# Measurement of Boron Concentration in Water by Using Track Technique

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### Received 4/1/2005, Accepted 3/4/2005

#### Abstract:

A technical method has been used to measure the Boron concentration in water by detecting the  $\alpha$  - track density in CN-85 plastic detector. Samples of water are taken from different regions of Basrah city and the results obtained showed that the Boron concentration is approximately larger than 3 PPM and less equal 6 PPM in different places of Basrah city. The high concentration is found in Fao region. That tell us that pollutant in this part of city is larger than the other parts.

# Introduction :

Solid state nuclear track detector with excellent resolution and high sensitivity has been applied to  $experiment^{[1-2]}$  in neutron personal dosimetery without any radiators such as fissionable material<sup>[3-5]</sup>.

In neutron dosimetery the counting of the direct tracks is simple and preferable because the use of fissionable material is unnecessary. The measurements of the direct track is more difficult than that of fission fragments produced by neutron. This difficulty is due to the fact that, the track has been created at various depth and direction, and their depth in general are comparatively short.

Several facilities have made use of polycarbonate in conjunction with fission foil, such as  $^{237}NP$  and  $^{232}Th^{[6]}$ . However, gamma rays emitted from the fissionable material in the dosimeter will deliver an undesirable dose to the wearer.

Cellulose nitrate foil is also used to detect fast neutrons by recording the recoil Carbon, Nitrogen, and Oxygen atoms as well as alpha particles of  $(n, \alpha)$  reaction<sup>[7]</sup>.

Water is regarded as the medium that spreads pollutant over a wide area due to its movement, especially when large amount of pollutant is dropped in nature as materials of low radiating activity. However, the  $\alpha$  particles emitted from nuclear reaction of  ${}_{5}B^{10}$  with thermal neutrons have sufficient energy to cause chemically etchable damage in an appropriately positioned detector. This is caused by the heavy ionization along their trajectory. Subsequent chemical etching of the detector enlarges the tracks to a size, which is visible with an optical microscope. Boron is an element, which has been extensively, studied using the track technique because the isotope  ${}_{5}B^{10}$  is present in such an abundance that there is less difficulty in pinpointing the nuclear reaction and its large thermal neutron cross section (3838 barn)<sup>[8]</sup> for undergoing a  $(n, \alpha)$  reaction. Due to current motivation in studying and understanding the cause of pollution in Iraq, we are using the  $(n, \alpha)$  reaction to measure the Boron concentration in Basrah water, which is taken from different regions in Basrah city.

# Experimental:

Many samples of water from different places have been supplied. One milliliter of each sample of water is dropped on the same area of the CN-85 track detector, and it is left to dry.

After drying, the samples are exposed to a thermal neutron-source for the same period of time (2 hrs). A nuclear reaction of type  ${}_{5}B^{10}(n,\alpha)$   ${}_{3}Li^{7}$  has been occurred, particles are emitted with energy 2.31 MeV which can make suitable track in CN - 85 plastic detector.

The samples, after being exposed, are washed in distilled water, then etched in a solution of 2.5N (Normality) NaOH at  $60^{\circ}$  temperature, 2 hrs eatching time, by using a bath held at a constant temperature. The track diameters and track density have been carried out using transmission optical microscope and a suitable calibration curve<sup>[8]</sup> is used to calculate the concentration of Boron.

# **Results and Discussion:**

To reach our goal in studying the pollution of Basrah by determining the Boron concentration in Basrah city, we have showed the distribution of these concentrations on the map of Basrah city (see Fig.1.).

The map and Table-1.show the typical relation between the place in Basrah city and the Boron concentration. Thus, we can say that the Boron concentration is higer than the normal distribution (2-3 PPM). Also we observed from the Table-1, the rate of the Boron concentration in some regions are increasing than the other regions because the some pollutant are found such as, the ships and salts deposit in the Arab- gulf, in Fao, and the other regions which the salts are avaliable..

## Table -1- Typical relation between the places in Basrah city

No.	The Name of the Place	Boron Concentration in(PPM)
1	Huwair AL-Aujan	3.5
2	Tigris river AL-Qurna-Muzereh	4.5
3	AL-Zubeir river	4.75
4	AL-Zubeir deep at 3.5 m	3.0
5	Khour AL-Zubair No.3	5.75
6	Tigris river AL-Deir AL-Nashwa	4.75
7	Shatt AL-Arab Abu-AL-Khaseeb Mahella	5.75
8	Nehran Aumer Station Al-Deir	5
9	AL-Huueir river	5.75
10	Thermal enrgy station AL-Hurtha	3.5
11	Shatt AL-Arab AL-Tennuma	5.25
12	The Tigris river AL-Qurna	3.6
13	AL-Zubeir deep at 4 m	6.4
14	Tigris river AL-Deir AL-Zwein	4.75
15	AL-Sorajy river- Abu-ALKhaseeb-Mulleua	4.0
16	Shatt Al-Arab AL-Fao	6.0
17	Jeikurr river Abu-AL-Khseeb	5.75
18	Khur AL-Zubair	5.25
19	Shatt AL-Arab AL- Seeba	6.0
20	Shatt AL-Arab AL- Jibasi	4.0
21	Telha	5.75
22	Mudeina	5.5

## and the Boron concentration.

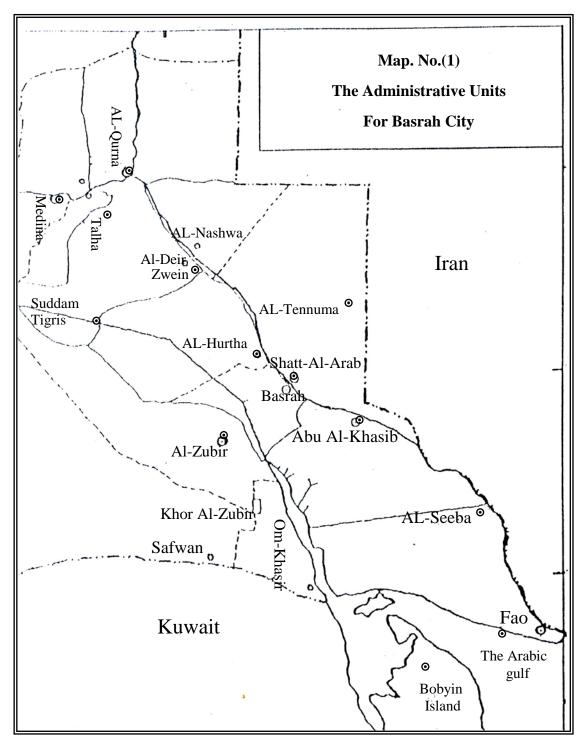


Fig.1. The sample are taken from the places shown on the map of Basrah city.

# **References:**

[1] I.E.Gureshi et. al., Radiation Measurements, 34, 249(2001).

[2] W.ENGE. et. al., Nuclear Instrument and Methods, 127, 125(1975).

[3] M.Narita, et. al. Nareg/cp-0029 Vol.1,Conf. 820321/v1 PP 451-458.

[4] M.Narita, et. al. Japanese Journal of Applied Physics. Vol. 27, No.1, Janury, 124(1988).

[5] T.sawamura, et. al., Journal of Nuclear Science and Technology Vol.18, No.10, 766 (1981).

[6] K.Amgarou, et. al., Radiation Measurement ,34 139 (2001).

[7] T.Sawamura et. al., Japanese Journal of Applied Physics, Vol. 22, No.8 1328(1993).

[8] R.K.Pitrus, and S.A.Amin, Journal of Radio Analytical and Nuclear Chemistry, Articles, Vol.120, No.1., 125(1988).

# Acknowledgments:

We thank Mr. Abdul Rahman Jari Marwan of Dep. of Geography, College of Education for supplying the maps and Manuscripts.

قياس تركيز البورون في المياه باستخدام تقنية عد الأثر ثائر منشد سلمان , طالب عبد النبي سلمان<sup>1</sup> و شاكر إبراهيم عيسى فزلطة ويَد , تَي بطهة نظي , جَدلع بطها شناب عض أ. فزلطة ويد , تَي بطه على , جَدلع بطها شنب

### الخلاصة

استخدمت تقنية عد آثار جسيمات ألفا في كاشف نترات السليلوز CN-85 لقياس تركيز البورون في المياه في مدينة البصرة. تم أخذ عينات من المياه من مناطق مختلفة في مدينة البصرة وبعد دراستها أظهرت النتائج أن تركيز البورون اكثر من S PPM وان اكبر تركيز وجد في قضاء الفاو (PPM 6) وهذا يظهر أن الفاو اكثر تلوثا بالبورون من المناطق الأخرى.