Cesium

The Basics

Who discovered cesium and cesium-137?

In 1860, Gustav Kirchhoff and Robert Bunsen discovered nonradioactive cesium in mineral water in Germany. Radioactive cesium-137, and many other radionuclides that are used in nuclear medicine, was discovered in the late 1930s by Glenn T. Seaborg and his coworker, Margaret Melhase.

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Where does cesium-137 come from?

Nonradioactive cesium occurs naturally in various minerals. Radioactive cesium-137 is produced when uranium and plutonium absorb neutrons and undergo fission. Examples of the uses of this process are nuclear reactors and nuclear weapons. The splitting of uranium and plutonium in fission creates numerous fission products. Cesium-137 is one of the more well-known fission products.

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What are the properties of cesium-137?

Cesium, as well as cesium-137, is a soft, malleable, silvery white metal. Cesium is one of only three metals that is a liquid near room temperature (83 °F). The half-life of cesium-137 is 30 years. It decays by emission of a beta particle and gamma rays to barium-137m.

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What is cesium-137 used for?

Cesium-137 is one of the most common radioisotopes used in industry. Thousands of devices use cesium-137:

- moisture-density gauges, widely used in the construction industry
- leveling gauges, used in industries to detect liquid flow in pipes and tanks
- thickness gauges, for measuring thickness of sheet metal, paper, film and many other products
- well-logging devices in the drilling industry to help characterize rock strata

Cesium-137 is also used in medical therapy to treat cancer.

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Exposure to Cesium and Cesium-137

How does cesium-137 get into the environment?

Cesium-137 in the environment came from a variety of sources. The largest single source was fallout from atmospheric nuclear weapons tests in the 1950s and 1960s, which dispersed and deposited cesium-137 world-wide. However much of the cesium-137 from testing has now decayed.

Nuclear reactor waste and accidental releases such as the Chernobyl accident in the Ukraine release some cesium-137 to the environment. Spent nuclear fuel reprocessing plant wastes may introduce small amounts to the environment. However, the U.S. does not currently reprocess spent nuclear fuel.

Although hospitals and research laboratories generate wastes containing cesium-137, they usually do not enter the environment. Occasionally, industrial instruments containing cesium-137 are lost or stolen. Anyone who unwittingly handles them may be exposed. These devices are typically metal, and may be considered scrap metal and sold for recycling. If they find their way into a steel mill and are melted, they can cause significant environmental contamination. They may also be discarded and sent to a municipal landfill, or sold for other reasons. These devices should be considered dangerous.

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How does cesium-137 change in the environment?

Cesium-137 undergoes radioactive decay with the emission of beta particles and relatively strong gamma radiation. Cesium-137 decays to barium-137m, a short-lived decay product, which in turn decays to a nonradioactive form of barium. The major dose from cesium-137 is from the barium-137. The half-life of cesium-137 is 30.17 years. Because of the chemical nature of cesium, it moves easily through the environment. This makes the cleanup of cesium-137 difficult.

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How do people come in contact with cesium-137?

Everyone is exposed to very small amounts of cesium-137 in soil and water as a result of atmospheric fallout. In the Northern Hemisphere, the average annual dose from exposure to cesium-137 associated with atmospheric fallout is less than 1 mrem; this dose continues to diminish every year as cesium-137 decays.

People may also be exposed from contaminated sites:

- Walking on cesium-137 contaminated soil could result in external exposure to gamma radiation. Leaving the contaminated area would prevent additional exposure.
- Coming in contact with waste materials at contaminated sites could also result in external exposure to gamma radiation. Leaving the area would also end the exposure.
- If cesium-137 contaminated soil becomes air-borne as dust, breathing the dust would result in internal exposure. Because the radiation emitting material is then in the body, leaving the site would not end the exposure.
- Drinking cesium-137 contaminated water, would also place the cesium-137 inside the body, where it would expose living tissue to gamma and beta radiation.

People may also unknowingly handle a strong industrial source of cesium-137. For example, certain moisture gauges contain cesium-137 sources.

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How do I know if I'm near cesium-137?

You need special equipment to detect the presence of any radionuclide. You cannot feel exposure to cesium-137, or taste or smell it.

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How does cesium-137 get into the body?

People may ingest cesium-137 with food and water, or may inhale it as dust. If cesium-137 enters the body, it is distributed fairly uniformly throughout the body's soft tissues, resulting in exposure of those tissues. Slightly higher concentrations of the metal are found in muscle, while slightly lower concentrations are found in bone and fat. Compared to some other radionuclides, cesium-137 remains in the body for a relatively short time. It is eliminated through the urine. Exposure to cesium-137 may also be external (that is, exposure to its gamma radiation from outside the body).

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Health Effects of Cesium-137

How can cesium-137 affect people's health?

Like all radionuclides, exposure to radiation from cesium-137 results in increased risk of cancer. Everyone is exposed to very small amounts of cesium-137 in soil and water as a result of atmospheric fallout. Exposure to waste materials, from contaminated sites, or from nuclear accidents can result in cancer risks much higher than typical environmental exposures.

If exposures are very high, serious burns, and even death, can result. Instances of such exposure are very rare. One example of a high-exposure situation would be the mishandling a strong industrial cesium-137 source. The magnitude of the health risk depends on exposure conditions. These include such factors as strength of the source, length of exposure, distance from the source, and whether there was shielding between you and the source (such as metal plating).

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Is there a medical test to determine exposure to cesium-137?

Yes, there are several. However, they are not routinely available in a doctor's office, because they require special laboratory equipment. Some tests can measure the amount of radionuclides in urine, or in fecal samples, even at very low levels. A technique called "whole-body counting" can detect gamma radiation emitted by cesium-137 in the body. A variety of portable instruments can directly measure cesium-137 on the skin or hair. Other techniques include directly measuring the level of cesium-137 in soft tissues samples from organs or from blood, bones, and milk.

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Protecting People from Cesium-137

What can I do to protect myself and my family from cesium-137?

Cesium-137 that is dispersed in the environment, like that from atmospheric testing, is impossible to avoid. However the exposure from cesium-137 in the environment is very small.

Serious exposure is unlikely. People most likely to accidentally encounter a cesium-137 source typically work in scrap metal sorting, sales and brokerage, metal melting and casting, and in municipal landfill operations. They may unwittingly encounter an industrial instrument containing a sealed cesium-137 radiation source.

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What is EPA doing about Cesium-137?

Both EPA and the Nuclear Regulatory Commission regulate Cesium-137. The Nuclear Regulatory Commission licenses its use. EPA has several regulations that protect you from cesium-137 in the environment. These include standards for the maximum amount of cesium-137 that nuclear facilities may release to the air, and maximum levels for cesium-137 in drinking water. EPA also sets risk-based criteria for clean up of soil and groundwater at sites contaminated with cesium-137 that must be met before the site can be approved for public use.

http://www.epa.gov/radiation/radionuclides/cesium.html