3. Half Value Layer

The half value layer (HVL) is the thickness of a shielding material required to reduce the intensity of radiation at a point to one half of its original intensity. It can be calculated by setting $I = \frac{1}{2} I_0$ and solving the attenuation equation for x:

$$0.5 = e^{-\mu x_{1/2}}$$

$$x_{1/2} = -\frac{\ln(0.5)}{\mu}$$

$$x_{1/2} = \frac{0.693}{\mu} = \text{HVL}$$

Half value layers for various shielding materials and selected radionuclides can be found on page 52.

When the HVL is known rather than μ, the total attenuation from *n* half value layers can be calculated by using the following equation:

$$I = \frac{I_0}{2^n}$$

The major factors in reducing radiation exposure are:

1 -Time: time decreases exposure decreases

2 -Distance : distance increases exposure decreases

3 -Shielding: shielding increases exposure decreases

Accidents that happen in health institutions and how to deal with them:

1- There are accidents that happen in nuclear medicine institutions, and there must be trained people to deal with these accidents, including:

-Vomiting

-Bleeding

- Urinate

The patient becomes a radioactive source when consuming or glowing the radioactive material, especially the high doses used for treatmentز

Detectors for Radiation Protection .

Ionization Chamber

A very simple radiation detector is the ionization chamber (see Fig.5.1). Radiation incident into an ionization chamber will produce electrons and ions by ionization of the counter-gas filling. These charge carriers are collected in a constant homogeneous electrical field. Since there is no gas gain in this type of chamber, the signals are very small. Therefore, these signals have to be amplified **elecionization chamber** tronically. Ionization chambers are excellently suited for the measurement of α rays which deposit their total energy in the chamber volume.

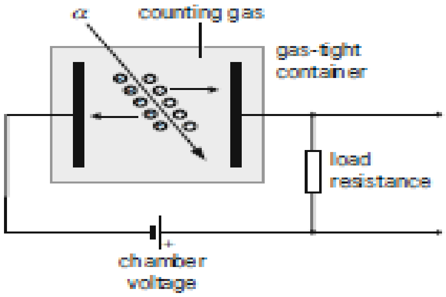

Figure 5.1
Working principle of an ionization chamber

Since the chamber signals are proportional to the energy, these detectors allow α-ray-spectroscopy measurements. Ionization chambers also permit an accurate measurement of the ion dose and the ion-dose rate via a measurement of the chamber current.

A novel passive personal dosimeter is based on <u>a combination of an ionization chamber with a special transistor as storage cell.</u> For this purpose, one uses a MOSFET transistor (Metal Oxide Semiconductor Field Effect Transistor) with an open floating gate. This MOSFET transistor is integrated into a small ionization chamber **with floating gate** with tissue-equivalent walls. The open gate is charged up by electrons which tunnel through a thin oxide layer. In this way a relatively stable charge level is reached so that this type of detector represents **memory cell** a memory cell. This electrically created charge level is modified by charge carriers which are produced by ionizing radiation incident into the ionization chamber and onto the tissue-equivalent chamber walls. The created charge carriers drift to the open floating-gate electrode of the MOSFET transistor where they change the pre-existing charge level. The modified charge level is a measure of the deposited dose.