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Measurement of radon concentration in some of cosmetics by using Nuclear Track Detector (CR-39)

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Abstract : In this paper, we study the concentration of radon gas in nine cosmetics samples from different origins in Hilla city/ Iraq by using alpha-emitters registrations that emitted from radon gas in CR-39 nuclear track detector. The results obtained shown that the highest average radon gas concentration in cosmetics samples which recorded (17.79 $Bq.m^{-3}$) for (Summer Cake powder) sample, while the less was (0.05 $Bq.m^{-3}$) for (Just Gold powder) sample. From the present work all cosmetics samples were with lowest concentrations of radon gas than the allowed limit from International Commission of Radiation protection (ICRP) agency[1].
Keywords : Radon concentration, CR-39 detector, alpha particles, cosmetics.

Introduction

Many researchers interested in the field of nuclear physics studying. The spectra of background radiation as it acquires an important aspect of environmental protection pollution and control of natural radioactivity and explore the possibility of radioactive materials. Where the background radiation is the basis for the distinction between isotopes existing in nature quantitatively and the outputs of the nuclear reactors that have acquired serious dimensions during the sixties and seventies of this century[2]. The natural radiation can be arranged as cosmic rays or ground and dose rates differ significantly between cosmic rays and the earth due to the dependence on the places where the measurements were conducted as well as the elevation above sea level and concentrations of radioactive isotopes in the ground of the main reasons for this difference[3]**.** Where are exposed all living things to a certain amount of natural radiation in the form of radiation particles in addition to the sun. All living beings suffer from coming from space cosmic rays and also suffer from background radiation natural, especially natural uranium, which contain isotopes of uranium-238 (ratio) 99.29% and uranium - 235 0.71% turns these elements through a series of decay which emits Alpha particles, Beta particles and Gamma rays to reach the lead element of a stable[4]**.** As well as the building materials and some rocks contain small amount of natural isotopes of a series dissolution of uranium, and this isotope is radon (Rn-222) half-life (3.82 d) thoron (Rn-220) half-life (56 sec)[5]. The greatest danger comes from exposure to radon and thoron through the inhalation of these isotopes, which are likely to cause lung cancer. To find concentrations of radon in environmental models, there are several ways to detect this gas[4]**.**

In the present work CR-39 nuclear track detector will be used to determine the levels of radon concentrations of some samples of cosmetics collected from the local markets in Babylon province/Iraq.

Materials and Methods

Nine samples were taken from the cosmetics used by women in the city of Hilla , the weight (0.5) gm of each sample and placed inside a sealed-cup it's length (7cm). The nuclear track detector CR-39 localized on the bottom surface of the sealed-cup cover and left samples with a detector for a month, as shown in Figure (1). After the exposure period, which lasted (30 days), CR-39 detector was etched in 6.25 N of NaOH solution at temperature of (60 ± 1 °C) by thermostat water bath (WATER BATH HH-2) for 5 hour and the calculated density track (ρ) by electron microscope (type ALTABIO-1007) with magnification of (400×) connected with camera 14 mp .

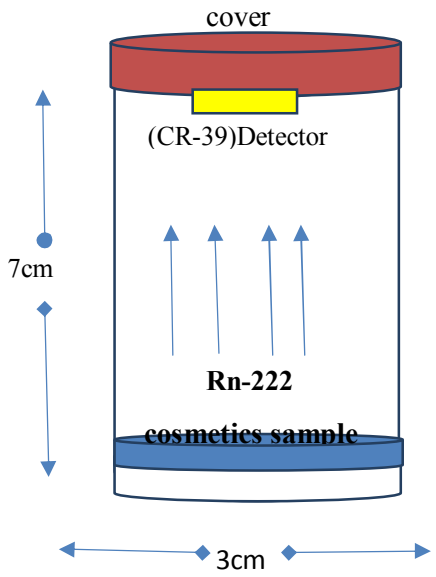

Figure. 1. A schematic diagram of the sealed-cup technique.

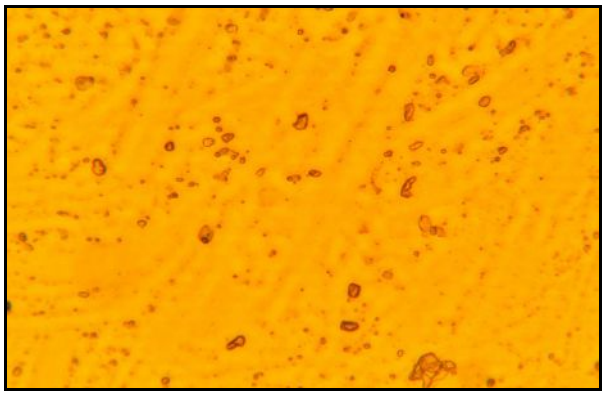

Figure 2. Some effects that have magnified by light microscopy for the sample No.5

For measuring radon concentration it's must determine diffusion constant (k) which varies from system to another depending on the geometry dimensions for sealed-cup technique from this relation[6]:

$$K = \frac{1}{4} r(2\cos\theta - {}^{r}/_{R_\alpha}) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where:

r : The radius of the irradiation tube equal to 1.75 cm

R_α: Extent of alpha particles in the air is equal to 4.15, [6]

θ_c: The critical angle of the detector is equal to 35 .

Then, the diffusion constant (K) is (0.52 Track.cm^{-2}.d^{-1}/Bq.m^{-3})

The tracks density measured by using equation (2)[27]:

$$\text{Track density}(\rho)(\text{track}.\text{cm}^{-2}) = \frac{Average\ number\ of\ total\ tracks}{view\ field\ of\ area} \ldots\ldots\ldots(2)$$

In present work, the Radon concentrations (C_{Rn}) in the air include the sealed-cup determined by the equation (3) [7].

$$C_{air} = \frac{\rho}{k.t} \quad \ldots\ldots\ldots\ldots(3)$$

t= exposure time (days) of distributed detectors

The radon gas concentration in the cosmetics samples were obtained by equation (4)[8]

$$C_s = \frac{\lambda_{Rn} C_a ht}{L} \quad \ldots\ldots\ldots(4)$$

C_a: The radon concentration in air (Bq.m^{-3})
C_s: Radon concentration in the sample (Bq.m^{-3})
λ: Dissociation constant of radon equal to 0.1814 d^{-1}
h: height the air tube equal to 6 cm
L: thickness sample up to 1 cm
t: Irradiation time is equal to 60 days

Results and Discussion

In the present study has been determining the concentrations of radon gas for various models of imported cosmetics. Table 1. Shows the measured concentrations of radon gas in the studied models.

Table (1) the concentration of radon in the cosmetics studied models

No. samples	Name sample	Made	Track density (track·mm^{-2})	Radon concentration C_a (Bq.m^{-3})	Radon concentration C_s (Bq.m^{-3})
1	Tawas Crown powder	Thalland	5.75	0.18	12.03
2	Ever Bilena powder	Iran	6.25	0.2	13.08
3	Just Gold powder	(B.R.C) Dubai	1.75	0.05	3.66
4	Flormar powder	Turkey	4.25	0.136	8.89
5	Summer Cake powder	Philippines	8.5	0.272	17.79
6	Eternity powder	Germany	7.5	0.24	15.69
7	Dali powder	Lebanon	5.5	0.176	11.51
8	Elena	Spain	4.25	0.136	8.89
9	Natural Rose (Saboha) powder	Lebanon	8.25	0.264	17.26

In this work, we study the radon gas concentration in nine samples selected cosmetics from different origins used by women in the province of Babylon by using CR-39 nuclear track detector .

Table 1. shows the measurement results of the concentration of radon (^{222}Rn) in the studied models, the results of this study indicate that there is a variation between the minimum and maximum concentrations of radon gas in each sample. This is due to the difference in the values of the foundation in the manufacture of all the cosmetics that affect the radon concentration. We found that the average ^{222}Rn concentrations in the air was (0.183 Bq.m^{-3}) and the average ^{222}Rn concentrations in the sample (12.12 Bq.m^{-3}). Where the highest value for

radon concentration in air (0.27 $Bq.m^{-3}$) that correspond to the highest value for the radon concentration in the Summer Cake powder sample, which equal (17.79 $Bq.m^{-3}$). While the lowest value of radon concentration in air was (0.05 $Bq.m^{-3}$) and which corresponds to the lowest value for radon concentration in Just Gold powder sample is (3.66 $Bq.m^{-3}$), while the rest of the samples ranging from (0.136 $Bq.m^{-3}$ to 0.264 $Bq.m^{-3}$) as Figures (3) (4).

Conclusion

In conclusion, we found that the radon levels in cosmetics sample are within the internationally acceptable values and there is no health risks. The average equals to (17.79) $Bq.m^{-3}$. The average of reading were lower than the permissible limits recommended by ICRP and EPA[1,9].Computed data indicates that imported cosmetics samples is safe without posing significant radiological threat to women.

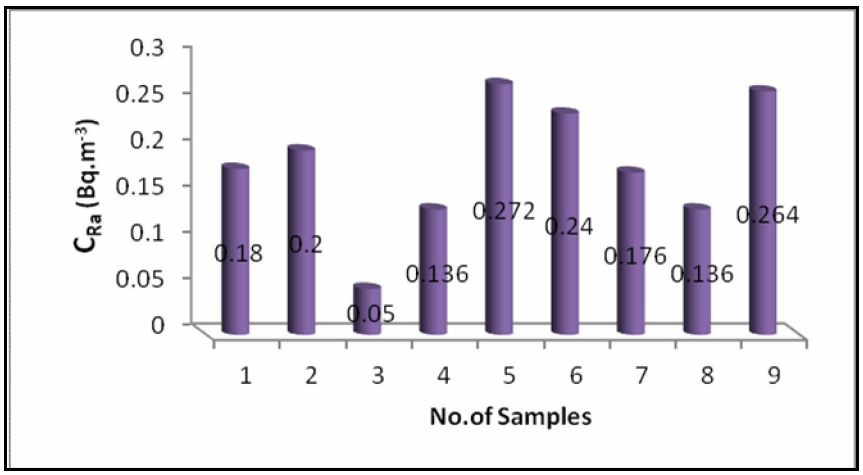

Figure 3. The concentration of radon in air for cosmetics **samples.**

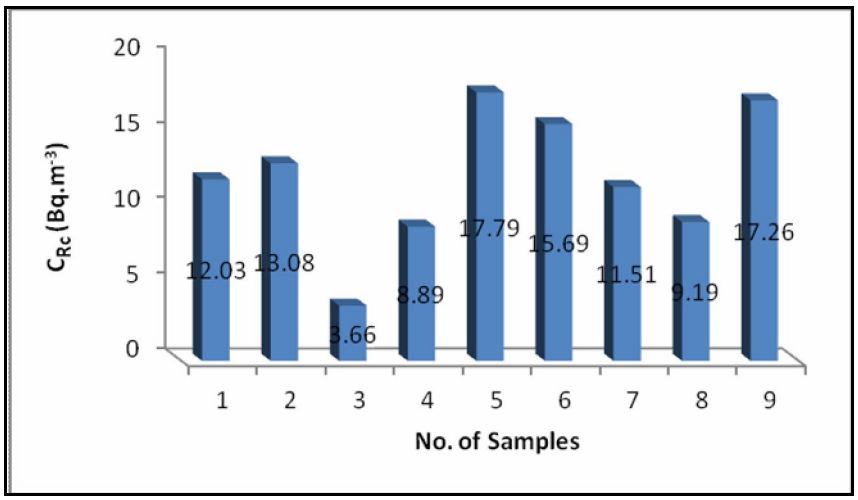

Figure 4. The concentration of radon gas for cosmetics **samples.**

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