

Checking the level (Item No.: P1315800)

Curricular Relevance



Difficulty



Difficult

Preparation Time



1 Hour

Execution Time



2 Hours

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Task and equipment

Introduction

Technologically the γ -radiation barrier are used for checking the level, when the container to be checked is either opaque or contains chemically reactive, inflammable or heated substances of high density. The prerequisite for using this method is a clear difference between the absorption coefficient of the container and the material contained in it. γ -rays are also suitable for checking the product pieces on running conveyor belts.

In the experiment described below, the content level of a sample tube filled with lead (small) shot will be checked with the help of a γ -radiation barrier.

Task

Equipment

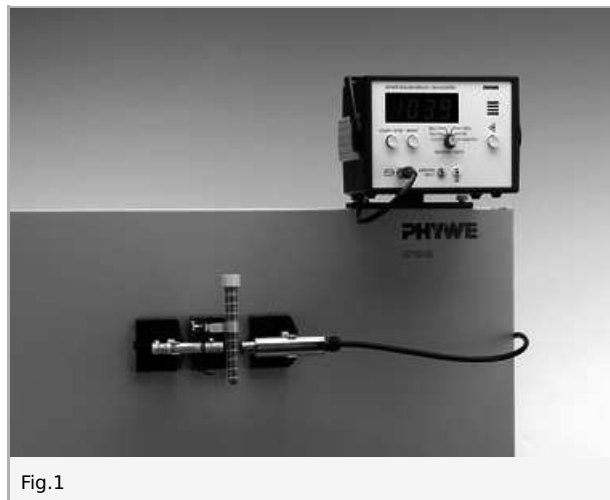
Position No.	Material	Order No.	Quantity
1	Radioactive sources, set	09047-50	1
2	Geiger-Müller-Counter	13606-99	1
3	Demo Physics board with stand	02150-00	1
4	Geiger-Mueller counter tube, 15 mm (type B)	09005-00	1
5	Clamp on holder	02164-00	1
6	Plate holder on fixing magnet	09203-00	1
7	Counter tube holder on fixating magnet	09201-00	1
8	Source holder on fixing magnet	09202-00	1
9	Support clamp for small case	02043-10	1
10	Specimen tube with holder	09203-01	1
11	Steel pellets, d = 2 mm, 120 g	03990-00	1
12	Support rod, stainl. steel, 100mm	02030-00	1

Set-up and procedure

Set-up

The experiment is set up as per Fig.1.

- Fill the sample tube upto the middle with lead (small) shot and seal it.
- Place the plate holder on the demo board and fix the sample tube with the holder vertically in the middle of the plate holder.
- Position the counter tube without the protective cap with the help of the counter tube holder such that its window is very close to the sample tube.
- Place the Co-60 radiation source in the source-holder and position it very close to the sample tube.
- Move the sample tube upwards till its lower marking ring lies in the radiation barrier. The measuring height will then be $a = 1$ cm.



Procedure

- Select a measurement time of 60 s; determine the count rate and enter the value in the table; thereafter lower the sample tube each time by one marking ring and determine the count rate for each position.
- If the count rate rises steeply between any two marks, take an additional reading in the middle of these two marks.
- After concluding the measurements put the radiation source back in the container and replace the protective cap back on the counter tube.

Results and evaluation

Results

Table 1

$\frac{a}{\text{cm}}$	$\frac{Z}{\text{Imp}/60 \text{ s}}$
1	1013
2	1032
3	1041
4	1049
5	1542
6	1580
7	1560
8	1542
4,5	1449

Evaluation

It can be seen from the table, that the count rate rises abruptly between the positions $a = 4 \text{ cm}$ and $a = 4.5 \text{ cm}$. Upon displaying the count rates Z graphically (Fig. 2) in dependence with the measurement position a of the radiation barrier, one gets the exact value of $h = 4.2 \text{ cm}$ for the filled height.

For confirming this value, one can measure the level with the help of a rod after opening the sample tube.

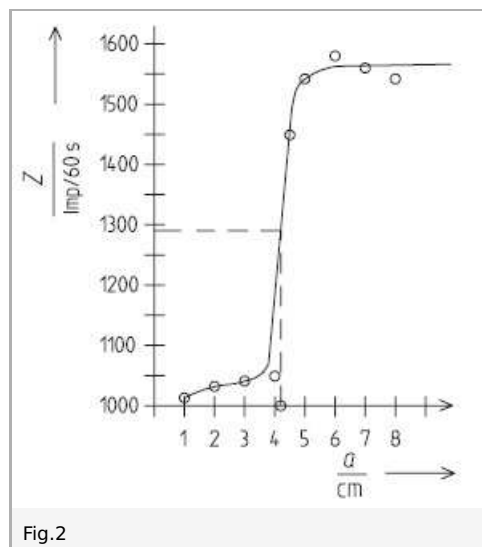


Fig.2