ADVANCED WATER SYSTEMS GROUP

Proudly Presents

Frequently Asked Questions (FAQs) About Residential Water Quality

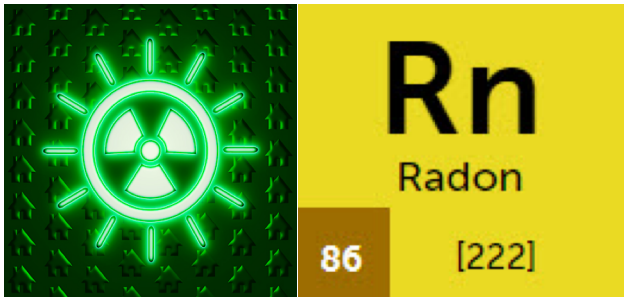
Do You Have Radon In Your Well Water?

Radon (Rn) is element number 86 on the Periodic Table of the Elements and exists as a naturally occurring radioactive noble gas that is found in many groundwater supplies in North Carolina. Radon is produced during the radioactive decay of uranium-238 (^{238}U) through a series of decay steps, each with different daughter products. This decay scheme is shown diagrammatically in the right column. Uranium is a common constituent of many rocks in the Piedmont and mountains of NC. Other daughter products that occur from the decay of ^{238}U include Radium ($^{226,228}Ra$), and Lead (^{210}Pb). As these radioactive elements decay, they give off different types of radiation including alpha particles, beta particles and gamma rays, which can be harmful.

RADON FACTS

- Radon is the leading cause of lung cancer among non-smokers (Field, 2010)
- Radon is one of leading environmental causes of cancer mortality in the US.
- Main pathway for radon into the body is by inhalation – leads to lung cancer
- Ingestion of radon is a minor pathway but can lead to stomach cancer
- Radon is responsible for 21,000 deaths per year according to the EPA.
- 4 picocuries per liter (pCi/L) is the EPA MCL for radon in the air. MCL is 4,000 pCi/L in water.
- 10,000 pCi/L of Rn in water is equivalent to 1 pCi/L of Rn in air

The EPA has recommended a threshold level of radon in drinking water of 4,000 pCi/L. If radon is below this level, then the contribution of ^{222}Rn from the water is considered minimal. If ^{222}Rn exceeds 4,000 pCi/L then the homeowner should consider a radon mitigation system. Exposure of radon from water is most pronounced in the shower and other places where the water is aerated and the radon can escape.



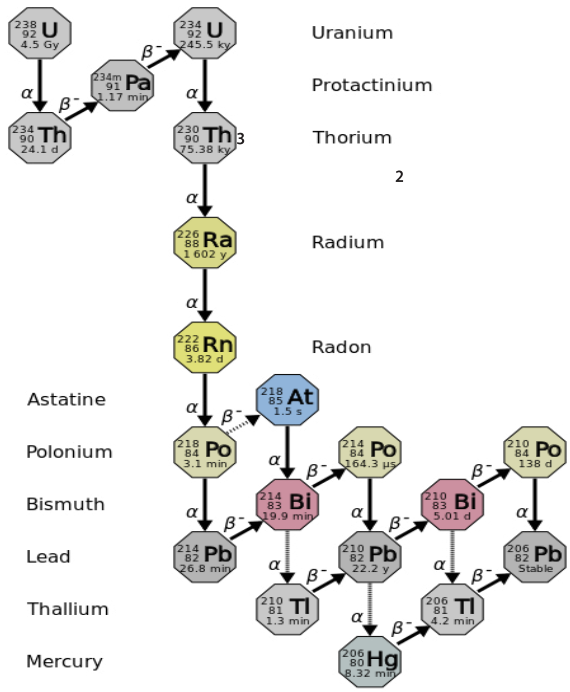
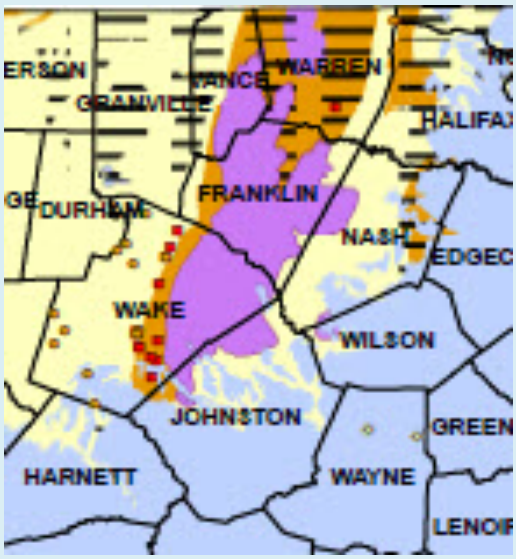


Figure 1. ^{238}U Decay Series. Note daughter products $^{226,228}Ra$, ^{222}Rn, and ^{210}Pb.

The NC Geological Survey has an ongoing mapping project aimed at identifying areas across the state that have a high susceptibility for elevated radon in the groundwater. A draft map of these results is available and a portion of this map is shown below for the Triangle and surrounding areas. Thanks go to Phil Bradley of the NCGS for this map (Bradley, 2014).

Mitigation of Radon in Groundwater



Treatment For Radon in Groundwater

Activated Carbon:

Treatment for radon should be at the point-of-entry, or whole-house. For radon levels below 10,000 pCi/L, a large granulated activated carbon (GAC) filtration system is effective for capturing the radon gas. The major drawback to using GAC to capture radon is the problem of radioactive emission from the tank and the accumulation of radioactive ^{210}Pb inside the tank. From Figure1, you can see that the half-life of ^{222}Rn is 3.82 days. Then decay continues through a series of up to 6 daughter products, last roughly 40-50 minutes before it settles in at ^{210}Pb, which has a half-life of 22.2 years. Thus, this radioactive species is accumulating in the tank.

Kinetico offers single tank (**DC1100-Rn**) and dual tank (**DC1100-2-Rn)** GAC systems for radon reduction, depending on the radon level, for high levels, we often use a two-tank system in a lead-lag configuration to provide additional GAC media. The GAC tanks must be changed out on a regular basis and should not be installed in small enclosed spaces where humans frequent, to minimize radiation exposure. AWS has a special program called *CARBDOSE* created by the EPA that calculates, based on the water radon level, the carbon life before it becomes a low-level radioactive waste, the gamma ray exposure risk, and the cancer risk.

Aeration Systems:

A second radon removal method that is normally recommended for radon levels exceeding 10,000 pCi/L, or for any level, is the home aeration unit. Aeration is considered the best available technology for radon removal from ground water, removing up to 99% of the radon. Kinetico proudly offers the radon aeration systems from RadonAway which includes the AIRaider Series of home aeration systems. The AIRaider 433 Series is a diffuse bubbler system that has an atmospheric storage tank with multiple aeration chambers. The system has an internal submersible pump to re-pressurize the water. This minimizes the footprint of the system and reduces noise.

The AIRaider systems have a vent pipe that carries the removed radon gas out of the building and up above the roof line for venting into the atmosphere. A site inspection is necessary to determine where the system would be located to accommodate the vent stack and to make sure the electrical infrastructure is present.

In some cases, pre-treatment of the water for other contaminants like iron and manganese, or hardness is needed before radon mitigation.

Finally, since radon is a decay product of uranium (^{238}U) and radium (^{226,228}Ra), the homeowner may want to consider a full radioactive water analysis if the radon in the well water is elevated. AWS offers solutions for all radioactive elements, including uranium and radium.

Field, R.W., (2010) Environmental Factors in Cancer: Radon, *Reviews on Environmental Health*, 25(1): 23:31
Bradley, P.J., (2014) Revised Dissolved Radon Susceptibility Map of North Carolina, Abstract: 63rd Annual Meeting Geological Society of America – Southeastern Section