Study and calculation the concentration of radon gas in Tarmia city, North Baghdad

Muamar Abdu Alaziz Kamil

Department of Physics, College of Education, University of Tikrit , Tikrit , Iraq

(**Received:** 20 / 4/ 2009 ---- **Accepted:** 27 / 10 / 2010)

Abstract:

In This work the radon Concentration has been measured in Tarmia city in room of buildings by using The (CN-85) Track detector. The bulk etch. rate (V_B), The Track etch. rate (V_T), etching efficiency (µ)and Sensitivity were determined at a temperature of ($60/^oc$) using (2,2.5,3) normality of NaOH as a track etching. The Second part of work is the radon and radon daughters' measurements in indoor of buildings Using (CN-85) detector also. The obtained result are illustrate in Table -2- it was Found that radon concentration is (103.99) Bq/m^3.

Introduction:

Radon: -

Radon is a naturally occurring radioactive gas found in varying amounts in all soils and rocks. It is accepted that long term exposure to radon can cause lung cancer and there is growing evidence that the risk from radon is considerably greater for those who smoke than for those who do not smoke [1].

Radon – ages:-

Radon is in able gas. It acts like ages in doors and in the ground. The gas is difficult to lock in or out and therefore it exists nearly everywhere in more or less measurable concentrations.

Radon gas cannot be smelt by a human being and is invisible, it is soluble in water to some extent a

least in the sense that it can be transported by water from on place to another the characteristics of noble gas's means that radon is difficult to find in chemical compound and consequently is more difficult to detect[2]. Radon daughters:-

Radon gas emanates from the crystalline structure of minerals into the pores and fracture networks of rocks. It migrates through the strata by a combination of diffusion and pressure gradient towards mine openings. Radioactive decay produces the solid particulates of the radon daughters, namely Half-life Polonium, Po218 or radium A, RaA 3.05 min Lead, Pb214 or radium B, RaB 26.8 min Bismuth, Bi214 or radium C, RaC19.7 min Polonium, Po214 or radium C', RaC' 164 µs lead, Pb210 or radium D, RaD 22 years.

As the half-life of RaD is 22 years, we need concern ourselves only with the radon series down to RaC'. Furthermore, RaC' has the extremely short half-life of 164 microseconds. Hence, the effect of its decay is normally coupled with that of RaC.The solid particulates of radon daughters that form during migration of the gas through strata are likely to plate on to the mineral surfaces and be retained within the rock. However, the remaining radon will continue to decay after it has been emitted into a mine opening. The radon daughters will then adhere to aerosol particles or remain as free ions within the air stream [3].

Radon – a cancer risk:-

The radiation from radon and its daughters produces a risk of lung cancer by inhalation of air with high radon and radon daughters' concentrations over a long period of time. The time Scale for cancer is about 25 years at a radon daughter (RnD) activity of 400 Bqm^{-3}.This activity corresponds to about (2×10^8) radon daughter atoms per m^3 of air. This number is tremendously small in comparison with 2.5×10^{25}, which is the approximate number of air molecules in 1 $m^3$of air at normal pressure and room Temperature.

The activity 400 $Bq/m^3$of RnD in doors is adopted as a level of health risk in Sweden. It is estimated that about 40.000 houses (2.5%) have RnD – activities exceeding this level. There is discussion as to what percentage of lung cancer cases are caused by radon or by smoking [4]. It is difficult to calculate the risk of lung cancer from radon [5].

The Source of indoor Radon:-

Radon is a radioactive gas. It comes from the natural decay of uranium that is found in nearly all soils. It typically moves up through the ground to the air above and into your home through cracks and other holes in the foundation [6]. Building materials are a second radon Source. Sometimes the mate rid is crushed and used as a filling between two storage. The emanation of radon gas from The light weight concrete is a effected by meteorological factors like Temperate changes, humidity and pressure drops .The other radon source is the ground earth the house the Soil or bed rock then must contain amounts of uranium [7].

The radon gas is transported into the building by diffusion and Streaming. The gas may pass into the building during the water and power supply cables. For house without crawl space. The cracks in the concrete may cause a leakage into the house [8].

Experimental details:-

Among the Various methods chemical etching is the most useful and reliable method to develop radiation damage tracks. The equipments needed to perform the chemical etching come is from extremely primitive to very advanced depending on the purpose and requirement of the particular experiment[9]. To develop and count the tracks of particle in CN-85 track detector. Al detector was etched in NaOH solution for different normality (2, 2.5, 3) according to the equation (1).

$W = N \times V \times Weq$ ………………(1)

Where: -

W = weight of NaOH

V = Volume of distilled water

Weq=weight equivalent for NaOH and equal to 40. By placing the CN-85 track detector into the NaOH solution to start etching when the time is over, take out the detectors from the solution and then dip it into water to wash off the remained NaOH, after drying in air the detector is ready to scan under optical microscope[10].

Radon measurements and calculations:-

The measurements of the radon concentration in Tarmia city by using (1×2cm) sheets of CN-85 were hang on some suitable place in room (indoor). The bulk etch rat (Vb) is determined by measuring the weight of each Samples before and after etching for (3hr) and Using equation (2) .

$V_{b=}$ [1/2Aρ] × Δd/Δt…………… (2)

Where: -

Vb: - bulk etch rate.

A: - area of the detector.

ρ :- density (no. of track / mm^2).

Δd/Δt:-Slope between diameter and etching time.

The exposure time for the CN – 85 detectors was two months in winter, after removing the CN – 85 detectors were etched in (2 N) NaOH at 60/^{o}c for (120 min). The tracks measured by optical microscope [11].

$V_t = (V_b)\ [1+ (V_D/2V_b)^2/(1-(V_D/2V_b)^2)]$……..(3)

$V= V_t/V_b$

$Eff=1-(V_b/V_t)$

Where:-

V_t: - Track etch Rate.

V: - Sensitivity.

V_D: - slope.

Eff: - Etching Efficiency. As shown in table (1).

Table (1) represent the Sensitivity, Track etch Rate and Bulk etches Rate with different normality

V	V_t(μm/hr)	V_b (μm/hr)	Normality	Eff
1.25	3.2	2.5	2	0.2
1.06	3.2	3	2.5	0.06
1.11	4	3.6	3	0.1

Table (2) represents the density and radon concentration in (2N) and permissible dose.

Location	ρ (no . of Tracks /mm^2)	Radon concentration (Bq/m^3)
House -1	72.2	100.27
House -2	134.3	186.5
House -3	62.7	87.08
House -4	77.6	107.7
House -5	61.04	84.7
House -6	59.7	82.9
House -7	60.44	83.9
House -8	71.19	98.87
Permissible dose		from7.4 to 56 [12]

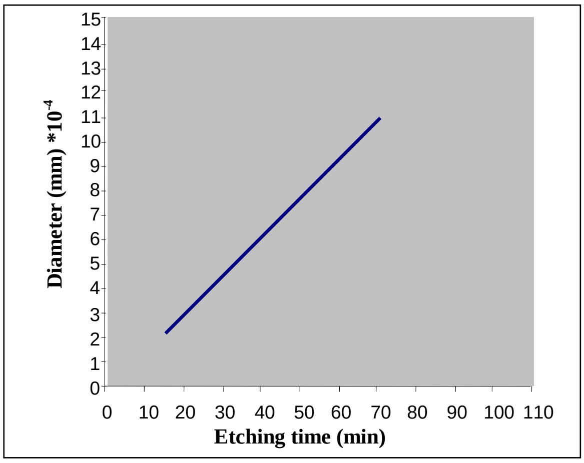

Fig (1) relationship between diameter and etching time for [2] normality

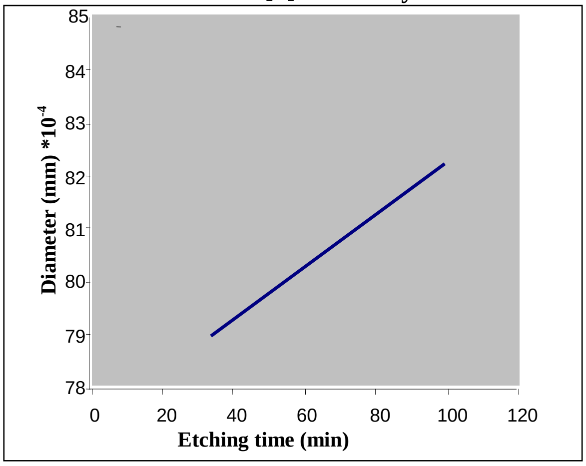

Fig (2) relationship between diameter and etching time for [2.5] normality

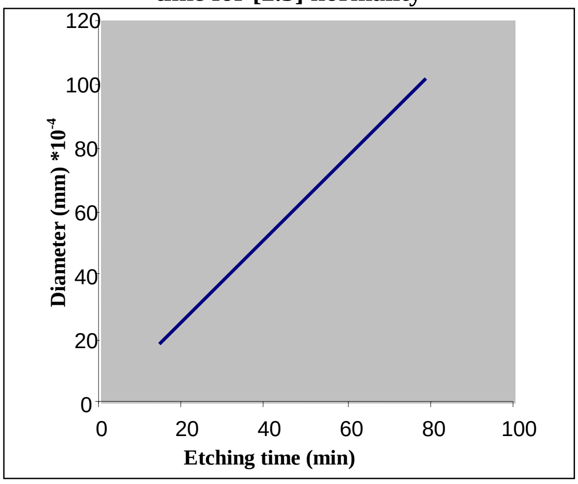

Fig (3) relationship between diameter and etching time for [3] normality

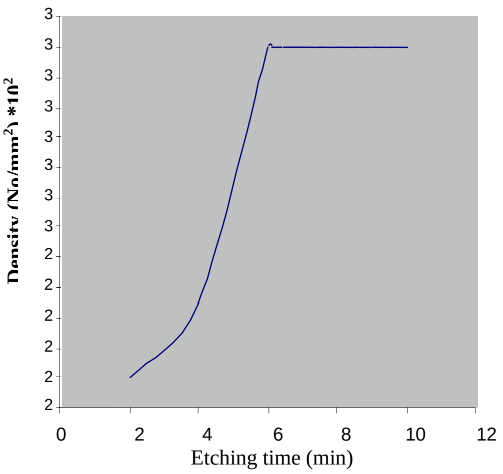

Fig (4) the relation ship between the density and etching time for [2] normality

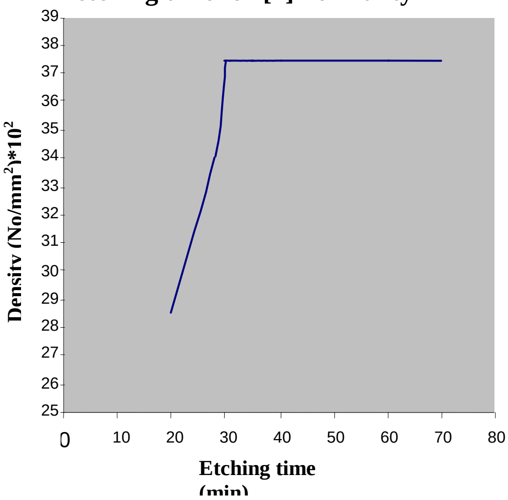

Fig (5) the relationship between the density and etching time for [2.5] normality

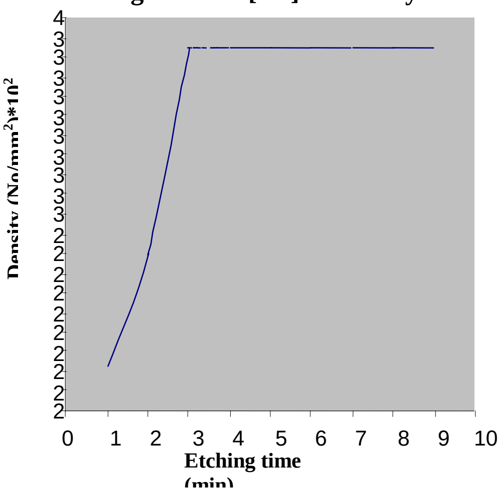

Fig (6) the relationship between the density and etching time for [3] normality

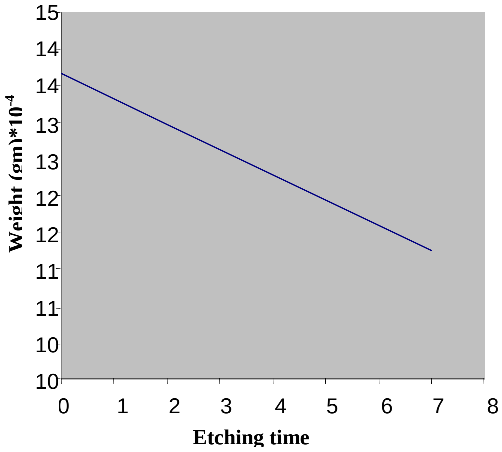

Fig (7) relationship between weight and etching time for [2] normality

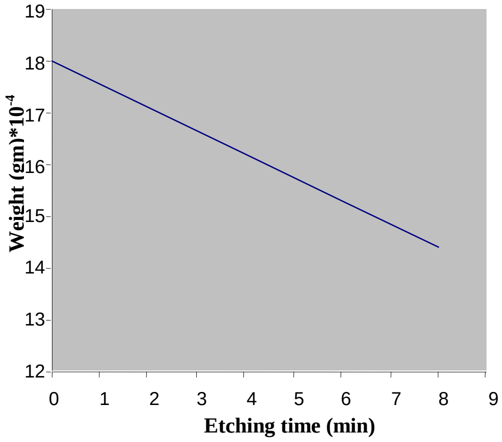

Fig (8) relationship between weight and etching time for [2.5] normality

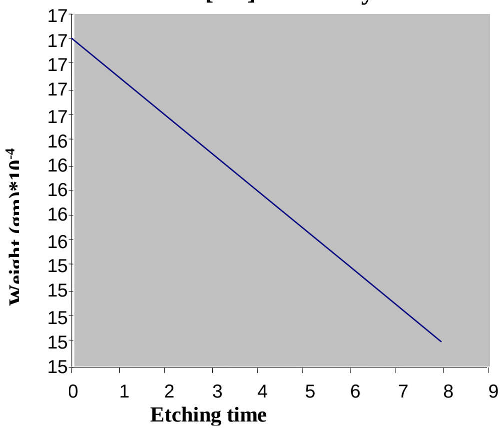

Fig (9) relationship between weight and etching time for [3] normality

Discussion of the result:-

In Fig (1, 2, and 3) show etch – pit diameters according to etching time and distribution on a detector become broader with etching time.

Fig. (4, 5, 6) shows the numbers of countable etch – pits with etching time. The figures show that the tracks increased rapidly with etching time. They will be noted in the course of etching new etch pits continually making their appearance. The etch pits

grow in size with etching time become easily detectable and remain so during a certain period.
In the first stage etching , the tracks penetrating the original surface of CN-85 detector coming into view taking the prolonged etching time the increase in rate become slower in the second stage the tracks existing in the layer removed from surface by bulk etching appeared in succession , the more prolonged etching time . The number of etch – pits saturated because the appearance of etch – pits compensated for disappearance. In the third stage, the surfer got rough due to deep bulk etching. From these observations it was found that the second stages were suitable for etching when (2, 2.5, and 3) normality solution of NaOH was used at 60oc for 80 minutes corresponding to suitable etching time.
Figures (7, 8, and 9) show the weight of the detector as a function of etching time. It shows that increasing etching time will decrease the weight of CN-85 detector because it causes increase of the removal layers of the detector.
Table (2) shows the concentration of radon and radon daughter's in AL Tarmia city in winter. The radon daughter level exceeding (186.5) Bq/m^3 because they use cement in their buildings which contain (Ra-226) decay (Rn-222) with half-life of (3-8) days emits alpha particle with energy (5.4 Mev), thus detectable quantities of radon can reach from the earth surface because uranium are deposits in the ground. In all other investigations the ground is assumed to be the main radon source, the factors affecting on radon concentration are the habits of the people living in a house with natural ventilation. It is important for the air exchange rate in such house if doors and windows are closed or open.

Conclusion:

Radon concentrations are changeable with different houses depending on the house materials like the cement building, coating wall and natural ventilation.
In many houses the radon concentration are larger than Permissible dose for the same reason above. The radon level should be monitored after the works are completed in order to ensure the success of the measures taken. The building must also be occasionally checked to ensure that the conditions giving rise to the radon have not changed and that the works remain efficient. Where electrical fans are used they must be properly maintained and replaced when necessary.

Reference:

1- Maria Pavia,1 Aida Bianco,1 Claudia Pileggi,1 & Italo F. Angelillo1 Bulletin of the World Health Organization **“Meta-analysis of residential exposure to radon gas and lung cancer ”**VOL.81,P.732-738, 2003.

2-A.Tanner”**Natural Radiation Environment”** Vol.3, No.1, P.55-56, 1980.

3- Jha, G. et al**”** Radon permeability of some membranes**”** Vol.42, N.5, P.723-725, 1982.

4-N J.Sinnave, G.Clemente and reorder M.**” Radiat. Protect. Dose”** Vol.7, P.15, 1984

5-A.James**” Radiat. Prot. Dos”** Vol. 7, P.353, 1984.

6-Bradley J. P. **“In *Treatise on Geochemistry”Vol. 1***, P. 689. (2003)

7- Field RW, Kross BC, Vust LJ. ***“Radon testing behavior in aSamp’zle of individuals with high home radon screening measurements”*** VOL.13, P.441-447, 1993.

8-G.Jonsson,**”Phys.Educ.”**Vol.16, P.102-103, 1981.

9-R.L.Fleischer, P.B.Price and R.M.Walker”***Nuclear Tracks in solids principles and applications*”** university of California, 1975.

10-G.jonsson, Nucl.**”Tracks Radation.Meas.”**Vol. 13, No.1, P.85, 1987.

11-Auvinen A, Makelainen I, Hakama M, et al.***” Indoor radon exposure and risk of lung cancer”*** VOL.88, P.966-72, 1996.

12-R. William Field. et al**." Residential Radon Gas Exposure and Lung Cancer"** Vol.151, N.11, 2000.

دراسة وحساب تركيز غاز الرادون في مدينة الطارمية، شمال بغداد

معمر عبد العزيز كامل

قسم الفيزياء ، كلية التربية ، جامعة تكريت ، تكريت ، العراق

(تاريخ الاستلام: ٢٠ / ٤ / ٢٠٠٩ ---- تاريخ القبول: ٢٧ / ١٠ / ٢٠١٠)

الملخص

في هذا البحث تم قياس تركيز غاز الرادون في منطقة الطارمية (داخل غرف الأبنية) عن طريق كاشف الأثر (CN–85) إن معدل قشط السمك (V_B) ومعدل قشط الأثر (V_T) وكفاءة القشط (μ) والحساسية تم حسابها عند درجة حرارة (60/^{o}c) وباستخدام تراكيز (٣،٢,٥،٢) من محلول (NaOH) كقاشط للأثر .

تم ايضا قياس تركيز غاز الرادون ومثيلات الرادون في مدينة الطارمية باستخدام نفس الكاشف .إن النتيجة التي حصلنا عليها توضح لنا أن تركيز الرادون يساوي (١٠٣,٩٩ Bq /m^3).