Frequently asked questions about radium in drinking water

Some Wisconsin community water supplies have naturally-occurring radium in quantities that exceed the safe drinking water standard.

This page will answer common questions about how and where radium occurs in water supplies; what are its health effects; options communities and private well owners have to remedy this problem; and radium regulations.

Table of contents

1. Where is radium found?
2. Where is radium a problem?
3. How is radium in drinking water monitored?
4. What is the drinking water standard for radium?
5. What are the health risks from radium?
6. How can community water systems correct a radium problem?
7. Does correcting for radium cause other problems?
8. Is radium a problem in private wells?
9. What funds are available for replacing a private well that has radium?
10. How is radium treated in private wells?
11. Why spend money reducing radium levels?
12. Radium Health Information (Courtesy of the Wisconsin State Laboratory of Hygiene).
13. Links to additional information.

Where is radium found?

The highest radium levels in water are found in water drawn from two rock formations; the deep sandstone of the state’s eastern quarter and the crystalline granite rock of north central Wisconsin.

Immediate health risks from drinking water containing low radioactivity levels are small, but consuming this water for a lifetime increases the health risks. Another natural radioactive element, uranium, has been detected in a few Wisconsin wells. Currently there is no drinking water standard for uranium.

Currently, approximately 50 of Wisconsin’s 1,300 community water systems exceed the drinking water standard for radium. The Wisconsin Department of Natural Resources (DNR) is providing guidance to help water system officials take corrective action to safeguard the environment as well as human health. Efforts are underway to identify the best methods of reducing radium in drinking water and disposing the wastes from treatment processes.

Where is radium a problem?

All rock contains some radium, usually in small amounts. Groundwater, which moves slowly through the pores or cracks in underground layers of rock, dissolves minerals as it travels. Where the rock contains significant amounts of radium, and the groundwater moves at a slow enough rate, the water can pick up higher amounts of radium.

In Wisconsin, most of the community water supplies which exceed the radium standard draw water from a deep sandstone aquifer and are located in a narrow band which stretches from
Green Bay to the Illinois state line. In addition, a few high radium levels have been found in groundwater from sandstone formations in west central Wisconsin and in granite formations in north central Wisconsin. In all cases, the radium was there long before the first well was drilled.

**How is radium in drinking water monitored?**

By law, all community water systems must be monitored for radioactivity. The testing process for water samples begins with a screening for "gross alpha particle activity" which measures the total amount of one type of radioactivity given off by the water. If gross alpha activity is found, further testing for radium is conducted. Radioactivity levels are measured in "picocuries" per liter of water (abbreviated "pCi/I").

**What is the drinking water standard for radium?**

The state and federal drinking water standard has been established at five pCi/I for the combined total of two forms of radium, Radium-226 and Radium-228. The standard applies to levels in the water distribution system, as determined quarterly and averaged over a one-year period.

**What are the health risks from radium?**

Radium is known to cause bone cancer when consumed in high doses.

The National Academy of Sciences has concluded that a long-term exposure to elevated levels of radium in drinking water does indeed pose a "higher risk of bone cancer for the people exposed." The U.S. Environmental Protection Agency estimates that long-term consumption of water containing five pCi/I radium will cause 44 added cancer deaths for every million people exposed. The risk doubles to 88 per million at 10 pCi/I, triples to 132 at 15 pCi/I, etc.

How does this level of risk compare to other risks in life? It is approximately the same as the risk of dying from lightning strikes, or tornadoes and hurricanes. Fortunately, the risk from radium is manageable because radium can be removed from drinking water.

In the 1920s, radium paint was used to make watch dials luminescent. The workers who painted the watch dials would touch the paintbrush tips to their tongues, and inadvertently swallow high doses of radium. In the decades since, this group of occupationally exposed workers (approximately 4,000) has developed an extremely high rate of death from bone cancer. This effect of radium has also been documented in laboratory animals.

The doses ingested by the radium watch-dial painters and laboratory animals were many times greater than the radium levels in any of Wisconsin’s water systems, and as expected, the associated risk from radium levels commonly found in drinking water is proportionately far lower.

**How can community systems correct a radium problem?**

Each community which exceeds the drinking water standard for radium must determine the best remedy for its situation. Quality, dependability, difficulty in maintaining and operating equipment, and cost of alternatives are important considerations. Corrective methods include obtaining a new water source, blending water from more than one source, or removing radium by treatment. The first two are usually preferable to treatment since they are less expensive and create no additional waste disposal problems.

Where possible, a source of treated surface water or groundwater with lower radium content, drawn from a different geologic formation, can replace or be mixed with an existing source. Systems unable to use these options will have to remove radium by treatment.
The most inexpensive treatment method is likely to be synthetic zeolite ion exchange such as used in home water softeners. This water softening process, is expected to remove about 90% of the radium. It produces a pleasing water supply that reduces scaling in pipes. However, it increases an average daily sodium intake by 200 to 400 mg compared to an estimated average daily intake of 2,000 to 7,000 mg. Increased sodium levels from the ion exchange process are a concern to some people, particularly those on low salt diets, but in most cases the increase will amount to no more than approximately 10% of the average dietary intake of sodium. Numerous treatment plants may be necessary for community systems with multiple wells. Other possible treatment methods include lime-soda ash softening and reverse osmosis. Comparatively high start-up and operating costs may make these options impractical for most affected Wisconsin systems.

Any of the options mentioned above will cost money. Although there may be federal funds available to cover part of the costs, some or all of the costs must be borne by local consumers through higher water bills.

**Does treating for radium create other problems?**

All treatment processes produce wastewater and solid waste (sludge) containing radium in varied concentrations. These treatment by-products must be disposed properly.

Radium waste disposal issues are relatively new to Wisconsin, and the problems they raise are complex and difficult. State officials, however, are working to establish environmentally safe waste disposal criteria.

**What about private wells?**

Generally, private wells are not drilled into the deeper geologic formations containing higher concentrations of radium. Nevertheless, radium has been found in a small number of private and non-community public wells.

A geological and geographical cross-section of Wisconsin’s private wells has now been tested for radium. Concerned owners whose wells have not been tested can contact their regional DNR office, which may be able to estimate groundwater radioactivity levels from previous well samplings. DNR staff will need well construction and location details to make this determination. Water samples can be analyzed for signs of radioactivity by private laboratories or the State Laboratory of Hygiene.

Private well owners wishing to reduce radium levels by reconstructing or replacing wells (the preferred methods) should seek DNR guidance on construction details. A good alternate groundwater supply is the most important factor with these options. In some cases, forming a community system or connecting to an existing system may be feasible.

**What funds are available for replacing a private well that has radium?**

Since radium occurs naturally, replacement or treatment costs are not covered under the new well compensation program.

**How is radium treated in private wells?**

Of the treatment methods described earlier, ion exchange using zeolite softening is effective for home use. Radium, however, could get past a softener which is improperly maintained. Owners need to check softeners regularly to assure that they are operating properly. These home units also build up wastes that need to be properly disposed, and will increase sodium levels in water.
Small "reverse osmosis" units and distillation units may be effective in radium removal in home systems, but the units have limited capacity and severely restrict water flow. The devices can only be used to treat water from a single faucet rather than the entire water supply. Additionally, other water quality problems such as high iron or manganese may interfere with these treatment methods.

The Department of Industry, Labor and Human Relations must approve in-home treatment units for radium removal. The DNR must approve the treatment process and each installation. Before purchasing or installing a treatment system, contact your local DNR region office.

Why spend money reducing levels of something that occurs naturally - like radium?

There is little question that radium does cause biological damage, and most experts agree that if not reduced, the levels of radium we have found could shorten the lives of some Wisconsin residents.

It has been estimated that as much as 80% of all human cancer is due to environmental sources (including diet and such activities as cigarette smoking). In many cases, the specific causes cannot be identified due to the complex patterns of exposure and our inability to measure them.

In the case of radium in drinking water, however, the exposure levels are known, our best science has identified a specific risk, and methods exist to deal with the problem.

The State of Wisconsin is committed to working with each affected community to permanently reduce radium levels delivered to consumers, in the shortest reasonable time.

Radium Health Information (Courtesy of the Wisconsin State Laboratory of Hygiene)

Radium behaves similarly to calcium when ingested. Because approximately 90 percent of radium in the body is deposited in the bones, the primary health risk of radium is bone cancer (Hahn 1984). It has been estimated by the Environmental Protection Agency (EPA) that 44 excess cancer deaths per million people will occur from the continuous ingestion of water at 5 pCi/L over a lifetime (Hahn 1984). Although it is not clear from the reference, most risk assessments are conservative so this risk is probably an upper limit risk or at least it over estimates the mean risk (Bro et al. 1987). Nevertheless, most authorities believe that any dose poses some risk (Hahn 1984). Children are more susceptible to the effects of radiation than are adults because their bodies are growing and radiation has its most profound effects on cells that are actively dividing (Haschke et al. 1987).


Links to Additional Information


http://www.epa.gov/radiation/radionuclides/radium.html