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Drinking Water Problems: Radionuclides

Author: Mary Stellato
Contact: Dr. Mary Stellato, Associate Agricultural Engineer, Texas Agricultural Extension Service, Texas A&M System, Water Resources Specialist, Texas Water Resources Institute, Senior Natural Resources Specialist Prairie View A&M University, Texas A&M Agrilife Extension, Texas A&M Agrilife Research, Texas A&M Agrilife Extension Professional and Texas Agricultural Experiment Station, The Texas A&M University System

Drinking water treatment plant

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What are the Sources of Radionuclides in Water?

Radionuclides are a type of drinking water contaminant that occurs from both natural and man-made. Radionuclides are all around us and have been present since the beginning of time.

Radionuclides are a chemical that is used in mining and other man-made sources. Naturally occurring radionuclides are created in the upper atmosphere when cosmic rays hit the earth's atmosphere. Radionuclides are created when cosmic rays hit the earth's surface and underground when cosmic rays hit the earth's surface and underground when cosmic rays hit the earth's surface and underground

With the initial spray, 50 percent of the radon is removed. As the water is sprayed multiple times, even more radon is removed.

To work properly, a spray aeration system needs to include a holding tank of at least 100 gallons.

Packed Column Aeration

In a packed column aeration system, radon is removed from contaminated water as it is sprayed into the top of a column filled with packing material (Fig. B). The thin layer of water is exposed to air being blown from the bottom of the column. The air then carries the radon gas out of the column to an outdoor vent. Depending on the height of the column, a packed column aeration system can remove 90 to 95 percent of the radon in the water. This treatment option is not practical for water having radon concentrations higher than 20,000 pCi/L.

figure-18-packed-column-aeration-system

Another drawback to this type of system is that over time, biological growth on the packing material or hardness in the water may cause scaling of the equipment.

Shallow Tray Aeration

Shallow tray aeration systems can remove more than 99.9 percent of the radon in water. In this type of system, contaminated water is sprayed onto a tray with tiny holes in it (Fig. B). As the water flows across the tray, air is blown up through the holes.

figure-19-shallow-tray-aeration-system

The water collects on the bottom of the tank and is then pumped to a water pressure tank. As with the other aeration systems, the radon-contaminated air escapes through an outside vent.

This type of unit is traditionally smaller than other types and uses low-pressure air blowers. Unlike the packed column, the tray is not subject to fouling.

A drawback to this type of system is that it uses more air per minute than the other systems; its air flow rate is so high that it can even depressurize the area where it is stored.

Costs

The cost of home aeration units starts at about $3,000. There will be additional installation and maintenance costs, such as energy requirements for blowers and filter replacement if GAC air filters are used.

Granular Activated Carbon

Another way to remove radon gas from water is to use granular activated carbon. GAC systems remove radon from water through adsorption—that is, when water is passed through the carbon material in the unit, radon collects on the surface of the material and is removed from the water.

The effectiveness of the adsorption process depends on factors such as the pH and temperature of the water; the chemical composition and concentration of the contaminants; and the system's water flow rate and exposure time to the carbon. As the temperature and pH levels drop, the rate of adsorption usually increases.

Granular activated carbon lasts longer when the water has low concentrations of contaminants and when flow rates through the unit are low. The type of carbon used in the system should be determined by the system manufacturer's recommendations.

If the source water contains bacteria or high levels of total suspended solids, the water may need to be prefiltered. Bacteria and suspended solids can disrupt a GAC system. If microorganisms collect and grow on the filter, the water treated by the filter may end up with a higher bacteria concentration than what was in the source water. Also, if TSS are not removed, the solids may clog the pore spaces, making the system ineffective.

A range of GAC systems is available for home use, including:

- Point-of-entry (POE) devices, which treat all the water entering a home. They include pourthough filters and faucet-mounted units.
- Point-of-use (POU) devices, which are used to treat water for drinking and cooking.

When a GAC system is used to remove radon, the filter eventually becomes radioactive as it picks up the radon gas. For this reason, the treatment unit must be placed outside of the home or in an isolated area. This makes GAC point-of-use systems impractical for radon treatment.

The disposal of spent filters may pose a problem. All waste needs to be disposed of in accordance with local and state laws. The contractor providing the media replacement may offer disposal of the spent GAC.

Costs

Point-of-entry GAC systems usually cost from $300 to $3,000. Depending on the unit's size and the manufacturer's recommendations, the GAC can treat about 100,000 gallons of water before needing replacement. Replacing the media costs $80 to $100 per cubic foot. The media will need to be replaced rather than backwashed because backwashing with hot water can release the captured radon.

Selecting a Treatment Unit

No single technology can treat all water contaminants. Before selecting a treatment option, you should have your water source tested by a qualified third-party laboratory to determine the water quality.

Once you have established what is in the water, research the different products on the market and find one suitable for treating that contaminant. If more than one contaminant is to be treated, check the systems' co-treatment compatibility. For example, an ion exchange unit can remove multiple types of radionuclides, but to do so, an appropriate resin must be chosen.

When comparing treatment units, consider the initial cost, operation and maintenance costs and requirements, the contaminant removal efficiency, warranties, the system's life expectancy and the reputation of the manufacturer. Before making a final decision, consider the wastewater or solid waste that the system will generate and whether or not you will be able to dispose of the waste.

It is important to note that home treatment systems are not regulated by federal or state laws. There are, however, national organizations that offer certification of products. The Water Quality Association (WQA) offers a validation program and advertising guidelines. Products that receive a Gold Seal Product Validation from the WQA are certified in their mechanical performance, but not in their ability to remove harmful contaminants.

The National Sanitation Foundation (NSF) provides certification of a product's ability to remove contaminants that affect health. For a list of drinking water treatment units with NSF certification, see http://www.nsf.org/Certified/DWTU/.

If you have questions about whether a particular product is certified, contact the NSF by calling 877-8-NSF-HELP (877-867-3435), e-mailing to info@nsf.org, or writing NSF International, NSF International, P.O. Box 130140, 789 N. Dixboro Road, Ann Arbor, MI 48113-0140.

If a product has an EPA registration number, this merely indicates that the unit is registered with the EPA. It does not imply EPA approval or certification.

Keeping the System Working

No matter what treatment technology is being used, the system must be maintained to keep operating properly. The first step to proper operation and maintenance is proper installation. Qualified installers:

- Carry liability insurance for property damage during installation
- Are accessible for service calls
- Accept responsibility for minor adjustments after installation
- Give a valid estimate of the cost of installation

After the system is installed, the unit must be maintained properly. RO membranes must be replaced as needed. The resin in ion exchange units must be replaced or recharged. Distillation units must be periodically cleaned to remove scaling and solid buildup. Any filters used in the system should be replaced according to the manufacturer's recommendations. All wastes should be disposed of properly.

Every system should be operated according to the manufacturer's specifications. If you treat more water than the system is designed for in a certain period, the treatment may be less effective and quality of the treated may be diminished.

To make sure your system is working properly, have the treated water tested regularly by a certified lab.

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