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RADCOMM RADIATION DETECTION SYSTEMS

Introduction to the principles of radiation protection

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How can we find radioactivity?

Detection of radiation has one large problem… radiation

- does not smell;
- cannot be seen;
- cannot be felt;
- can do long lasting damage

There are however detectors to help locate and identify the radioactive source.

How can we detect radioactivity?

When detecting radioactivity, a **scintillation** detector is more effective and sensitive than a gas detector, such as the Geiger-Muller Tube.

Different types of scintillators can identify different types of radiation.

In order to *find* the radioactive source, we often use units of **counts per second** (cps).

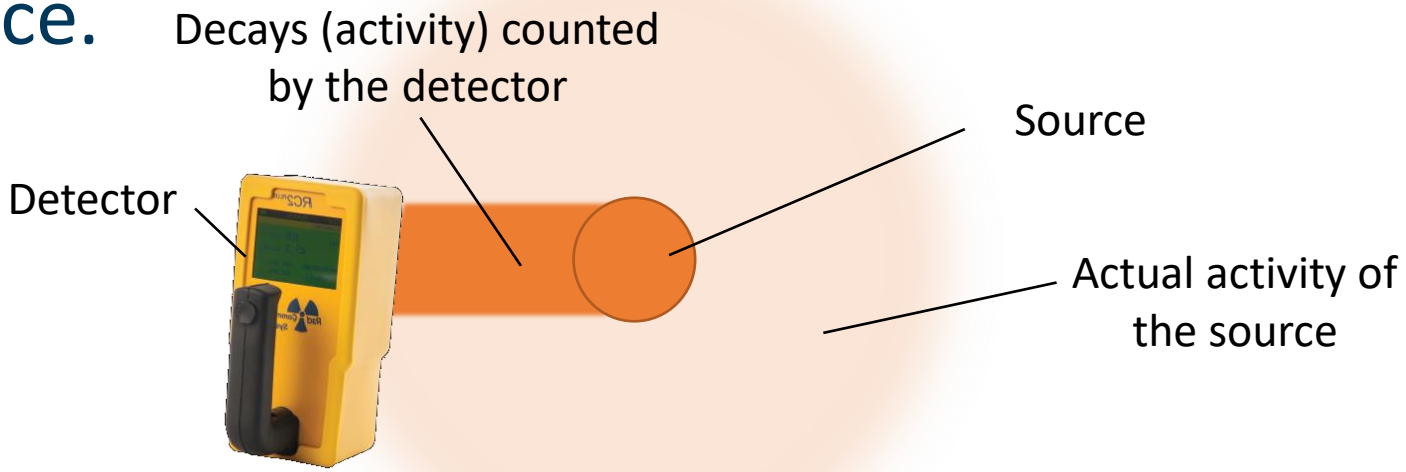
How can we detect radioactivity?

The units of cps do not tell us about the strength or the actual *amount* of radiation being given out (**emitted**).

They simply tell us that a greater number of radioactive **disintegrations** (decay) is being detected.
It is an *indication* that a radioactive source is likely to be present.

Why do we measure in cps?

The **cps** is an indication of the activity, but not an accurate measurement of it, because a detector cannot detect *all* the disintegrations emitted from a source.



To count all the radiation emitted, a detector would need to completely surround a source.

How can we measure radioactivity?

The SI (Système International) unit for the *total amount* of radioactive decay emitted by an atom is the **becquerel (Bq)**.

1 Bq means that one atom is decaying each second. In reality this is a *rate* rather than a *quantity*.

Each type of radiation has a particular energy, measured in **electronvolts (eV)**.

We usually talk about Mega electronvolts (MeV) = 1,000,000 eV.

Why is radiation harmful?

As each type of radiation travels from the nucleus, it 'interacts' with other atoms it meets and **ionises** them so they can no longer **bond** to form compounds in the same way.

Remember: all materials are made of atoms joined (bonded) together to make compounds (materials).

Why is radiation harmful?

When considering the harm radiation can cause our body, we talk of the **dose** of radiation received rather than just the amount emitted.

Alpha particles produce greater harm than do beta particles, gamma rays and X-rays for a given **absorbed dose**.

Absorbed dose is measured in **gray (Gy).** It is the amount of energy absorbed per kg.

Why is radiation harmful?

As different radiation types have different energies, 1 Gy of alpha radiation is more harmful than 1 Gy of beta radiation (alpha radiation has higher energy than beta).

However, in order to directly compare the harm from different radiation, we use the **effective dose**, which is based on the *absorbed dose* but takes into account the energy and type of radiation as well as the part of the body being affected.

Why is radiation harmful?

Ultimately in a cell, a *dose* of radiation will alter the atoms that make up compounds, through **ionisation**, causing the DNA to change (DNA is made of large compounds).

- The cell may die…
- It may change its function (different cells have different functions in the body, such as skin cells and blood cells)… or
- It may grow uncontrollably… which we know as cancer.

How does ionising radiation affect us?

The harm that ionising radiation can do to the human body is determined by a range of factors including:

- The *amount* of radiation emitted by the source
- The *type* of radiation emitted by the source
- The *tissue* exposed that absorbs the radiation.
- The *distance* you are from the radioactive source
- The *time* you are exposed to the source
- The *shielding* between you and the source

How can you stay safe?

Of these factors, some we can control and use to help protect ourselves:

- **Time**: Spend as little time in the vicinity of the radioactive source as possible.
  Some damaging effects are more likely with increased exposure time (**stochastic effects**) whilst others will increase the severity of harm caused (**deterministic effects**)

How can you stay safe?

- **Distance**: Stay as far from the source as your can. Doubling your distance from a gamma source reduces the dose to a quarter (inverse square low).
  Alpha and beta sources are most harmful when ingested or inhaled, so *not eating or drinking* will help prevent them entering the body (keeping them at a distance).
  Use tools to extend your distance if you have to handle a source.

How can you stay safe?

- **Shielding**: Use a barrier (shield) between you and the source.
  Do not handle any radioactive source directly.
  The shield should be appropriate to the type of radiation.
  Wear appropriate PPE. Remove these without touching their external surfaces and dispose of after use.

What shielding should be used?

Shielding uses a material between you and the source to prevent the radiation reaching your body.

Beta radiation are typically stopped with clothing, thick gloves and plastic goggles.
Whilst alpha radiation cannot penetrate the surface of the skin, wearing plastic disposable gloves will prevent it entering through any damaged areas of skin.

What shielding should be used?

Gamma radiation requires a much more substantial shield as it is so penetrating.

This should be handled by qualified personnel wearing items such as lead aprons or full protection suits.

How can we stay safe with radioactivity?

Detection of a source is key to helping protect us:

- Scan unknown materials with a scintillation detector
- If working in the waste / scrap industry, scan all materials entering and leaving the premises
- Have a clear and established procedure for eliminating false alarms and for securing positive alarms
- Ensure you know who the Radiation Protection Officer is and how to contact them

What do we do if there is an alarm?

If an alarm sounds, do **not** ignore it. The reason for the alarm **must** be identified, as either one of three possibilities:

- a **positive** alarm and there is radioactive material present
- a **false** alarm possibly caused by a fault in the system
- a **false-positive** alarm such as caused by uneven loading of material or a driver who has had a medical treatment

What do we do if there is an alarm?

To identify the type of alarm (summary):

- Pass the material through the detector again at least three times, slowly, (backwards & forwards)
- If no repeat of alarm, this may be a false alarm
- Check the loading of the vehicle
- If the alarm consistently sounds, use a portable detector to locate the increased radiation level on the outside of the load
- **Do not approach** the load if higher than 5000cps

What is radiation protection?

In summary:

- All *ionising* radiation is dangerous as it interacts with the atoms in the cells of our body.
- Different types of radiation can penetrate different distances into different materials and so be stopped by some materials.
- Detection is important in identifying the type of source and therefore the protection, particularly shielding, are appropriate.
- *Time*, *Distance* and *Shielding* are the easiest factors we can control when protecting ourselves from a source.