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How To Remove Radioactive Iodine-131 From Drinking Water

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The Environmental Protection Agency recommends reverse osmosis water treatment to remove radioactive isotopes that emit beta-particle radiation. But iodine-131, a beta emitter, is typically present in water as a dissolved gas, and reverse osmosis is known to be ineffective at capturing gases.

Photo by spettacolopuro via flickr

A combination of technologies, however, may remove most or all of the iodine-131 that finds its way into tap water, all available in consumer products for home water treatment.

First, the standard disclaimers: Every government agency involved in radiation monitoring—the EPA, FDA, USDA, NRC, CDC, etc.—has stressed that the radiation now reaching the United States has been found at levels thousands of times lower than standards of health concern. When it found iodine-131 in drinking water samples from Boise, Idaho and Richland, Washington this weekend, the EPA declared:

> An infant would have to drink almost 7,000 liters of this water to receive a radiation dose equivalent to a day's worth of the natural background radiation exposure we experience continuously from natural sources of radioactivity in our environment."

But not everyone accepts the government's reassurances. Notably, Physicians for Social Responsibility has insisted there is no safe level of exposure to radionuclides, regardless of the fact that we encounter them naturally:

> There is no safe level of radionuclide exposure, whether from food, water or other sources. Period," said Jeff Patterson, DO, immediate past president of Physicians for Social Responsibility. "Exposure to radionuclides, such as iodine-131 and cesium-137, increases the incidence of cancer. For this reason, every effort must be taken to minimize the radionuclide content in food and water."
>
> *via Physicians for Social Responsibility, psr.org*

No matter where you stand on that debate, you might be someone who simply prefers not to ingest anything that escaped from a damaged nuclear reactor. If so, here's what we know:

Reverse Osmosis

The EPA recommends reverse osmosis water treatment for most kinds of radioactive particles. Iodine-131 emits a small amount of gamma radiation but much larger amounts of beta radiation, and so is considered a beta emitter:

> Reverse osmosis has been identified by EPA as a "best available technology" (BAT) and Small System Compliance Technology (SSCT) for uranium, radium, gross alpha, and beta particles and photon emitters. It can remove up to 99 percent of these radionuclides, as well as many other contaminants (e.g., arsenic, nitrate, and microbial contaminants). Reverse osmosis units can be automated and compact making them appropriate for small systems.
>
> via *EPA, Radionuclides in Drinking Water*

However, EPA designed its recommendations for the contaminants typically found in municipal water systems, so it doesn't specify Iodine-131 by name. The same document goes on to say, "Reverse osmosis does not remove gaseous contaminants such as carbon dioxide and radon."

Iodine-131 escapes from damaged nuclear plants as a gas, and this is why it disperses so quickly through the atmosphere. It is captured as a gas in atmospheric water, falls to the earth in rain and enters the water supply.

This is what happened in Boise, Idaho, where iodine-131 was found in rainwater samples last week and then in drinking water samples a few days later.

Reverse osmosis works by forcing water through material with very tiny pores—as tiny as .0001 microns—so that almost nothing except water emerges on the other side. *Almost* nothing.

"Dissolved gases and materials that readily turn into gases also can easily pass through most reverse osmosis membranes," according to the University of Nevada Cooperative Extension. For this reason, "many reverse osmosis units have an activated carbon unit to remove or reduce the concentration of most organic compounds."

Activated Carbon

That raises the next question: does activated carbon remove iodine-131? There is some evidence that it does. Scientists have used activated carbon to remove iodine-131 from the liquid fuel for nuclear solution reactors. And Carbon air filtration is used by employees of Perkin Elmer, a leading environmental monitoring and health safety firm, when they work with iodine-131 in closed quarters. At least one university has adopted Perkin Elmer's procedures.

Activated carbon works by absorbing contaminants, and fixing them, as water passes through it. It has a disadvantage, however: it eventually reaches a load capacity and ceases to absorb new contaminants.

Ion Exchange

The EPA also recommends ion exchange for removing radioactive compounds from drinking water. The process used in water softeners, ion exchange removes contaminants when water passes through resins that contain sodium ions. The sodium ions readily exchange with contaminants.

Ion exchange is particularly recommended for removing Cesium-137, which has been found in rain samples in the U.S., but not yet in drinking water here. Some resins have been specifically designed for capturing Cesium-137, and ion exchange was used to clean up legacy nuclear waste from an old reactor at the Department of Energy's Savannah River Site (pdf).

Triple Threat

The best solution may be the one used routinely to treat water at the Savannah River Site. The process combines activated carbon, reverse osmosis, and ion exchange. If one doesn't get the iodine-131, two others have a chance to capture the radiation through other means.

And that may be the best solution for the average drinker of tap water as well.

[*Disclosure: I have a brother who sells air and water purification equipment. I have no personal investment or involvement in his enterprise or any similar business.*]

Vegetable Contamination

Once you have access to cleaned water, be sure to use it to wash your vegetables. The FDA has not yet begun monitoring U.S. produce for radiation because, the agency says, there is not yet a radiation threat here. The Chinese have been monitoring vegetables, and they've urged their citizens to wash their spinach:

> The Ministry of Health also issued a statement Wednesday evening saying trace levels of radioactive isotope iodine-131 had been found in spinach planted in the open fields within the three regions.
>
> It is has been proven that washing the spinach with water can effectively remove radioactive materials, the Health Ministry said.
>
> It is believed that recent rains in these regions helped drop the radioactive iodine from the air to the ground, and the radioactive materials fell onto the surface of the spinach, the ministry said."
>
> via Xinhua

There may be readers who have other insights into removing iodine-131, cesium-137, or other radionuclides from drinking water. If so, please share them in comments.

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