



Radiation Protection

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Tritium

Tritium (chemical symbol H-3) is a radioactive isotope of the element hydrogen (chemical symbol H).

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The Basics

Who discovered tritium?

Tritium was discovered by physicists Ernest Rutherford, M. L. Oliphant, and Paul Harteck, in 1934, when they bombarded deuterium (a hydrogen isotope with mass number 2) with high-energy deuterons (nuclei of deuterium atoms).

Where does tritium come from?

Tritium is produced naturally in the upper atmosphere when cosmic rays strike nitrogen molecules in the air. Tritium is also produced during nuclear weapons explosions, as a byproduct in reactors producing electricity, and in special production reactors, where the isotope lithium-6 is bombarded to produce tritium.

What are the properties of tritium?

Tritium is a hydrogen atom that has two neutrons in the nucleus, in addition to its single proton, giving it an atomic weight near three. Although tritium can be a gas, its most common form is in water, because, like non-radioactive hydrogen, radioactive tritium reacts with oxygen to form water. Tritium replaces one of the stable hydrogens in the water molecule, H_2O , and is called tritiated water (HTO). Like H_2O , tritiated water is colorless and odorless. Tritium has a half-life of 12.3 years and emits a very weak beta particle.

What is tritium used for?

Tritium has several important uses. Its most significant use is as a component in the triggering mechanism in thermonuclear (fusion) weapons. Very large quantities of tritium are required for the maintenance of our nation's nuclear weapons capabilities.

Tritium is also produced commercially in reactors. It is used in various self-luminescent devices, such as exit signs in buildings, aircraft dials, gauges, luminous paints, and wristwatches. Tritium is also used in life science research, and in studies investigating the metabolism of potential new drugs.

Exposure to Tritium

How does tritium get into the environment?

Tritium occurs naturally in the environment in very low concentrations. Most tritium in the environment is in the form of tritiated water, which easily disperses in the atmosphere, water bodies, soil, and rock.

In the mid-1950s and early 1960s, tritium was widely dispersed during the above-ground testing of nuclear weapons. The quantity of tritium in the atmosphere from weapons testing peaked in 1963 and has been decreasing ever since.

Today, sources of tritium include commercial nuclear reactors and research reactors, and government weapons production plants. Tritium may be released as steam from these facilities or may leak into the underlying soil and ground water. However, such releases are usually small and are required not to exceed federal environmental limits.

A recently documented source of tritium in the environment is tritium exit signs that have been illegally disposed of in municipal landfills. Water, which seeps through the landfill, is contaminated with tritium from broken signs and can pass into water ways, carrying the tritium with it.

How does tritium change in the environment?

Tritium readily forms water when exposed to oxygen. As it undergoes radioactive decay, tritium emits a very low energy beta particle and transforms to stable, nonradioactive helium. Tritium has a half-life of 12.3 years.

Current treatment of landfill leachates do not remove tritium.

How are people exposed to tritium?

People are exposed to small amounts of tritium every day, since it is widely dispersed in the environment and in the food chain. People who live near or work in federal weapons facilities or nuclear fuel cycle

facilities may have increased exposure. People working in research laboratories may also come in contact with tritium.

How does tritium get into the body?

Tritium primarily enters the body when people swallow tritiated water. People may also inhale tritium as a gas in the air, and absorb it through their skin.

What does tritium do once it gets into the body?

Tritium is almost always found as water, or "tritiated" water. Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted through the urine within a month or so after ingestion. Organically bound tritium (tritium that is incorporated in organic compounds) can remain in the body for a longer period.

Tritium atoms can exchange with any hydrogen atoms. If the hydrogen atom is part of an organic molecule, the tritium becomes 'organically bound' and is transported with the molecule rather than moving freely like water.

Health Effects of Tritium

How does tritium affect people's health?

As with all ionizing radiation, exposure to tritium increases the risk of developing cancer. However, because it emits very low energy radiation and leaves the body relatively quickly, for a given amount of activity ingested, tritium is one of the least dangerous radionuclides. Since tritium is almost always found as water, it goes directly into soft tissues and organs. The associated dose to these tissues are generally uniform and dependent on the tissues' water content.

Is there a medical test to determine exposure to tritium?

Urinalysis is the easiest bioassay method for determining exposure to tritium. Liquid scintillation counting is a quick and relatively inexpensive method for assessing the concentration of tritium in urine. Because tritium is found naturally in most water supplies at very low concentrations, levels in drinking water would be measured to determine whether the tritium levels exceed the levels present in the body.

Protecting People from Tritium

How do I know if I'm near tritium?

You have to have specialized equipment to detect tritium.

What can I do to protect myself and my family from tritium?

Everyone is exposed to tiny amounts of tritium, much of it produced naturally. If you live near, or work at, a nuclear research facility, a commercial reactor, or a government weapons facility, you should be aware that your tritium exposure may be elevated. Also, be careful not to break open an exit sign, or other device that may contain tritium as an illuminating agent.

What is EPA doing about tritium?

EPA has established standards for the maximum amount of tritium that may be released by nuclear facilities, and that may be found in drinking water. In addition, before being approved for public use, sites previously contaminated with tritium must meet EPA's risk-based criteria for soil and ground water. These criteria set a person's increased risk of developing cancer from exposure to tritium at a cleaned-up site as

being no more than a 1-in-10,000 to a 1-in-1,000,000 chance.

Understanding Radiation in Your Life, Your World

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