THE IMPACT OF SURFACE TYPES ON THE MEASUREMENT OF SUPERFICIAL RADIOACTIVE CONTAMINATION

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Abstract

Human senses cannot detect ionizing radiation. However, excess and long-term exposure may cause adverse health effects. Hand-held radiation measuring instruments are the tools used as a first line of defence in the detection of the presence of such radiations and are often used to avoid unwarranted exposure to radiation. It is vital that correct radiation monitoring is carried out when there is likelihood for radiation exposure. It is equally important that the correct monitoring instrument is selected and used in an emergency setting. Nuclear rate meter for measuring surface contamination, which indicates the potential internal exposure when a radioactive substance is distributed over a surface. The measurements were done in the different surfaces: wood, foam, and plastic. The source used as alpha emitter was Cm-244 and the beta emitter was Sr-90. The measurements of surface contaminated samples after calibration of the system are done with SAB-100 probe for measurement of surface contamination designed to be used with any CSP survey meter (Radiagem 2000).

Key words: Surface contamination, gross alpha beta radioactivity, calibration, wood, foam, plastic.

Introduction

Two categories of surface contamination are as follows: fixed and removable. Removable is the activity that can be removed via a smear or swipe sample and that which can be removed by decontamination. Activity that cannot be removed is labelled as “fixed”. Surface contamination meters indicate the total contamination, which includes that which is fixed to the surface and that which is removable. Total contamination may constitute an external radiation dose hazard; however, that which is removable presents a potential for an internal radiation dose hazard via inhalation. The direct measurement may suffice as an indicator of the potential for an overall hazard.

The removable contamination may be assessed by using a moistened filter paper to wipe an area of contaminated surface and by measuring the amount of activity on the wipe. It is normally assumed that only about 10% of the

removable contamination transfers to the smear. The measured activity is multiplied by 10 and divided by the area wiped to complete the assessment.

In situations where surface access is limited or where surfaces are contaminated by alpha or low-energy beta emitters, smears are generally counted in a liquid scintillation counter [IAEA-PRTM-1 (Rev.1)

A suitable surface contamination meter should be available wherever unsealed radioactive substances such as liquids and powders may be present in the workplace even during routine work. Caution is taken to avoid contact of the instrument with potentially contaminated surfaces. Instruments that have a detachable probe provide versatility in decay mode detection (alpha, beta, and gamma).

Flat surfaces (bench tops, floors, desktops, etc.) that are easily accessible are routinely monitored with surface contamination meters. Liquids or thick surfaces (tiles, carpet, flooring, etc.) will cause sever attenuation of alpha and beta particles and low-energy gamma emitters. An understanding of the magnitude of attenuation will be important to determine activity levels properly. The user of a surface contamination meter must understand the instrument used and follow a procedure to obtain a meaningful measurement.

Experimental

The samples used for this study are taken from the Inter laboratory Exercise on Determination of Surface Contamination by Handheld Equipment under the TC Project RER7008 "Strengthening Capabilities for Radionuclide Measurement in the Environment and Enhancing QA/QC System for Environmental Radioactivity Monitoring".

Each individual printed paper was prepared in IAEA Terrestrial Environment Laboratory and distributed by the IAEA to the participating laboratories. A master solution was prepared by combining specific amounts of each of the individual solution containing the nuclides of interest and diluting to an appropriate final weight. The source used as alpha emitter was Cm-244 and the beta emitter was Sr-90. Associated uncertainties for Cm-244 solution was 0.75% (k=1) and for Sr-90 solution was 0.25 % also (k=1). [IAEA, Vienna, 2004]

The master solution containing the radionuclides of interest at known activities was used to spike the individual printed papers samples. The solution activity onto each printed paper was verified and found not to vary by more than about 0.2% between paper sets, therefore all samples can be considered statistically identical to each other within the uncertainties given for the known values.

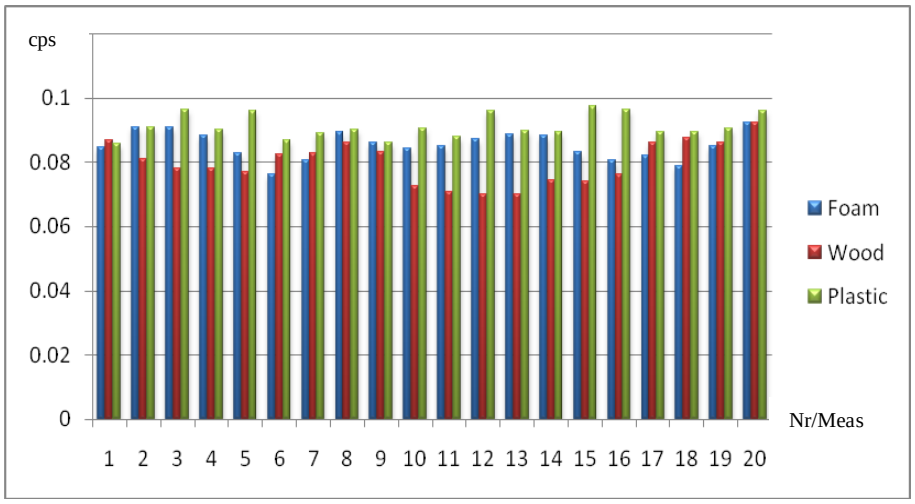
The measurements of surface contaminated samples after calibration of the system were done with SABG-100 probe for measurement of surface contamination designed to be used with any CSP survey meter (Radiagem

2000) [Cfarku *et al]*. Each measurement was performed in the fixed distance 0.5 cm (20 readings). Three sets of measurements were done using the same sample with different support (Foam, plastic and wood), in order to see the impact of the surface type.

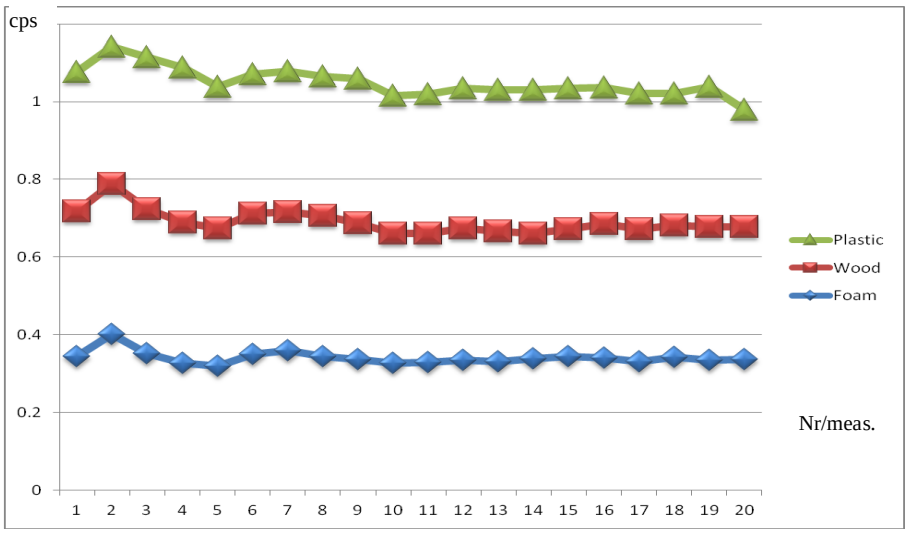
Results and discussions

The value of each measurement of the reference samples alpha (code 02), beta (code 01), measured in this study is shown in the graphic 1 and 2.

Graphic 1. Alpha sample (code 02)



Graphic 2. Beta sample (code 01)



Conclusions

Target values and associated standards uncertainties (U) of the proficiency test sample and measured value are respectively:

Sample 01 beta:

A_β(IAEA) = (1.21 ± 0.01) Bq/cm^2 A_β = (1.09 ± 0.12) Bq/cm^2.

Sample 02 alpha:

A_α (IAEA) = (0.71 ± 0.09) Bq/cm^2 A_α = (0.69 ± 0.07) Bq/cm^2

In the case of surface contamination beta measurement the impact of the surface material is significant when the measurements are made on higher density surfaces such as plastic and steel, while in the case of the alpha surface contamination measurement this effect is not significant.

In situations where we have to make an assessment of alpha/beta radioactive surface contamination in different materials we should also keep this effect in mind and calculate the rate of indication.

References

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