRODUCTION

Group IIIA of the periodic table contains the nonmetallic element boron, which has an oxidation state of (+3). Its atomic weight is 10.81 and its atomic number is 5. Boron is formed by the combination of two stable isotopes, (^{10}B) (80.2%) and (^{11}B) B (19.8%) (Retardants, 1998). It's a substance found naturally in water, soil, and rocks. It is thought that the earth's crust contains fewer than 10 parts per million of boron, despite the fact that boron-rich regions have high quantities of up to (100) parts per million (Sweaf & Salman, 2019). It is present in mixes containing boric acid, tourmaline, and borax. However, in elemental form as colemanite, kernite, ulexite, or borates, it

does not present on Earth (Algrifi & Salman, 2022a; 2022b; Kostick, 2006; Goldberg & Suarez, 2011). Environmental boron toxicity may result from the use of boric acid and borates in the manufacturing of glass, detergents and soap, flame retardants, and neutron absorbers for nuclear power plants. For many reasons, including not causing cancer in mammals and having less insect resistance than organic pesticides, borates are utilized as fertilizer, herbicide, and insecticide in agriculture (Derun, et al., 2010; Diaconu et al., 2008). In igneous, metamorphic, sedimentary rocks that are resistant to weathering and are not easily absorbed by plants, boron is found as borosilicate. Figure 1 shows the chemical structures of a few boron compounds.

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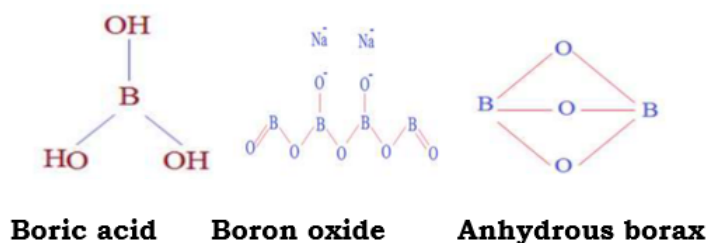


Fig. 1. Chemical Structures of some boron compounds

Very little borate is found naturally in surface and groundwater. Surface water's borate concentration can rise significantly because of wastewater discharges due to the usage of borate compounds in domestic cleaning solutions (Spencer & Erdmann, 1979). The geochemical makeup of the drainage area, its closeness to coastal marine regions, and the quantity of boron introduced by urban and industrial effluents are some of the variables influencing the amount of boron in fresh water. Borax decomposes at (75 °C. At 100°C, it loses 5H₂O and at 150°C, 9 H₂O. At 320°C), it becomes anhydrous. The melting point of anhydrous borax is around 700°C, while its decay temperature is 1575°C (Altieri et al., 2008). The ICP-OES technique determines the boron content by measuring the electromagnetic radiation that excited B atoms release. The wavelengths at which boron is typically detected are (182.52, 249.678, and 249.773 nm). The range of the detection limits is (0.005 to 0.01 mg/L). According to van de Wiel (2003), iron and chromium are the

main sources of interference. An example of a plasma source is an ICP, which uses electromagnetic induction to maintain electrical currents produced in an expelled gas, such as argon gas. Depending on the spray and the spray chamber, the samples are often prepared in the aqueous phase while considering the extraction and purification phases. Afterward, they are put into the device's plasma (Sweaf & Salman, 2019; Kmiecik & Podgórn, 2009; Kmiecik, 2011). The electromagnetic radiation emitted by the atoms and ions that draw energy from the plasma source can be detected using a particular kind of ICP known as ICP-OES. According to Kmiecik et al., (2016), each element can be identified by the wavelength of the light it emits.

In addition to evaluating the dangers associated with water samples, this study intends to explore the complex linkages and reactions with water flow. In actuality, the water samples from the south of the Maysan Governorate, which is in southern Iraq, were used in this investigation. Examine Figure 2.

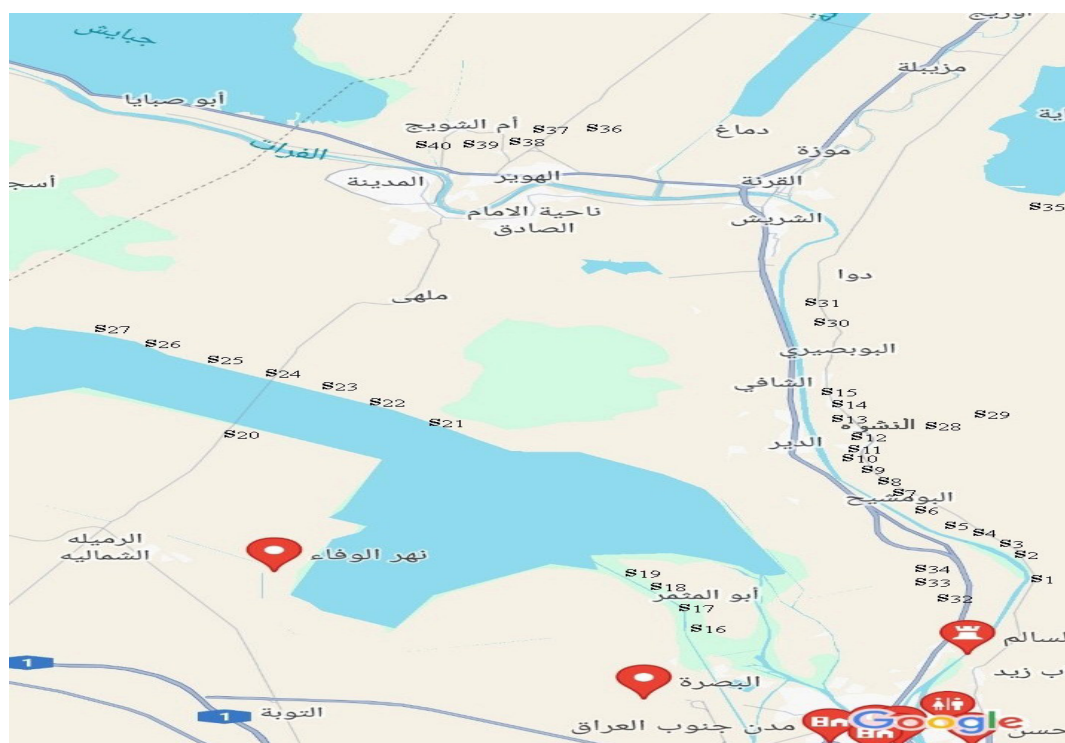


Fig. 2. Part of northern Basra Governorate. The points represent the places from which samples were taken. The numbering is at station No. (S) (Map from Google Earth)

MATERIAL & METHODS

Samples were taken in May 2023 from 35 locations with rivers and streams in certain regions of the southern Maysan Province. After collecting all the 0.25-liter bottles, they were filled with water and sealed firmly to keep out air. The quantity of boron in the water was measured using the ICP/OES method. A potent method for identifying metals in a variety of sample matrices is Inductively Coupled Plasma Optical Emission Spectroscopy, or ICP/OES. This technique involves delivering liquid samples to an argon plasma produced by radio frequencies (RF) via an aerosol device or sample introduction equipment. The ocular fog that enters the plasma is rapidly dried, evaporated, and charged with electricity by shock excitation at high temperature. A lens or mirror is used to catch the axial or radial atomic emission from the plasma, which is

then projected onto the wavelength sensor's entry slit. Individual elements may be measured affordably with a simple monochromator/photomultiplier tube (PMT) combination, and up to 70 elements can be measured concurrently with a polychromator and array detector. In terms of sensitivity and sample processing speed, these analytical systems are on par with most conventional inorganic analysis techniques. River and stream water samples were gathered in plastic bottles for boron detection and glass containers with a 0.25-liter capacity for assessing chemical standards. The calibration graph was plotted using a borate stock solution, and ICP/OES devices generated a calibration scan from this solution at 249.772 nanometers. The slope factor was computed upon observation of the linear calibration. Milligrams per liter is the unit of measurement for the findings.

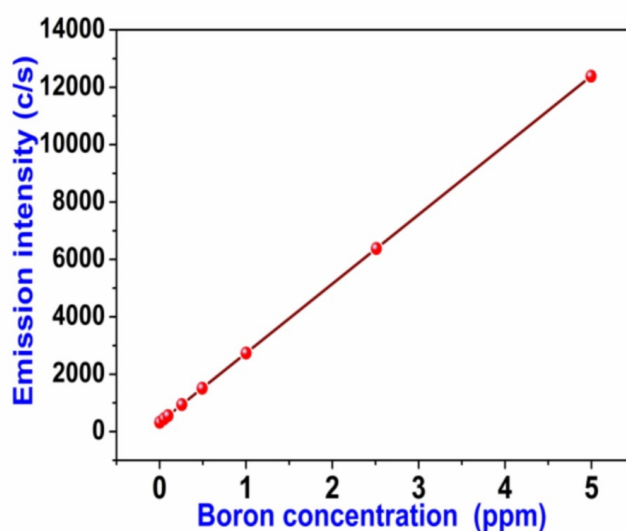


Fig. 2. Calibration curve for concentration of boron (ppm) vs emission intensity (c/s), Regression equation $y = 2414.52x + 323.735$; $R^2 = 0.999995$.

RESULTS & DISCUSSIONS

What makes drinking water unique compared to other forms of water depends on its source. According to (Öner et al., 2011), most individuals around the world believe that the range of boron content is between (0.1 and 0.3 mg/L). The levels of borates in freshwater and seawater vary significantly; freshwater contains an average of (4.5 parts per million and 4.6 mg/L), while its levels in seawater range from (0.5 to 9.6 mg/L). (Ismail & Jaafar 2011; Farhat et al., 2013; Kabay et al., 2010). High concentrations of boron are frequently found in geothermal sources (Dill, 2010; Bundschuh et al., 2013; Tomaszewska & Szczepański, 2014; Tomaszewska et al., 2014). note that this is particularly applicable to TS concentrations exceeding 1 g/L (Tomaszewska et al., 2014). The amount of boron

discovered in water samples collected from several locations in the southern part of Maysan Governorate is shown in Table 1. Table 1 shows that while many of the water samples under investigation were very low, the remaining samples were very high. The list includes the 35 classified sites in Maysan Governorate. These sites extend from the city of Al-Mashrah to the city of Al-Azair. The amount of boron present in the city of Al-Azair is 0.28 parts per million, while in the city of Al-Mashrah it is (2.13 parts per million). Thirty samples with boron values of less than 1 part per million were found. The number increases to (5) samples with values exceeding (1 part per million), ranging from (0.28 to 0.95 parts per million). It is restricted to levels ranging from (1.03 to 2.13 parts per million).

Table 1

Measurements of boron concentration in rivers and streams north of Basra Governorate in southern Iraq. Using CP-OES

No of site	Location of samples (Area name)	Location type of samples (Area type)	Concentration of boron in water by (ppm)
S 1	Al-Mashrah	Agricultural area	0.39
S 2	Al-Mashrah	Agricultural area	0.36
S 3	Al-Mashrah	Agricultural area	0.37
S 4	Al-Mashrah	Water swamp	2.13
S 5	Hilla	Agricultural area	0.39
S 6	Hilla	Agricultural area	0.39
S 7	Hilla	Agricultural area	0.34
S 8	Al-hijama	Agricultural area	0.36
S 9	Al-hijama	Agricultural area	0.49
S 10	Al-khasaf	Agricultural area	1.03
S 11	Halfaya oil field	Oil area	0.47
S 12	Halfaya oil field	Oil area	1.16
S 13	Halfaya oil field	Oil area	0.34
S 14	Halfaya oil field	Oil area	0.94
S 15	Halfaya oil field	Oil area	0.36
S 16	Al-Kahla	Residential and agricultural area	0.37
S 17	Al-Kahla	Residential and agricultural area	2.00
S 18	Al-Kahla	Residential and agricultural area	0.47
S 19	Al-Kahla	Residential and agricultural area	0.42
S 20	Al-Kahla	Residential and agricultural area	0.95
S 21	Qaleat Salih	Residential area	0.31
S 22	Qaleat Salih	Agricultural area	0.35
S 23	Qaleat Salih	Residential area	0.34
S 24	Qaleat Salih	Residential area	0.32
S 25	Qaleat Salih	Residential area	0.47
S 26	Qaleat Salih	Empty area	0.33
S 27	Al-Uzair	Residential area	0.28
S 28	Al-Uzair	Residential area	0.36
S 29	Al-Uzair	Residential area	0.52
S 30	Al-Uzair	Agricultural area	1.30
S 31	Al-Uzair	Residential area	0.33
S 32	Al-Uzair	Residential area	0.32
S 33	Al-Uzair	Agricultural area	0.32
S 34	Al-Uzair	Agricultural area	0.33
S 35	Al-Uzair	Agricultural area	0.32

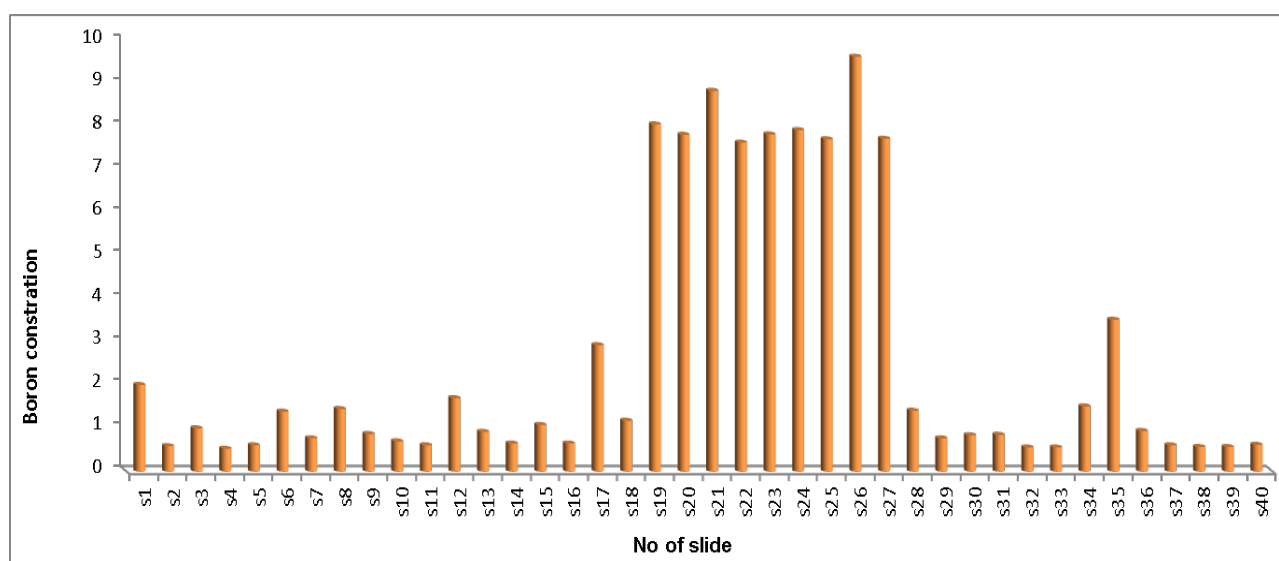


Fig. 4. Boron Concentration in rivers and streams north of Basrah Governorate by using (ICP-OES)

CONCLUSIONS

The study's primary focus was Mesan Province's

southern parts. When utilized for irrigation in cities, garbage from homes, businesses, and agriculture continues to flow from rivers and streams, posing a

threat to the ecology, fishing and crops. The findings of the laboratory analysis carried out on 35 samples of study area water indicate that there may be more boron in some places than the worldwide recommendation, which could have a negative impact on the ecology and public health. High concentrations of contaminants in water need the removal of trash from river basins and

streams or the remediation of pollution sources. To further guarantee that water-received plants are free of high boron concentrations, it is advised that fishing be minimized in areas with high boron concentrations and that boron-focused testing be continued.

Competing Interest

The authors had no competing interests.

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