Search for possible radionuclide dispersion near Kolkata from the Fukushima reactor accident

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Introduction

Radioactivity spread in the environment poses a concern both for internal and external exposure. The recent tsunami in Japan on March 11, 2011 caused severe damage to the nuclear reactor in Fukushima and radioactive contamination was observed near the site. As an initial step to search for a possible distribution of this radioactivity [1] in the eastern region of the Indian continent we have made an attempt to detect the radioactivity present in the air and soil. Since this is our first study of the environmental radioactivity around the site, in absence of previous measurements, it is not feasible to carry out a quantitative estimate of any possible activity dispersion in the region. So we have only tried to qualitatively assess the radioactivity distribution from the Fukushima reactor accident in terms of the presence of possible radioisotopes in the environment. In this work we identify the different radioisotopes present in the environment around the site of study and try to detect the presence of potential candidates like ^{137}Cs, ^{131}I, ^{133}Xe or others from the Fukushima fallout [1]. As our measurements were done in June 2011, three months after the accident, the soil sample was also analysed for detection of any dispersed activity that might have deposited in the soil from air.

Experiment

We have detected the radioactivity present in the air and soil samples through γ-ray spectrometry of the samples using a HPGe detector. The relative efficiency of the HPGe detector is ~25%. Energy calibration of the detector was done with ^{60}Co and ^{137}Cs sources which emit characteristic γ-rays of energy 1.17 MeV, 1.33 MeV and 0.662 MeV, respectively.

Air sample was collected with the help of an air suction fan kept on the rooftop of the premises. The machine was fitted with an air filter with a pore size of 5 micron. Air was sucked through this filter continuously for a period of ~168 hours (nearly 7 days). The filter was then taken out, folded into a rectangular parallelepiped of dimension 13cm x 8 cm x 1 cm and was counted for a period of 22 hrs. Soil sample was also collected from the site at a depth of 1 ft below the ground. This soil was grounded to fine powder and 85g of it was taken in the form of a rectangular cuboid of dimension 6.5cm x 6cm x 1cm and counted for 48 hrs. γ-spectra of the samples were recorded and displayed with Amptek ADMCA and the related Display and Acquisition Software. The recorded spectra were analysed using the software NSCTSK [2].

In order to estimate the radioactivity present in the environment and any possible dispersion of radioactive particles from Fukushima reactor site to this region, we have recorded the background spectrum of the laboratory where the experiment was setup for a period of 64 hours before counting the air and soil samples. All the three spectra were then normalized and analysed.

Results and Discussion

The room background spectrum was analysed for radionuclides present and the gamma peaks were identified from literature. Analysis of this room background spectrum reveals the presence of ^{232}Th, ^{226}Ra and ^{40}K isotopes which are abundantly present in the earth's crust along with some other isotopes. In

Fig. 1 we have shown the γ–spectrum of air sample, detected from the air-filter. A preliminary analysis showed that along with the isotopes of Ra, Th and K present in the background spectrum a few other unidentified γ-peaks are also present. In Fig. 2. we have shown

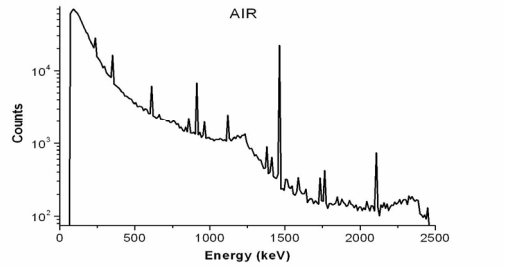

Fig. 1 γ-spectrum of air sample

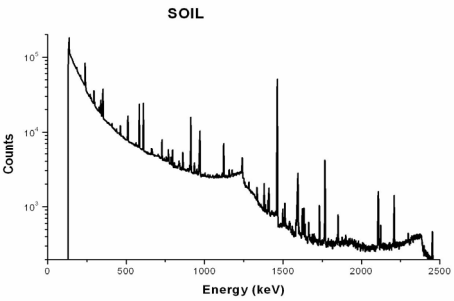

Fig. 2 1 γ-spectrum soil sample

the γ–spectrum of the soil sample for precipitation of any dispersed activity and observed a few peaks other than ^{226}Ra and ^{232}Th.

In the next part of the work we tried to develop a method to determine the relative efficiency of the detection system for background spectrum acquisition. For background data it is difficult to define the geometry for efficiency measurement. So we have studied the variation of the C/I ratio (where C=counts, I=intensity of a γ-peak) for two isotopes ^{226}Ra and ^{232}Th in the background spectra. We propose that any correlation between the nature of these curves for ^{226}Ra and ^{232}Th would give an indication about the relative spatial distribution of the two isotopes in our environment. In such a case the relative efficiency for one isotope could be used to estimate the abundance of the other one. In figures 3 and 4 we have shown the plot of C/I vs. γ–energy for ^{226}Ra and ^{232}Th present in background. Analysis of these plots shows that relative spatial distribution of the two isotopes could not be described conclusively.

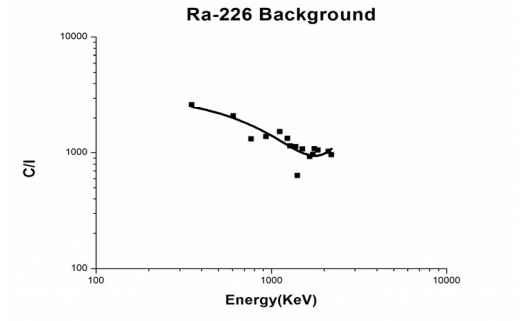

Fig. 3 C/I vs. E for ^{226}Ra in room background

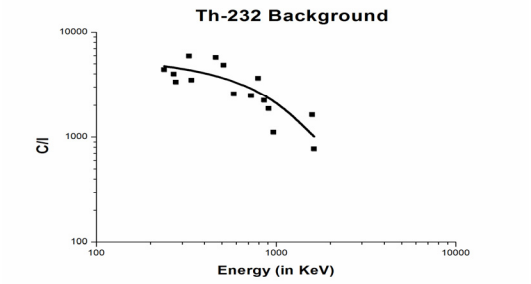

Fig. 4 C/I vs. E for ^{232}Th in room background

Conclusion

We have detected some γ-peaks in the air and soil samples besides those present in the room background. More detailed studies with a long time data acquisition need be done to infer dispersionof radionuclides from reactor accident.

Acknowledgement

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References

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