

What is radioactivity and radiation?

Radioactivity occurs when unstable isotopes release energy as invisible waves or particles that are called radiation.

Ionizing radiation includes cosmic rays, X rays and the radiation from radioactive materials. *Non-ionizing radiation* includes ultraviolet light, radiant heat, radio waves and microwaves.

There are five main types of ionizing radiation, classified by the type of energy particle or waves they produce: alpha particles, beta particles, gamma rays, X rays and neutrons. This toolkit will refer to ionizing radiation simply as “radiation”.

What does radiation do?

The effect of radiation will depend on its ability to penetrate, which in turn depends on the type of energy particle or wave released.

Alpha particles (helium nuclei) can barely penetrate the outer layer of human skin, so are only hazardous when they are taken into the body by breathing or eating or through a wound. Beta particles (electrons) can penetrate only about a millimetre of tissue, so they are hazardous to superficial tissues, but not to internal organs, unless they too are taken into the body. Gamma rays, X rays and neutrons can pass through the body.

How are radioactive materials used?

Because radiation can penetrate matter, radioactivity and radioactive materials have many uses in medicine, agriculture, industry, mining and oil exploration, and research.

Radioactive pharmaceuticals can be given to medical patients to test for changes in normal functioning of the organs. Radioactive iodine is used to treat thyroid disease. Radiation is used to kill cancer cells and radiation can also be used to sterilize medical equipment.

In agriculture, food can be exposed to a short burst of radiation to kill harmful bacteria without affecting the food. Irradiation is used to prevent

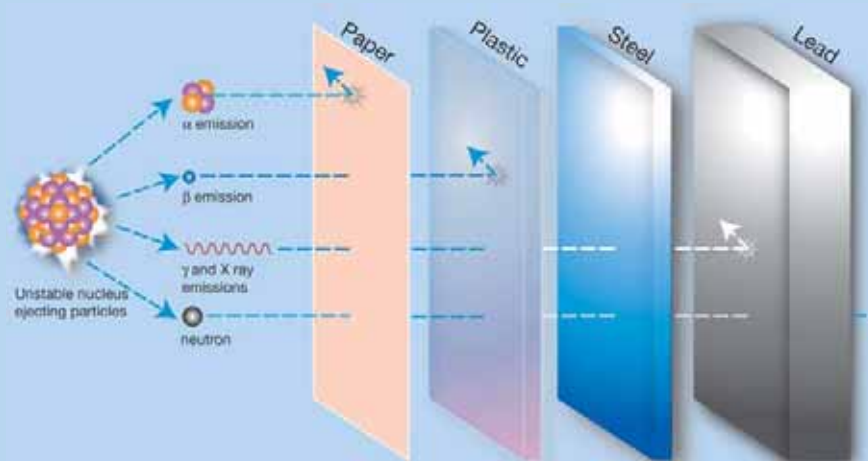
early sprouting of seeds, and it can also be used to sterilize insect pests, like the Mediterranean fruit fly, so that they cannot reproduce when released into the environment.

In industry, radioactive materials are used in special gauges to measure the thickness of materials, the flow rate of liquids, and the level of materials in tanks. In gamma radiography, radioactive materials are used in special devices that monitor the quality of welds on gas and water pipelines during construction. Because radioactive materials will interact with individual substances differently, they can be used in special equipment to prospect underground soil and rock formations for minerals, oil, or water.

What are the dangers of radiation?

Like any technology, technologies that use radiation have both benefits and risks. The level of risk depends upon the type and amount of radiation produced. High doses of radiation can damage healthy tissues, causing skin burns and an increased risk

of cancer. To avoid overexposure, radiological protection measures include equipment design, special procedures by users, and regulations limiting radiation doses. The ultimate goal is to ensure that exposures are as low as reasonably achievable and within acceptable limits.



How can I tell when radioactive materials are being used?

Because ionizing radiations are invisible, special equipment is needed to detect them. In most countries, regulations require radiation monitoring wherever radioactive materials are used. Equipment capable of producing radiation and radioactive materials should have radiation warning labels. Areas where radioactive materials are regularly used, such as hospital cancer treatment wards, will also have warning signs. The trefoil is the radiation symbol used around the world. The word radiation or radioactivity may also appear on the label.

What is a sealed radioactive source?

A sealed radioactive source is radioactive material that is permanently sealed in a capsule or bonded and in a solid form. The capsule of a sealed source is strong enough to maintain leak-tightness under the conditions for which the source was designed, including foreseeable mishaps.

How are sealed radioactive sources used?

Sealed sources are widely used throughout the world as a source of radiation in medicine, agriculture, and industry. In medicine, radiation is used to kill tumours in a cancer patient. The sealed radioactive source that produces this radiation is part of a special piece of equipment called a teletherapy machine. A cancer patient is placed near the teletherapy

machine to receive a short burst of radiation targeted at the tumour site. Another cancer treatment, called brachytherapy, uses a small radioactive source that can be implanted in or near the tumour. The patient remains in the hospital during this treatment.

In agriculture, sealed radioactive sources are used to irradiate seeds and food. To prevent early sprouting, crop seeds can be exposed to short bursts of radiation in irradiators. Irradiators are also used to sterilize food and prevent food borne diseases.



Top to Bottom:

An old transport container for radioactive material recovered during an IAEA assisted mission. (Georgia, 2002)/IAEA

The trefoil symbol is used to indicate the presence of radiation

Industrial radiography source capsule, used to contain approximately 0.1 Curie of radium-226/Oak Ridge Associated Universities 1999

A radium applicator once used for insertion into patient's nasal passageways to shrink the lymphoid tissues/Oak Ridge Associated Universities 1999





In industry, sealed radioactive sources are used in gauges that measure the evenness of asphalt during road paving. Sealed sources are also used in gamma radiography to check pipe welds. The source is placed inside the pipe at point of the weld and when the source is removed from its protective shielding by remote control, radiation will pass through the pipe and onto special film (radiograph). Faults in the weld will be visible on the radiograph once it is developed.

Top to Bottom:

Medical radiographer wearing film badge

Industrial radiographer wearing TLD badge (thermoluminescent material in a special holder)

During the June 2002 survey in Georgia, a team member measures radiation levels using a hand-held radiation detector. P. Pavlicek/IAEA

Teletherapy equipment uses powerful radioactive sources to kill cancer tumours.

What are the dangers of sealed sources?

In most countries, the use of sealed radioactive sources is regulated and users are required to be properly educated and trained in radiation safety and protection. The manufacture of the equipment itself is also regulated, so that radiation doses received by users, bystanders, and patients are tightly controlled. Dose limits for individuals have been adopted by the International Community in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), Safety Series No. 115.

The major risks from these sources occur when the source is lost, stolen, or otherwise outside of regulatory control. These so-called orphan sources (orphan meaning they are no longer under proper control) can pose a significant danger if someone obtains or finds such a source and does not realize that it is radioactive. Injuries or death are possible, when sources are found and someone unknowingly takes it home or tries to open it.

Sealed radioactive sources that had been discarded



How can I recognize a sealed radioactive source?

Unfortunately, sealed radioactive sources can look quite harmless — often like a small piece of metal. The only certain way to recognize them is from their radiation label called the trefoil. Depending on the size of the source, it may also have the word “radioactive” engraved on the source itself or its container. Sometimes sealed sources will be inside a larger piece of equipment, protected by heavy lead shielding. Because of the weight of the lead shielding, such equipment is much heavier than it looks. If you find a metal container that is unusually heavy, it may have a sealed source inside and should not be opened. Seek expert assistance.



What should I do if I find a sealed radioactive source?

Stay away from any object with a radiation label. Do not touch it or pick it up. If you find an object with a radiation label or find an unusually heavy piece of metal equipment, contact the appropriate authorities or the police immediately. Do not let anyone else near the object, until trained help arrives. If you feel unwell, see a doctor immediately. Be sure to tell them that you were near to a possible source of radiation. Radiation injuries can look like burns, but do not heal. Symptoms of radiation poisoning include nausea, diarrhea, and vomiting.



IAEA

International Atomic Energy Agency

For more information:

Contact your national regulatory authority or

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