Experiments for Training in Nuclear and Radiochemistry

Practical Training

Measurements in Contaminated Areas

von

Siegurd Möbius

Forschungszentrum Karlsruhe GmbH
Fortbildungszentrum für Technik und Umwelt

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Introduction to the Experiment

To assure safety during handling of radioactive materials it is necessary to prevent the possibility of the organism to be irradiated from both internal and external sources.
When radioactive substances are manipulated as open radiation sources, attention must be devoted in particular to prevent these elements from entering into any organism.
This may be achieved, among others, by preventing or at least reducing to a minimum the possibility of radioactive contamination of the laboratory.
To determine the radiation and contamination levels that exist in such a laboratory, means that a continuous program of monitoring as fellows is necessary:

1. Air monitoring: The air of the laboratory must continuously be taken in over filters on which radioactive dust can be adsorbed and detected.

2. Dose monitoring: The β-γ-dose rate must be measured with a suitable dose monitor.

3. Contamination measuring: With a survey meter and by taking smear-tests you have to look for eventual contaminations.

In the following experiment, a table separated into three areas should be examined for eventual radiation and contamination.

Apparatus and Materials

- Dose monitor
- Contamination monitor (α, β, γ-counter, survey meter)
- Filter-paper for smear-test (≈ 5 cm Ø)
- G-M counter (end-window type)
- Gloves
- β-standard source

Experimental Details

(1) **Dose Monitoring:**
Measure the dose rate of each area with a β-γ-monitor and note it in documentation sheet.

(2) **Contamination measuring with survey meter:**
Using the β-standard source determine the efficiency η_{D1} of the survey meter as follows:

$$\eta_{D1} = \frac{R_M - R_0}{R_E} \cdot 100\%$$

R_M = Measuring rate
R_0 = Background
R_E = Emission rate of the source

Measure the count rate of each area with the monitor (attend to constant geometry of the survey) and calculate the strength of each contamination A [Bq/cm^2].

$$A = \frac{R_M - R_0}{\eta_{D1} \cdot A_D}$$

A_D= Area of the detector

(3) **Contamination measuring with smear-test:**
Determine the efficiency η_{D2} of the G-M counter (see 2), wipe off about 300 cm^2 of each area using filter-papers and determine the count rate with the G-M counter (wear gloves!). Calculate the strength of the contamination A [Bq/cm^2] and note it.

$$A = \frac{R_M - R_0}{\eta_{D2} \cdot \eta_{ST} \cdot A_{ST} \cdot 60}$$

η_{ST} = Efficiency of smear-test, part of dust you wipe off (about 10%)
A_{ST} = Wiped area (300 cm^2)

→ **Discuss the distinct results.**

Documentation sheet: Measuring in Contaminated Areas

Area	Dose Monitor DR [µSv/h]	Contamination Monitor		G-M counter for smear-test	
		[counts/sec]	[Bq/cm^2]	[counts/min]	[Bq/cm^2]
I					
II					
III					
		R_0 = counts/sec η_{D1} = % A_D = cm^2		R_0 = counts/min η_{D2} = % η_{ST} = 10 % A_{ST} = 300 cm^2	