Chapter 22 Living in a nuclear age

Short investigation 22.2: The absorption of beta radiation by plastic

Name: .....

Aim

To determine how the penetration of beta radiation through plastic (polyethylene) depends on the thickness of the plastic

Materials

Geiger counter (G-M probe and radiation counter with power supply), beta particle source, plastic squares of absorbing material

Note: As noted in the previous activity, cutting up a 2 litre ice cream container will provide good absorbing material. If this proves to be too highly absorbing, the plastic used in Chinese takeaway containers is usually thinner and less absorbing than that from the ice cream containers.

Handling radioactive sources

The radioactive sources are almost always sealed sources, in which the radioactive material is sealed inside a protective casing that prevents the material from leaving the source. These sources are quite safe, however, the following rules should be observed while working with them:

- Remove a source from storage only when you are ready to use it, and replace it as soon as you have finished with it.
- Do not eat, or drink in areas where sources are being used.

Theory

A beta particle source will be placed close to the G-M probe and different thicknesses of plastic inserted between the source and probe. A graph of activity against thickness will be plotted and the thickness of plastic required to reduce the activity to half its initial value determined.

Method

1. Set up the G-M probe so that it is mounted vertically about a centimetre above the beta particle source.
2. Remove the beta particle source and make a reading of the background count for an interval of at least one minute.
3. Replace the beta particle source and insert about 10 squares of plastic between the source and the probe. Measure the activity during a 15 second interval.

The activity will probably be quite low. If it is already at the level of the background count, you should use about 10 sheets of a thinner plastic material. (You could use fewer plastic squares, but that will reduce the number of data points obtained.) It may be necessary to investigation with different plastic until you find one of a thickness that best suits your source and detector.

4. Make measurements of the activity for about 10 different thicknesses of plastic. Each reading should be repeated several times.

Analysing the results

Subtract the background count from each of your values and obtain the average value of the activity for each thickness. Plot a graph of activity against thickness and draw a smooth curve through the points.

Questions

1. What thickness of plastic is required to reduce the intensity to one half its initial value? (You can check this for different values across your graph.)

2. The values determined from your graph in question 1 should be similar. What type of graph does this indicate?

3. If you were to plot a graph of log(activity) against thickness, what sort of graph would you hope to obtain? (You may wish to try it and see.)

Notes:

