EPA Facts about Thorium

What is thorium?

Thorium is a naturally occurring radioactive metal that is found at low levels in soil, rocks, water, plants, and animals. Almost all naturally occurring thorium exists in the form of either radioactive isotope thorium-232, thorium-230, and thorium-228. There are more than 10 other thorium isotopes that can be artificially produced. Smaller amounts of these isotopes are usually produced as decay products of other radionuclides and as unwanted products of nuclear reactions.

What are the uses of thorium?

Thorium is used to make ceramics, lantern mantles, welding rods, camera and telescope lenses, and metals used in the aerospace industry.

How does thorium change in the environment?

Thorium-232 is not a stable isotope. As thorium-232 decays, it releases radiation and forms decay products that include radium-228 and thorium-228. The decay process continues until a stable, nonradioactive decay product is formed. In addition to thorium-232, thorium-228 is present naturally in background. Thorium-228 is a decay product of radium-228, and thorium-228 decays into radium-224.

The radiation from the decay of thorium and its decay products is in the form of alpha and beta particles and gamma radiation. Alpha particles can travel only short distances and cannot penetrate human skin. Beta particles are generally absorbed in the skin and do not pass through the entire body. Gamma radiation, however, can penetrate the 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 thorium-232 is very long at about 14 billion years. As a result of the extremely slow rate of decay, the total amount of natural thorium in the earth remains fairly constant, but it can be moved from place to place by natural processes and human activities.

How are people exposed to thorium?

Since thorium is present at very low levels almost everywhere in the natural environment, everyone is exposed to it in air, food, and water. Normally, very little of the thorium in lakes, rivers, and oceans is absorbed by the fish or seafood that a person eats. The amounts in the air are usually small and do not constitute a health hazard.

Exposure to higher levels of thorium may occur if a person lives near an industrial facility that mines, mills, or manufactures products with thorium.

Thorium-232 on the ground is of a health risk because of the rapid build-up of radium-228 and its associated gamma radiation. Thorium-232 is typically present with its decay product radium-224, which will produce radon-220 gas, also known as thoron, and its decay products that result in lung exposure. Thorium-230 is part of

the uranium-238 decay series. Thorium- 230 is typically present with its decay product radium-226, and it is therefore a health risk from gamma radiation from radium-226 decay products, lung exposure from radon-222 gas and its decay products, and inhalation and ingestion exposure.

How does thorium get into the body?

Thorium can enter the body when it is inhaled or swallowed. In addition, radium can come from thorium deposited in the body. Thorium enters the body mainly through inhalation of contaminated dust. If a person inhales thorium into the lungs, some may remain there for long periods of time. In most cases, the small amount of thorium left in the lungs will leave the body in the feces and urine within days.

If thorium is swallowed in water or with food, most of it will promptly leave the body in the feces. The small amount of thorium left in the body will enter the bloodstream and be deposited in the bones, where it may remain for many years.

Is there a medical test to determine exposure to thorium?

Special tests that measure the level of radioactivity from thorium or thorium isotopes in the urine, feces, and exhaled air can determine if a person has been exposed to thorium. These tests are useful only if administered within a short period of time after exposure. They require special equipment and cannot be done in a doctor's office.

How can thorium affect people's health?

Studies of workers have shown that inhaling thorium dust will cause an increased risk of developing lung disease, including lung cancer, or pancreatic cancer. Liver disease and some types of cancer have been found in people injected in the past with thorium to take special X-rays. Bone cancer is also a potential health effect through the storage of thorium in the bone.

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 thorium. 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 thorium, are summarized in the fact sheet "Primer on Radionuclides Commonly Found at Superfund Sites."

For uranium mill tailing sites, EPA has established 5 picoCuries per gram (pCi/g) of radium as a protective health based level for cleanup of the top 15 centimeters of soil. Since thorium decays into radium, these regulations for radium under 40 Code of Federal Regulations (CFR) Part 192.12 have often been used as Applicable or Relevant and Appropriate Requirements (ARARs) at Superfund sites for thorium-contaminated soil. The EPA document "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" provides guidance to EPA staff regarding when 5 pCi/g of

thorium is an ARAR or otherwise recommended cleanup level for any 15 centimeters of subsurface soil contaminated by thorium other than the first 15 centimeters. This document is available online at: http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/umtrcagu.pdf.

If regulations under 40 CFR Part 192.12 are an ARAR for radium in soil at a Superfund site, then Nuclear Regulatory Commission (NRC) regulations for uranium mill tailing sites under 10 CFR Part 40 Appendix A, I, Criterion 6(6), may be an ARAR at the same site.

Criterion 6(6) requires that the level of radiation, called a "benchmark dose," that an individual would receive be estimated after that site was cleaned up to the radium soil regulations under 40 CFR Part 192.12. This benchmark dose then becomes the maximum level of radiation that an individual may be exposed to from all radionuclides, except radon, in both the soil and buildings at the site. The EPA document "Remediating Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criterion 10 CFR Part 40 Appendix A, I, Criterion 6(6)" provides guidance regarding how Criterion 6(6) should be implemented as an ARAR at Superfund sites, including using a radium soil cleanup level of 5 pCi/g in both the surface and subsurface when estimating a benchmark dose. This document is available online at: http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/part40.pdf.

EPA has established a Maximum Contaminant Level (MCL) of 15 picoCuries per liter (pCi/L) for alpha particle activity, excluding radon and uranium, in drinking water. Thorium is covered under this MCL.

For more information about how EPA addresses thorium at Superfund sites

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