

MEASUREMENT OF NATURAL RADIOACTIVITY OF URANIUM IN SOIL SAMPLES

¹G. R. Pansare, ²Fareha Khan, ³Javid Ali

¹Professor, ²Research student, ³Research student
¹Department of Physics,
¹Haribhai V. Desai College, Pune, India

Abstract: Uranium-238 is naturally occurring radioactive element which is present on the earth crust since beginning with long half life of 4.5×10^9 years. Though the Uranium is important but it is hazardous for human being as well as for animals and crops because it emits gamma radiations, beta radiations and alpha particles. In the present work, it has found that Uranium salt emits gamma radiations of energies **133.51KeV, 178.02KeV and 216.95KeV**. To measure the concentration of Uranium in soil, we have used NaI (TI) gamma ray spectrometer. We have prepared samples of soil with different concentrations of **1%, 0.5%, 0.25%, 0.125%, 0.0625%, 0.003125%** of Uranium salts. Minimum level of concentration of Uranium in soil which can be detected with NaI (TI) gamma ray spectrometer is found to be **0.003125%**. Estimated gamma activity of this minimum level is found to be **3.53Bq**.

Keywords- Na(Tl) Scintillation Gamma Ray Spectrometer, Uranyl Nitrate, Activity.

I. INTRODUCTION

Uranium is naturally radioactive and decays with their own series, resulting into many radioactive nuclides as Thorium-234, Protactinium-234, Uranium-234, Thorium-230, Radium-226, Radon-222 and eventually get stable with lead-208. Many of them are having long half lives. These radioactive products emit alpha, beta and gamma radiations. These radiations are harmful to the living organisms. Uranium is available in the form of salts. These salts dissolve into the water and make soil and water pollution. Finally, these salts are taken up by the various crops through the water. This results into nuclear pollution in vegetables and foods. Literature survey shows that the soil of coastal areas of India is naturally contaminated with Uranium and Thorium salts. In view of this, present research work is carried out to estimate trace concentration of Uranium salt in soil samples.

II. RESEARCH METHODOLOGY

2.1 Sample Preparation and Experimental Set up:

NaI (TI) gamma ray detector is calibrated using the standard gamma ray sources provided by the B.A.R.C., Mumbai. This detector is coupled to 8k M.C.A analyzer and computer. Detector efficiency and geometrical factor were estimated using standard gamma sources. Soil samples are prepared using Uranium salt with different concentration levels in the range of 1% to

0.03125%. Here we have used standard Uranyl Nitrate $[\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$. Gamma ray activity of each soil sample with different concentrations is finally measured and reported in the work. Table1 represents Gamma ray activities of soil samples with different concentration of salts.

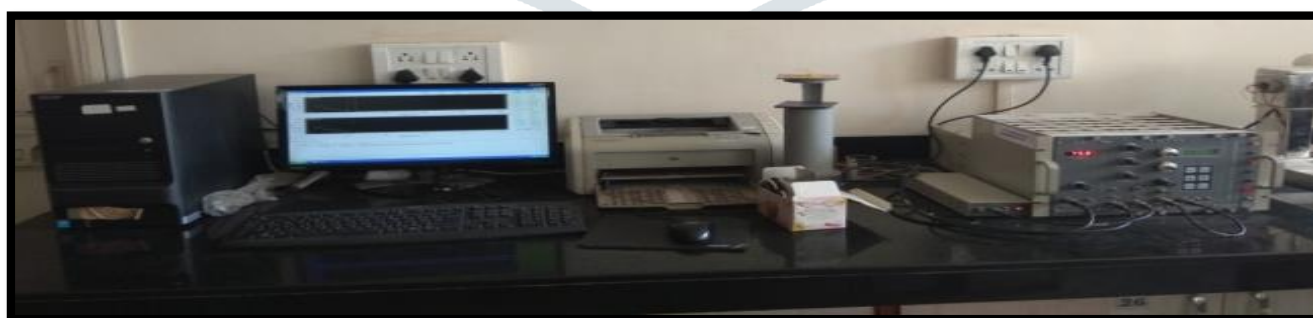


Fig.1 Experimental Set up of computer NaI (TI) gamma ray spectrometer with 8k MCA coupled to computer facility.

Table1. Measured activity of Uranium in soil samples

% of Uranyl Nitrate in soil	Amount of Uranyl Nitrate (gm)	Measured Counts for 3600sec under photo peak	Measured Activity (Bq)	Estimated Activity (Bq)
100%	1	388137	107.81	539.05
1%	0.1	19174	5.32	26.6
0.5%	0.05	12789	3.55	17.75
0.25%	0.025	7250	2.01	10.05
0.125%	0.0125	4417	1.22	6.1
0.0625%	0.00625	3122	0.867	4.335
0.03125%	0.003125	2543	0.706	3.53

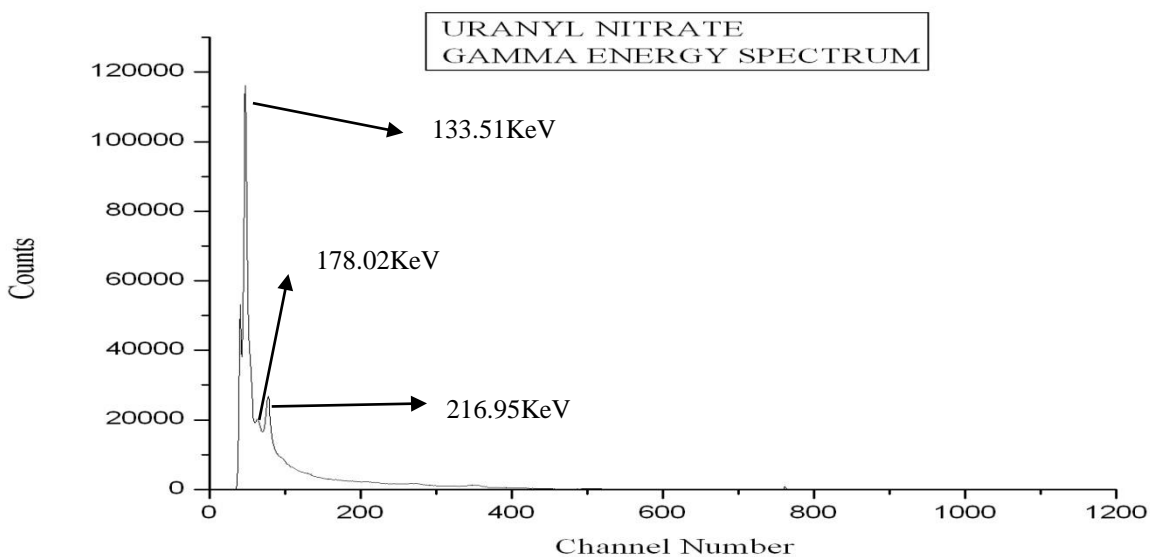


Figure2. Gamma ray spectrum of 100% Uranyl Nitrate [UO₂(NO₃)₂·6H₂O]

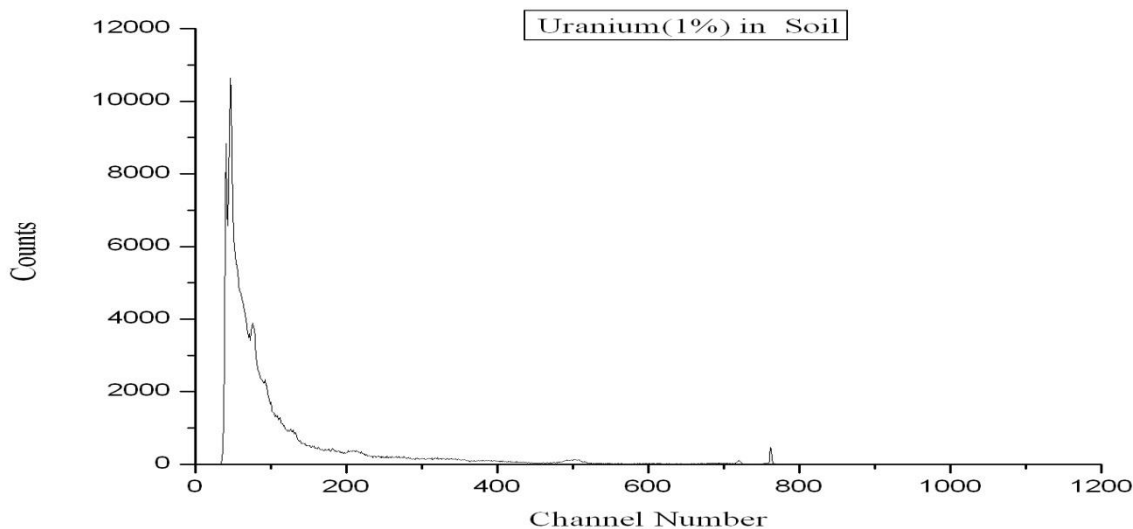


Figure3. Gamma ray spectrum of 1% Uranyl Nitrate [UO₂(NO₃)₂·6H₂O] in soil

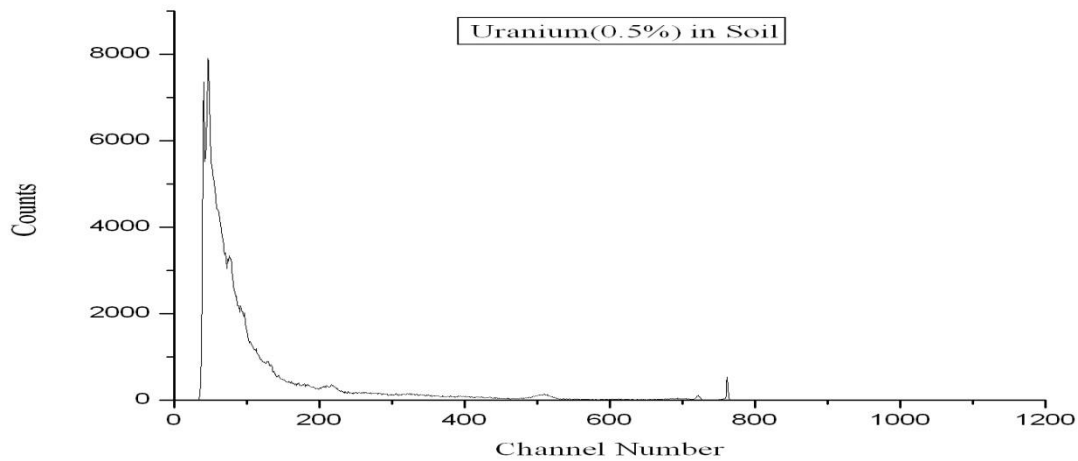


Figure4. Gamma ray spectrum of 0.5% Uranyl Nitrate $[\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$ in soil

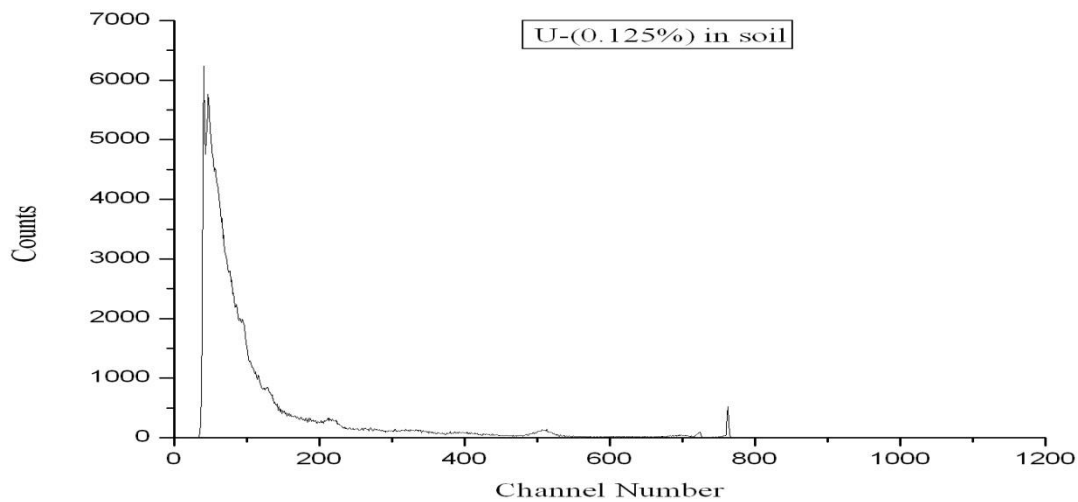


Figure5. Gamma ray spectrum of 0.125% Uranyl Nitrate $[\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$ in soil

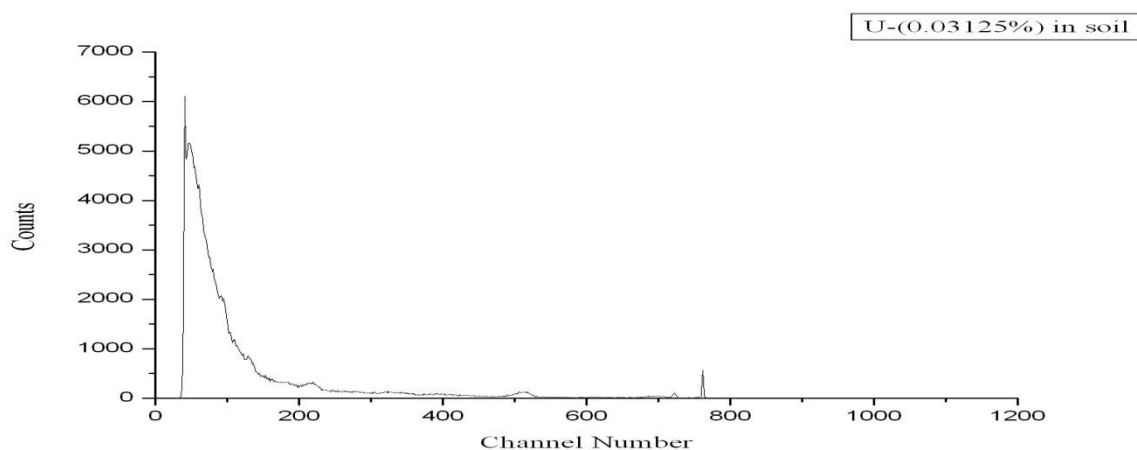


Figure6. Gamma ray spectrum of 0.03125% Uranyl Nitrate $[\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$ in soil

RESULTS AND CONCLUSIONS:

Gamma ray spectrum of uranyl nitrate salt given in fig.1 shows that the Uranium salt $[\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$ emits gamma rays of energies 133.51KeV, 178.02KeV and 216.95KeV. The intensity of gamma rays of energy 133.51KeV is found to be much more as compared to the other gamma radiations. Gamma ray spectrum of soil samples with concentration of 1%, 0.5% 0.125% and 0.03125% Uranium salt given in fig.3,fig.4, fig.5 and fig.6 respectively shows that the intensity of gamma radiation has decreased rapidly. Fig.5 shows the minimum detection level of the gamma radiation. The results obtained in the present work shows that the minimum level of Uranium salt in soil sample is found to be 3.53Bq.

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