

## Wastes from Medical & Industrial Activities

### Overview

Radioactive materials are used for a wide range of purposes in medical and industrial activities. In particular, radioactive materials are used for the sterilisation of equipment, to help diagnose and treat medical illnesses, to examine metal welds and joints, to gauge the thickness of items and in various devices, such as smoke detectors, and can also be used as tracers to assess the behaviour of liquid effluents.

Most of these processes involves the use of radioactive sources, which are sealed within metal containers. The source then releases a controlled amount of radiation through a small window in the container. This beam of radiation can then be directed at a specified area for diagnosis or treatment purposes. They may also use radioactive gases or liquids, contained within glass tubes.

The amount of radioactive waste produced by medical and industrial activities is small. This waste is generated primarily from the manufacture, use and disposal of radioactive sources and radiopharmaceuticals.

## Use of Radioactive Materials in Medical Activities

Radioactive materials are used for the sterilisation of equipment, and to help diagnose and treat medical illnesses.

The extent to which the radiation penetrates the body varies and is affected by the radiation type, the energy of the radiation and the density of the material the radiation is travelling through.

Rapidly dividing cells are particularly sensitive to damage by radiation. For this reason, some cancerous growths can be controlled or eliminated by irradiating the area, either through external radiotherapy (directing a beam of radiation at the affected area) or through the use of radiopharmaceuticals.

Radiopharmaceuticals are chemicals that contain radioactive isotopes. They can be injected into the body, inhaled or ingested for both diagnosis and treatment purposes. These substances can be easily detected and tracked until they disappear due to decay leaving no trace.

Different chemicals can be absorbed preferentially by different organs in the body. Taking advantage of this, radiopharmaceuticals can be used to assess the condition of particular organs. In diagnostics, the amount of radioisotope added to the body is very small, being just enough to obtain the required information before the isotope decays.

Radioactive sources and radiopharmaceuticals are manufactured by commercial companies at specialist facilities in the UK and overseas. Many thousands of radioactive sources are in use in UK hospitals.



Image: Manufacturing radiopharmaceuticals.  
Source: [www.comecer.com](http://www.comecer.com)

## Use of Radioactive Materials in Industry

### Gamma sterilisation

Radioactive sources are used for the sterilisation of equipment in the medical industry, particularly for items that would be damaged by heat sterilisation, such as syringes, gloves, clothing and fine instruments.

The food industry also uses gamma sterilisation, extending the shelf life of products and reducing the risk of food-borne diseases.

### Gamma radiography

Similar to X-rays, gamma sources are used to penetrate solid objects to show their internal structure. This is called gamma radiography and can be used as part of quality checks in construction and component manufacturing processes, highlighting any flaws in metal casting or welded joints. Different sources are used for different material thicknesses.

### Gauging

Radioactive sources are routinely used to measure the thickness of materials. A radioactive source is directed at the material and a detector placed on the other side. The thickness of the material can then be determined by how much radiation passes through the item. This is a common technique used in the manufacture of items such as plastic film and paper, to help with quality control assessments.

### Smoke detectors

Many smoke detectors used in homes and offices are Ionisation Chamber Smoke Detectors (ICSDs). These devices contain a small ionisation chamber, in which the air between the electrodes is ionised by a radioactive source. A potential difference is applied between the electrodes, causing a small current to flow. If heavy smoke particles enter the detector, the flow of current reduces, triggering the alarm to sound.

The majority of modern ICSDs use the radioactive isotope americium-241. The amount of radioactive material used in these devices is very small and causes no danger to people. Smoke alarms can be safely disposed of with other household and office waste electrical items.

### Tracers

Many different radioisotopes are used as tracers. The radioisotope used is selected on the basis that the half-life is just long enough to obtain the required information and does not cause harm to people or the environment. An example is the tracing of sewage dispersion in sea outfalls and small leaks in fossil fuel power station heat exchangers.



Image: Smoke alarm



## Radioactive Wastes Produced by Medical Activities

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Many different radioactive wastes are produced by medical activities, although usually in relatively small volumes. These include:

- used sealed sources from hospitals
- contaminated laboratory equipment and materials
- other solid wastes such as swabs, vials, syringes, gloves and dressings
- liquid wastes, such as mildly active washings from laundry treatment of protective clothing
- waste radiopharmaceuticals - radiopharmaceuticals often have short half-lives and so need to be replaced at regular intervals

Radioactive waste from medical applications is typically categorised as LLW, and is often suitable for disposal through incineration at appropriately licensed facilities.

Higher activity sealed sources are often returned to the manufacturer for recycling or disposal.

## Radioactive Wastes Produced by Industrial Activities

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In industry, the amount of radioactive waste produced is small. This waste is generated primarily from the manufacture and use of radioactive sources and from the disposal of these sources after they have been used.

During the manufacture of radioactive sources, highly radioactive materials may need to be remotely handled and assembled in shielded gloveboxes. Many thousands of sources can be manufactured in these gloveboxes, leading to an accumulation of wastes contaminated by radioactivity, including equipment, metal shavings, glassware, rubber gloves and paper tissue.

Used sources are managed in a variety of ways. Lower activity redundant sources can often be safely incinerated. Higher activity sources are usually returned to the manufacturer for recycling or disposal.

Some liquid radioactive wastes are also produced in industry, including mildly active wastes from washing protective clothing.