

## Uranium Concentration Measurements in Al- Dura Soil of Baghdad Governorate using pm - 355 Detector

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### Abstract

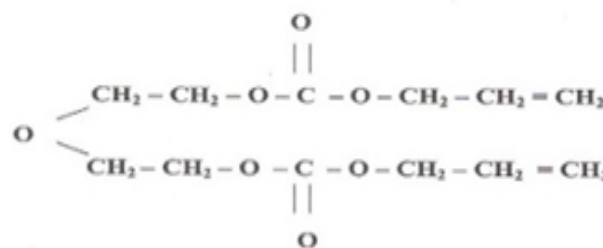
The nuclear track registration technique with pm-355 detector used to determine the uranium concentrations for twenty-eight samples of soil distributed in seven districts for Al-Durra city in Baghdad governorate with depth (5) cm. The uranium concentration in soil samples measured by bombardment uranium with thermal neutron from (<sup>241</sup>Am-Be) source that has flux of ( $5 \times 10^3 \text{ n.cm}^{-1}$ ). The concentration values were calculated and comprised with standard samples. The results showed that the maximum value of uranium was (1.478 ppm) in Al-Gameaea district and the minimum value was (0.676 ppm) in Al-Maelemeen district.

**Keyword:** Uranium concentration, soil, PM-355

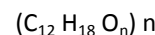
### 1. Introduction

The PM-355 detector (plastic) appeared to be the most excellent one, particularly for the recognition of light ions including protons, deuterons, h, c, and s-ions, this detector was principally used in the plasma experiments and called pollally-diglycol-carbonate detector, its structure shown in figure (1) [1]. Irradiation by ionizing radiation is distinctive for modifying the physical properties for polymers. Radiation induces modification in the chemical, physical and mechanical properties in the polymer material [2]. Molecular chain scission, intermolecular cross-linking, rearrangement of bonding and formation of carbon-rich clusters are some structural deformations in the irradiation polymer that direct to modify in the optical and dielectric properties of the material [3]. It is noticeable that the main physical interaction of radiations with SSNTDs creates particular damage identified as chemical bond scission, free radicals and consecutive cross-linking. Also its one of the SSNTDs which response to alpha particle with high efficiency. It have high homogeneity, isotropy, high optical transparency, density of  $1.129 - 1.31 \text{ gm/cm}^3$  and glass transition temperature (85 c) [4,5]. For numerous polymers, together processes coexist and whichever one may dominate depending not only upon the chemical structures of the polymer, but also upon the circumstances of irradiation [6]. The uranium is a radioactive heavy metal with very high density ( $11.35 \text{ gm/cm}^3$ ). Metallic uranium has high melting point (1132 °C), boiling point ( $4/3$  °C) and has a tensile strength similar to most steels. Natural uranium consists of three

isotopes; <sup>238</sup>U, <sup>235</sup>U, <sup>234</sup>U and their concentrations are (99.27%), (0.78%), (0.005%) respectively [7,8].



Fig(1). The structure of pollalyl- diglycol- carbonate



### 2. Material and Methods

1. Twenty – eight soil samples distributed in seven districts in AL-Durra city were taken from location of study for depth (5) cm. The samples were cleaned, dried in an oven at (70°C) for few hours, then were powdered and sifted by using special sieves (25)µm. in diameter.

2. Each sample was taken with weight (0.5) gm of soil samples powder mixed with (0.1) gm of methyl cellulose powder was used as a binding material. The mixture was pressed into a pellet of (12) mm. diameter and (1.5)mm.thickness using a hydraulic machine. The pellets were covered with PM- 355 detectors, then putting in plate of paraffin wax at a distance of (5)cm, from the neutron source as shown in figure (2).

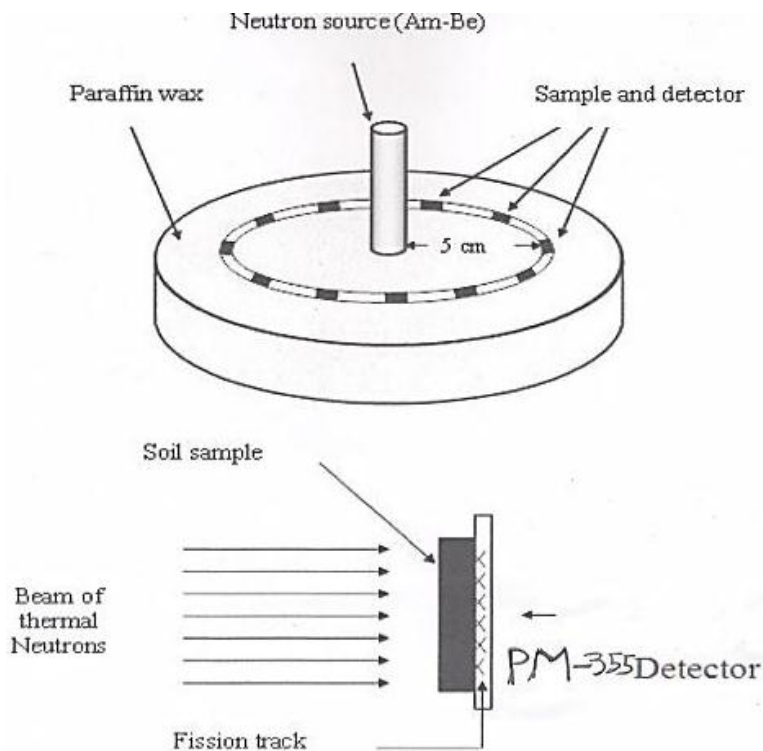


Fig (2) The irradiation of the detectors and samples by the neutron source

3. The chemical reaction of PM- 355 with NaOH solution is  $C_{12}H_{18}O_7 + 4NaOH \rightarrow 2Na_2CO_3 \cdot H_2O + 2C_3H_6O + C_4H_{10}O_3$  [9]. After irradiation for seven days, the pM detectors removed and etched in a ( 6.25 N ) for six hours as shown in figure (3).

the standard geological sample pellets as shown figure (4) , by using the following [10]

$$\frac{Cx(sample)}{fx(sample)} = \frac{Cs(standard)}{fs(standard)}$$

$$Cx = Cs(fx/fs) \text{-----}(2)$$

Where,

- Cx : uranium concentration in unknown sample (ppm).
- Cs: uranium concentration in standard sample (ppm).
- fx ; track density of unknown sample ( track / mm<sup>2</sup>)
- fs: track density of standard sample ( track / mm<sup>2</sup>)

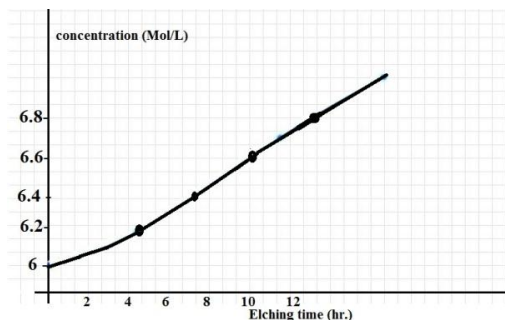


Fig (3)The change of concentration of (NaOH) solution with respect to etching time.

Then the detectors were rinsed with distilled water and dried in air. The density of the fission tracks was calculated according to the following relation:

$$f_x = \frac{N_{av}}{A} \text{-----}(1)$$

- where f: fission track density ( track / mm<sup>2</sup>)
- N: Average number of total tracks
- A: Area of field view

The uranium concentration in the soil samples were measured by comparison track between track densities register on the detectors of the sample pellet and that of

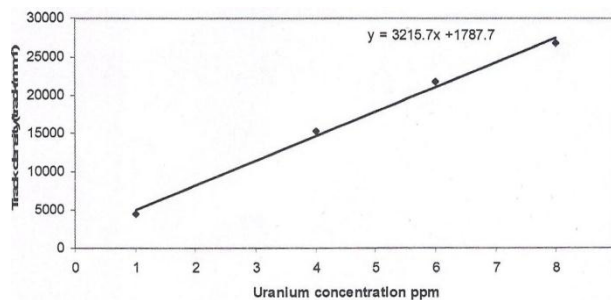


Fig (4)The relation between track density and uranium concentration (ppm) for geological soil samples

### 3. Results and Discussion

Table (1) presents the tracks density, uranium concentrations, and the rates for different study areas in

Table (1) Uranium concentration in soil samples

Study Region	District	Samples	Tracks Density (Track/mm <sup>2</sup> )	Uranium Concentrations (ppm)
Baghdad Governorate Al - Durra City	1 Al-Gameaea الجميلية	S1 <sub>1</sub>	34741.38±2113.583	1.201
		S2 <sub>2</sub>	38017.24±1792.237	1.314
		S3 <sub>3</sub>	32586.21±1335.511	1.126
		S4 <sub>4</sub>	42758.62±1531.369	1.478
	2 Al-Jumhorya الجمهورية	S1 <sub>5</sub>	31379.31±1163.704	1.084
		S2 <sub>6</sub>	33017.24±1468.051	1.141
		S3 <sub>7</sub>	35344.83±1675.561	1.222
		S4 <sub>8</sub>	34051.72±1015.958	1.177
	3 Al-Shutra(1) الشرطة (1)	S1 <sub>9</sub>	33017.24±1410.682	1.141
		S2 <sub>10</sub>	25431.03±1363.051	0.879
		S3 <sub>11</sub>	21724.14±792.1867	0.751
		S4 <sub>12</sub>	20517.24±1059.718	0.709
	4 Al-Shurta (2) الشرطة (2)	S4 <sub>13</sub>	21896.55±1163.704	0.757
		S4 <sub>14</sub>	20344.83±1163.704	0.703
		S4 <sub>15</sub>	20258.62±732.6177	0.700
		S4 <sub>16</sub>	20775.86±857.2663	0.718
	5 Asia district حي آسيا	S1 <sub>17</sub>	19827.59±1573.915	0.685
		S2 <sub>18</sub>	23103.45±1665.675	0.798
		S3 <sub>19</sub>	22500±1181.311	0.777
		S4 <sub>20</sub>	21724.14±1897.422	0.751
	6 Al-Mechanic الميكانيك	S1 <sub>21</sub>	21982.76±1479.257	0.760
		S2 <sub>22</sub>	23275.86±1149.425	0.804
		S3 <sub>23</sub>	22758.62±1297.884	0.786
		S4 <sub>24</sub>	22241.38±1714.533	0.769
	7 Al-Mualemeen المطيين	S1 <sub>25</sub>	22672.41±1222.531	0.783
		S2 <sub>26</sub>	19568.97±1350.88	0.676
		S3 <sub>27</sub>	21810.34±1628.071	0.754
		S4 <sub>28</sub>	21896.55±1733.69	0.757

irradiated soil samples that measured by *PM-355* detector. The samples collected from twenty-eight location distributed in seven districts in different sites in Al-Durra city by (5 cm) depth.

2- The results showed that the maximum value of uranium was (1.478 ppm) in Al- Gameaea district and the minimum was (0.676ppm) in Al-mualemeen.

3- The uranium concentration in Al-Gameaea district is relatively higher than the other districts as shown in figure (5), this due to difference in the composition of the soil in the abundance of minerals and ores .Also that the samples had been taken from residential area and the outskirts of the city.

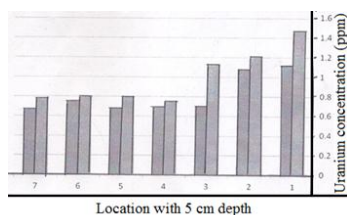


Fig (5) Average concentration of uranium in soil samples for study areas

**Conclusions**

1. The results showed that the concentration and density of the solution , in which PM-355 has been etched increase linearly with respect to the etching

time , this increase in concentration is generally due to the dissolution of detector material , which also changes the other physics – chemical properties like density , turbidity and properties the number total dissolved solids .

2. Chemical etching is the simplest and most widely used technique for revealing the latent damage trials of ionizing particles in solids.
3. The uranium levels in the soil of this study within the acceptable values.

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