

Radon Entry & Behavior in Indoor Air

Review

After learning the content of this chapter and completing the corresponding reviews and hands on assignments, the following learning outcomes should be achieved:

- ☐ Identify the primary routes of radon entry into a building
- ☐ Identify (4) mechanisms that transport radon into a building
- ☐ Identify (3) ways in which Pressure Driven Airflow draws radon into a building
- ☐ Define the concept of stack effect
- ☐ Define the concept of neutral pressure plane. List negative pressure sources (thermal bypasses) in a building
- ☐ Explain how a spike in radon levels inside the home can occur
- ☐ List six pathways for pressure driven transport
- ☐ Identify the five common foundations common in the US and define which are pathways for pressure driven airflow
- ☐ Explain how daily and seasonal variations effect radon concentrations.
- ☐ Describe the effect of ventilation on indoor radon concentrations.
- ☐ Identify the EPA Guideline for radon in water
- ☐ Identify the primary contribution to indoor air caused by radon in water
- ☐ Identify the primary sources of radon in water.
- ☐ Identify the primary contribution to a radon in air problem due to radon in water.
- ☐ List the typical water sampling methods.
- ☐ Identify the two methods of analyzing collected water samples.
- ☐ Name at least one pro and one con for each water sampling method.

1. The requirements needed for radon to enter buildings and homes:
 - a. A **source**.
 - 1) Soil or bedrock under/near the home.
 - 2) Aquifer or water supply under/near the home.
 - 3) Building materials of the home.
 - b. A **transport mechanism** or a “force” to draw radon into the building.
 - 1) Aquifers or well water
 - 2) Concentration Gradient Diffusion
 - 3) Emanation from building materials
 - 4) Pressure Driven Airflow
 - Mechanical Equipment
 - Wind Induced Airflow
 - Temperature Differentials
 - Barometric Pressure
 - Hydraulic Pressure
 - c. An **opening or pathway** for radon to enter the building.
 - 1) Cracks or openings in foundations
 - 2) Sand, gravel & uneven pebbles
 - 3) Cracks in soil
 - 4) Cracks, fissures, and caverns in underground bedrock
 - 5) Perforated pipe (as used in drainage systems)
 - 6) Plumbing & electrical chases
 - 7) Floor drains
 - 8) Unsealed sill plates & window frames in lower levels
 - 9) Void spaces in hollow block walls
2. **Stack effect** is a convective current powered by temperature-driven airflow. The effect is similar to the draft on a chimney.
3. The **neutral pressure plane** determines the direction of interior convective airflows only.
 - a. Below the neutral pressure plane (the negative side), the convective flow is towards the neutral pressure plane.
 - b. Above the neutral pressure plane (the positive side), the convective flow is away from the neutral pressure plane.
4. Some common negative pressure sources or thermal bypasses in a home:
 - a. Recessed lighting fixtures (by code, these cannot be sealed unless designed for sealing).
 - b. Air gap around chimneys (no combustibles allowed within 2').
 - c. Plumbing chases (especially behind baths and showers).
 - d. Balloon frame walls (two-story wall studs without fire stops).
 - e. Wire penetrations
 - f. Exhaust fans
 - g. Plumbing stacks
 - h. Chimney
 - i. Ductwork Joints
 - j. Floor drains

5. Things that cause radon spikes in levels inside the home:
 - a. Hydraulic pressure.
 - b. Temperature differentials/Convective airflows
 - c. Wind-driven pressure
10. EPA guidelines suggest that it takes approximately 10,000 pCi/L of radon in water to give an airborne concentration of 1pCi/L. So, that's an air-to-water ratio of **1:10,000 pCi/L**.
11. The primary sources of radon in water:
 - a. Underground aquifers via private well or, less commonly, public water supply system that uses ground water.
12. How radon degasses in the home through water:
 - a. Radon off gassing from hot water use in the home is the primary source of concern with regards to radon entering the air via water. Although dish washing and clothes washing can contribute to this source, the main source is a homeowner running a shower or hot bath that emits steam and humidity into the air. Radon and radon decay products can readily cling to these particles and remain in the air.
13. Five foundations common in the US and define which are pathways for pressure driven airflow:
 - a. Pier
 - Yes! Even homes on Pier foundations can have a radon problem!
 - b. Crawl space
 - c. Slab
 - d. Full basement
 - e. Combination