MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Research Article

Received: 05/12/2021 **Accepted:** 20/12/2021 **Published:** 01/03/2022

ESTIMATION THE CONCENTRATION OF BORON IN THE WATERS OF PARTS OF IRAQI MARINE ENVIRONMENT USING SSNTDS(CR-39)TECHNIQUE

Ali F.HABEEB [1]
University of Basrah, Iraq

Thaer M.SALMAN
University of Basrah, Iraq

Abstract

The aim of work is knowing the concentration of boron in the different sites from some parts of the arabian Gulf starting from Khor Al-Zubair and port of Umm Qasr down to deep oil port, where this study included 20 samples. Laboratory examination has been performed using SSNTDs technology. The obtained boron concentrations ranged between 2.319 mg/L near buoy 25 and 6.747 mg/L near buoy 31within the marine environment of Iraq. In order to highlight the distinct complementary contributions in the event of pollution and in order to implement the standards related to quality, maintaining the non-pollution of the target water samples is the goal and the need to be able to be used by people. This work reveals that 20 water samples have boron more than detection limit.

Keywords: Boron, marine environment, SSNTDs.

http://dx.doi.org/10.47832/2717-8234.10.11

[1] alialbasri1269@gmail.com, https://orcid.org/0000-0002-7034-9051

Introduction

SSNTDs is one of the various materials important for investigations in basic science and technology [1]. SSNTDs is widely used in environmental radiation monitoring and radiation protection. More than forty years ago their theory was developed, that the basic principles can be found in Somogyi and in more details [2,3]. More information for the detection of alpha particles, which from BNCT's point of view is important information [4]. Therefore, here we refer to only some aspects of interest. In general, the ionized particle is thought to cause a damaged region in the plastic, the diameter of this region ranging from 10 nm to 100 nm. This area is visible after the chemical etching process, so that the particles move in the material of detector. Where we can say that the optical microscope is used in order to see the damages formed on the detector. Based on the etching process and the method of observation it can be said that the basic requirements are of two types are the range and energy deposition of the particle must be sufficient. Boron does not belong to the metals and is located in Group (IIIA) on the periodic table, and its oxidation state is (+3). The atomic number of Boron is (5), and its atomic weight is (10.81). There are two stable isotopes of boron are ^{11}B make up a ratio (80.2%) and ^{10}B make up a ratio (19.8%) [5]. Boron is an element that is naturally present in soil, rocks and water. Boron is found in the crust of earth, where the concentration of boron was estimated to be less than 10 ppm , whereas, in boron-rich regions, boron concentrations can be found as high as (100 ppm) [6]. Boron-10 is used in the application because of the nuclear properties of boron, one of these properties is that the boron element does not radiate and is readily available. The cross section of absorption gives the probability of a neutron being absorbed by this stable isotope through the ^{10}B (n,α) ^{7}Li capture reaction (^{10}BNC reaction). Its value is a function of the impinging neutron energy. The energetic fragments emitted in the (^{10}BNC- reaction) produce a high value of Linear Energy Transfer (LET) or (dE/dx), that is a measure of the number of ionizations per unit distance as they traverse the absorbing material. They are very suitable because their combined path lengths are short, where local damage is beneficial. There was a goal to obtain high concentrations of boron-10 isotope, and for that, innovative industrial processes were carried out in order to modify the natural isotopic structure of boron.

Materials and Methods

In the marine environment in southern Iraq, twenty samples were taken from twenty different stations. Passive methods were used to measure the concentration of boron in water. We used SSNTDs technique to measure the concentration of boron in water. The CR-39 detectors were cut into square pieces 1.5 x 1.5 centimeters. Several samples were provided from different locations. A few drops of the sample are placed on the detectors, and then left to dry. Samples are placed around the neutron source for a period of seven days. Through the ^{10}B (n, α) ^{7}Li nuclear reaction, alpha particles with an energy of 2.3MeV are emitted, which can cause tracks in the detector.

Irrdiation of the water samples

After the water droplets were dried on the CR-39 detectors, they were placed around a paraffin wax at five centimeters away from the source of neutrons which is (Am-Be), where the flux of thermal neutron is (5×10^{3} n.cm^{-2} s^{-1}) . This is illustrated by Figure (1) [7].

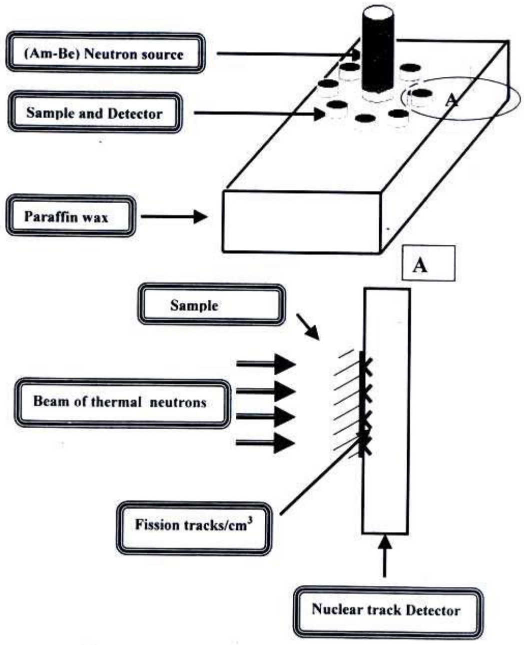

Figure (1) Shows the sample and irradiation of detector in front of neutrons source

Etching and microscopic scanning

After irradiation for seven days, [7], detectors are ejected from the front of the neutron source, then etched into a solution of (NaOH) 6.25 N (Normality) at 70°C , the detectors remain for six hours, which is the normal duration of eaching [8] . An optical microscope with magnification (400X) was used to calculate the tracks that were recorded in the irradiated detectors. The density of the tracks is calculated using optical microscope as well as a appropriate calibration curve is used for calculating the boron concentration.

Calibration Curve for samples

The concentration of boron in samples was found by a calibration curve of track density of alpha particle (ρ_s) formed on the standard samples detectors as a function of the concentration of boron derived from stander solutions . It is observed that the calibration is linear, as shown in figure (2) the Regression equation: y =352.71X + 2767.67and R^2 =0.9735

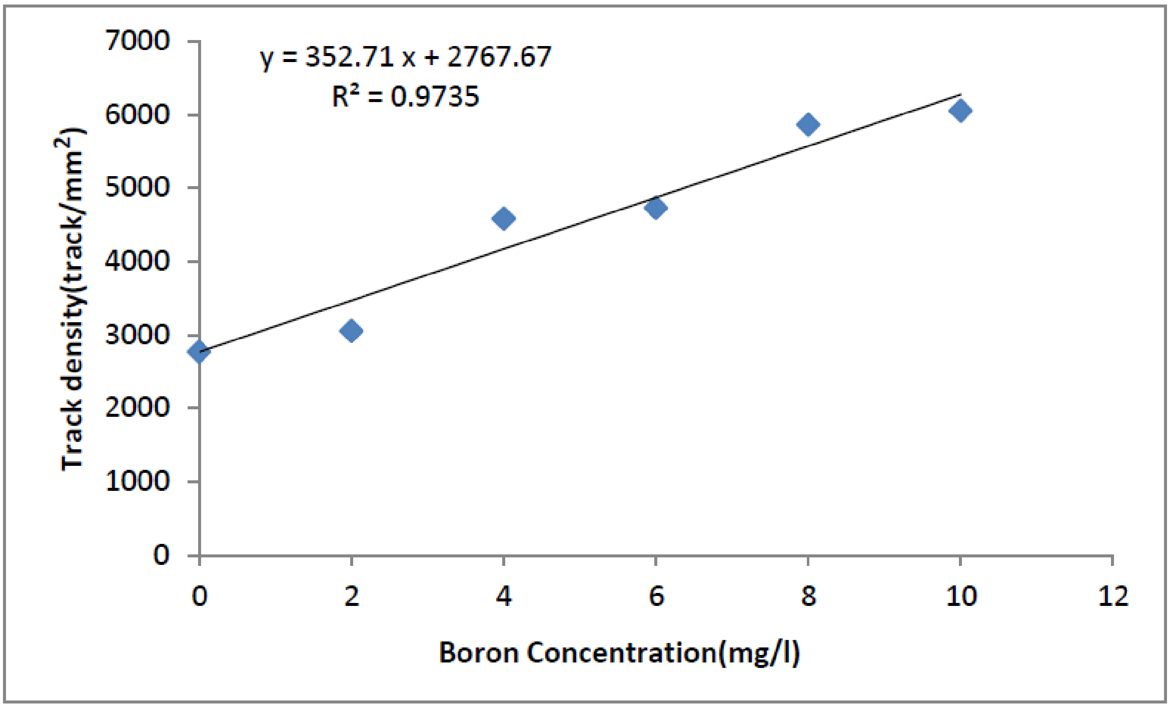

Figure (2) shows the relation between the concentration of boron and track density

Results and Discussion

Twenty samples were collected from the waters of a number of sites within the marine environment of Iraq, including the Khor Al-Zubayr Commercial Minar and Umm Qasr Commercial Port, as well as the Iraqi oil ports, Al-Faw Port and Khor Abdullah Canal. The results indicated that the lowest concentration of boron in samples was recorded near buoy 25, which amounted to 2.319 mg/L, while the highest concentration was near buoy 31, where it was 6.747 mg/L. Through table (1) and Figure (3), it can be observed the concentrations of boron that were calculated in the samples taken from parts of Arabian Gulf.

Table (1): Concentrations of boron in water samples in parts of the marine environment in Iraq using (SSNTDs)

Numbers of sites	Sites	Density of Tracks (ρ) (tracks/mm^2)	Concentrations of boron (mg/L)
S1	Buoy (31)	5148	6.747
S2	Buoy (29)	4594	5.178
S3	Buoy (27)	4204	4.073
S4	Buoy (2)5	3585	2.319
S5	Umm Qasr	4667	5.385
S6	Basra Oil Port(1)	4365	4.530
S7	(Basra Oil Port 2)	3644	2.461
S8	(Basra Oil Port 4)	4491	4.887
S9	Deep oil port	4925	6.118
S10	Basra Oil Port (3)	4548	5.049
S11	Western breakwater (AL-Faw)	3892	3.190
S12	Near Khor Al Zubair Canal 2	4922	6.107
S13	The Khor Al Zubair Canal 1	3845	3.056
S14	The Khor Al Zubair Canal 5	4541	5.028
S15	Near berth 4 in the Khor Al Zubair port	4417	4.676
S16	The Khor Al Zubair Canal 6	4417	4.782
S17	The Khor Al Zubair Canal 3	4610	5.220
S18	Al-Faw Naval Base	3832	3.020
S19	near the port of Umm Qasr	5007	6.349
S20	The western breakwater of the port of Faw near the navigation hatch	4322	4.409
Average		4398	4.629

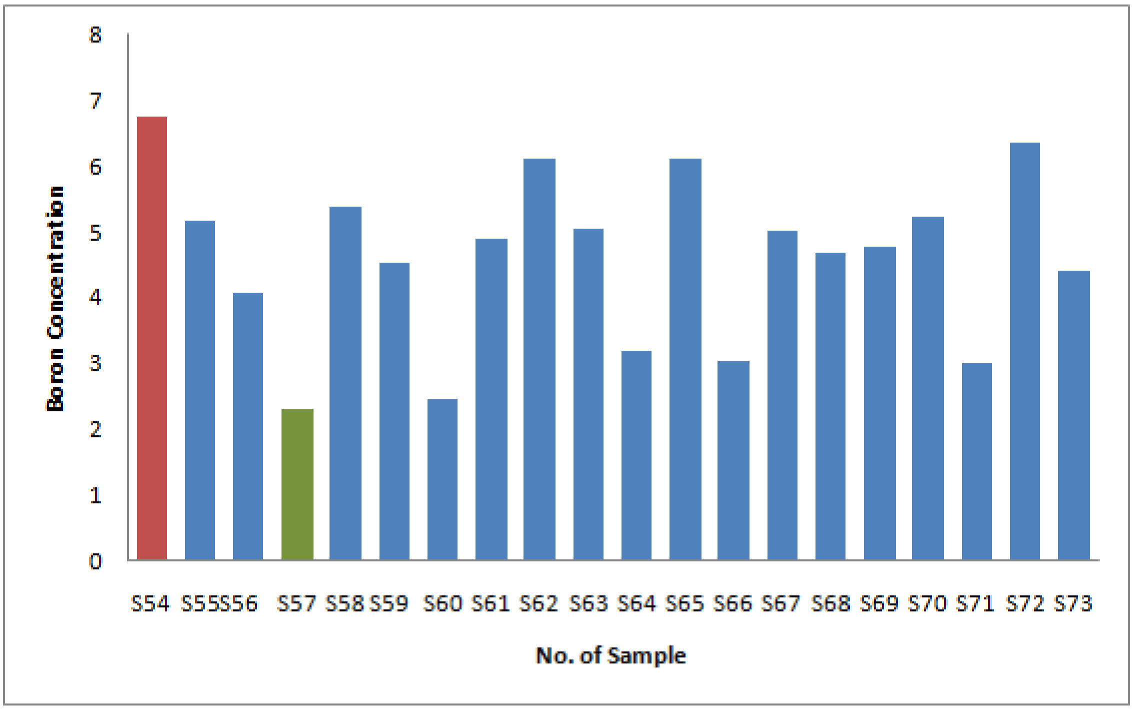

Figure (3): concentrations of boron in water samples in parts of the marine environment in Iraq using (SSNTDs)

Conclusion

This research included measuring the concentration of boron for samples of surface water within parts of the territorial waters of Iraq. And the results indicated that although the boron concentrations of samples taken in the marine environment of Iraq are not very high if compared with the average boron concentration in the seas, the boron concentration is much higher than in fresh water. Based on that, it may pose a danger to humans if sea water is used for any purposes related to human activity. And if there is a desire by the concerned authorities to desalinate marine water in the future, those waters that are desalinated may still contain high concentrations of boron, which indicates the need to reduce those concentrations to reach less than 0.5ppm.

References

[1] Salman, T.M. and Qasim, M.A., (2013). The measurements of boron concentration rate in water using curcumin method and SSNTDs Techniques. *Advances in Applied Science Research*, *4*(1), pp.105-112.
[2] Somogyi, G. and Szalay, S.A., (1973). Track-diameter kinetics in dielectric track detectors. *Nuclear Instruments and Methods*, *109*(2), pp.211-232.
[3] Durrani, S.A., Bull, R.K.,(1987). *Solid State Nuclear Track Detection: Principles, Methods and Applications*. Pergamon Press Oxford, pp 284.
[4] Nikezic, D. and Yu, K.N., 2003. Calculations of track parameters and plots of track openings and wall profiles in CR39 detector. *Radiation Measurements*, *37*(6), pp.595-601.
[5] Salman, T. M. and Habeeb A. F.,(2020), MEASUREMENT OF BORON CONCENTRATION IN PARTS OF THE IRAQI MARINE ENVIRONMENT USING ICP-OES TECHNIQUE, MINAR International Journal of Applied Sciences and Technology, Vol.3,pp. 15-20.
[6] Fleifil, S. S., and Salman, T. M.(2016). Estimation of Boron Concentration in Soil Samples in Al-Zubair, Abu-khasib and Al-mdiana districts of Basrah governorates using SSNTDs Techniques. Pelagia Research Library, 7(4): pp.42-46.
[7] Fleifi, S. S., & Salman, T. M.(2016). The measurements of boron concentration in water samples of the rivers in Basrah Governorates using SSNTDs techniques. *Measurements*,*53*,29-34.
[8] Singh, S., Malhotra, R., Kumar, J. B., Singh, Singh, ,L.(2001)"Radiation Measurement", 34427-431.