EPA Facts About Technetium-99

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What is technetium-99?

Technetium-99 (Tc-99) is predominantly an artificially produced radioactive metal. Tc-99 also occurs naturally in very small amounts in the earth's crust. Tc-99 was first obtained from molybdenum but is also produced as a nuclear reactor fission product of uranium and plutonium. All isotopes of technetium are radioactive, and the most commonly available forms are Tc-99 and Tc-99m.

In addition to being produced during nuclear reactor operation, Tc-99 is produced in atmospheric nuclear weapons tests. Metastable Tc-99 (Tc-99m), the shorter-lived form of Tc-99, is also a component of nuclear reactor gaseous and liquid effluent. Tc-99m is used primarily as a medical diagnostic tool, and it can be found as a component of industrial and institutional wastes from hospitals and research laboratories..

What are the uses of technetium-99?

Tc-99 is an excellent superconductor at very low temperatures. In addition, Tc-99 has anti-corrosive properties. Five parts of technetium per million will protect carbon steels from corrosion at room temperature. Tc-99m is used in medical therapy in brain, bone, liver, spleen, kidney, and thyroid scanning and for blood flow studies. Tc-99m is the radioisotope most widely used as a tracer for medical diagnosis.

How does technetium-99 change in the environment?

Technetium-99 is not a stable isotope. As Tc-99 decays, it releases beta particles and eventually forms a stable nucleus. Beta particles can pass through skin, but they cannot pass through the entire body. The time required for a radioactive substance to lose 50 percent of its radioactivity by decay is known as the half-life. The half life of Tc-99 and Tc-99m is 210,000 years and 6 hours respectively.

How are people exposed to technetium-99?

Man-made Tc-99 has been found in isolated locations at federal sites in the ground water beneath uranium processing facilities. Tc-99 contamination at these selected sites is a concern if individuals are exposed to Tc–99 through drinking contaminated water and ingesting contaminated plants. The potential exposure from external radiation by Tc-99 is minimal because the isotope is a weak beta emitter. Tc-99m is not a concern at these sites because of its short half-life. Tc-99 is also found in the radioactive waste of nuclear reactors, fuel cycle facilities, and hospitals.

In the natural environment, Tc-99 is found at very low concentrations in air, sea water, soils, plants, and animals. The behavior of Tc-99 in soils depends on many factors. Organic matter in soils and sediments plays a significant role in controlling the mobility of Tc-99. In soils rich in organic matter, Tc-99 is retained and does not have high mobility. Under aerobic conditions, technetium compounds in soils are readily transferred to plants. Some plants such as brown algae living in seawater are able to concentrate Tc-99. Tc-99 can also transfer from seawater to animals.

How does technetium-99 get into the body?

At radioactively contaminated sites with Tc-99 contamination, the primary routes of exposure to an individual are from the potential use of contaminated drinking water and ingestion of contaminated plants.

Technetium exposure may occur to persons working in research laboratories that perform experiments using Tc-99 and Tc-99m. Patients undergoing diagnostic procedures may receive controlled amounts of Tc-99m, but also avoid a more invasive diagnostic technique.

Is there a medical test to determine exposure to technetium-99?

Special tests that measure the level of radioactivity from Tc-99 or other technetium isotopes in the urine, feces, hair, and exhaled air can determine if a person has been exposed to technetium. These tests are useful only if performed soon after exposure. The tests require special equipment and cannot be done in a doctor's office.

How can technetium-99 affect people's health?

Once in the human body, Tc-99 concentrates in the thyroid gland and the gastrointestinal tract. The body, however, constantly excretes Tc-99 once it is ingested. As with any other radioactive material, there is an increased chance that cancer or other adverse health affects can result from exposure to radiation.

What recommendations has the Environmental Protection Agency made to protect human health?

Please note that the information in this section is limited to recommendations EPA has made to protect human health from exposure to technetium-99. General recommendations EPA has made to protect human health, which cover all radionuclides including technetium-99, are summarized in the Introduction section of this booklet.

EPA has established a Maximum Contaminant Level (MCL) of 4 millirem per year for beta particle and photon radioactivity from man-made radionuclides in drinking water. Technetium-99 would be covered under this MCL. The average concentration of technetium-99 which is assumed to yield 4 millirem per year is 900 picocuries per liter (pCi/l). If other radionuclides which emit beta particles and photon radioactivity are present in addition to technetium-99, the sum of the annual dose from all the radionuclides shall not exceed 4 millirem/year.

For more information about how EPA addresses technetium-99 at Superfund sites, please contact either:

EPA's Superfund Hotline
1-800-424-9346 or 1-800-535-0202
or EPA's Superfund Radiation Webpage
http://www.epa.gov/superfund/resources/radiation