EPA Facts about Technetium-99

What is technetium-99?

Technetium-99 (Tc-99) is a radioactive metal. Most technetium-99 is produced artificially, but some also occurs naturally in very small amounts in the earth's crust. Technetium-99 was first obtained from the element molybdenum, but it 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 technetium-99 and technetium-99m.

In addition to being produced during nuclear reactor operation, technetium-99 is produced in atmospheric nuclear weapons tests. Metastable technetium-99 (technetium-99m), the shorter-lived form of technetium-99, is also a component of gaseous and liquid effluent from nuclear reactors. Technetium-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?

Technetium-99 is an excellent superconductor at very low temperatures. In addition, technetium-99 has anti-corrosive properties. Five parts of technetium per million will protect carbon steels from corrosion at room temperature. Technetium-99m is used in medical therapy in brain, bone, liver, spleen, kidney, and thyroid scanning and for blood flow studies. Technetium-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 technetium-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 is 210,000 years for technetium-99 and 6 hours for technetium-99m.

How are people exposed to technetium-99?

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

In the natural environment, technetium-99 is found at very low concentrations in air, sea water, soils, plants, and animals. The behavior of technetium-99 in soils depends on many factors. Organic matter in soils and sediments plays a significant role in controlling the mobility of

technetium-99. In soils rich in organic matter, technetium-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 technetium-99. Technetium-99 can also transfer from seawater to animals.

How does technetium-99 get into the body?

At radioactively contaminated sites with technetium-99 contamination, the primary routes of exposure to an individual are from the potential use of contaminated drinking water and ingestion of contaminated plants. Exposure may occur to persons working in research laboratories that conduct experiments using technetium-99 and technetium-99m. Patients undergoing diagnostic procedures may receive controlled amounts of technetium-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 technetium-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 administered 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, technetium-99 concentrates in the thyroid gland and the gastrointestinal tract. The body, however, constantly excretes technetium-99 once it is ingested. As with any other radioactive material, there is an increased chance that cancer or other adverse health effects can result from exposure to radiation.

What recommendations has the U.S. 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 at Superfund sites (the 10^{-4} to 10^{-6} cancer risk range), which cover all radionuclides including technetium-99, are summarized in the fact sheet "Primer on Radionuclides Commonly Found at Superfund Sites."

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

For more information about how EPA addresses technetium-99 at Superfund sites

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http://www.epa.gov/superfund/resources/radiation/