READING MATERIAL
RADON

What Is Radon?

Radon is a naturally occurring radioactive isotope. Radon is colorless and odorless regardless of concentration and is the only member of a chain of decaying isotopes that is a gas. Radon is produced from radioactive disintegration reactions that begin with uranium-238, which is widely distributed throughout the Earth's crust. With a half-life of 3.8 days, radon has time to escape from soil and enter buildings before decaying into polonium-218, a radioactive particle (solid).

Where Does It Come From?

The majority of radon that enters a building comes in through cracks in the foundation and basement floor, crawl spaces, floor drains, joints between walls and basement floor, water pipes, and electrical conduits. Other sources of indoor radon include water (primarily well water) and building materials made of rock, such as brick and concrete. Radon levels may vary a lot from one building to the next in a neighborhood. Radon levels are higher in the basement and lower floors, which are closer to the source, than the upper floors. They also tend to be higher in cold weather when doors and windows are closed.

What Are Its Effects?

It is polonium-218, with a half-life of three minutes, and some of its solid decay products (such as lead-214, bismuth-214, and polonium-214) that present the greatest risk to human health. Alpha particle emissions from the radioactive disintegrations of these radon decay products are sufficiently powerful to penetrate lung tissue and damage the sensitive basal epithelial cells, which leads to lung cancer. Disintegration of the decay products outside the lungs is of little concern because alpha emissions are easily stopped by a couple of centimeters of air, and they are unable to penetrate the skin.

Although the number of deaths due to radon is disputable, the Centers for Disease Control, the American Lung Association, and other major health authorities agree that radon causes thousands of preventable lung cancer deaths each year. Radon is certainly a danger to uranium miners and others exposed to high doses. In the United States, estimates of the number of deaths from lung cancer caused by radon range between 7,000 and 30,000 per year, which is about 10 percent of the lung cancer deaths attributed to smoking. Evidence suggests that radon and cigarette smoking may act synergistically, increasing the cancer risk more than simply adding the risks of radon and smoking.

The U.S. Environmental Protection Agency (EPA) urges home owners to reduce their radon exposure if levels average greater than 4 picocuries per liter (pCi/L). The curie (Ci) is the basic unit of measurement most commonly used in the United States for radioactivity. One curie is equal to 37 billion radioactive disintegrations per second, which is a lot of radioactivity. The radioactivity released by radon and its decay products is usually measured in picocuries (pCi), or trillionths of a curie.

How Do We Detect It?

Measuring radon levels in houses is easy and relatively inexpensive. There are several methods, but the three most common detection units are charcoal canisters, alpha track monitors, and electret ion chambers. The charcoal canister has a radon absorption device and can measure radon levels in 2-7 days. Usually, the canister is mailed to the manufacturer for analysis. Alpha track monitors require 3-12 months to measure radon by recording the tracks of alpha particles emitted when the radon decays. The electret ion chamber, which is designed for short- or long-term testing, contains a specially charged device that, when exposed to the air, reacts to the radioactive decay of radon. The recommended procedure is to begin with a short-term test, and if the results show high radon levels, add further tests.

How Do We Reduce Its Effects?

If the radon detection tests indicate that radon levels are too high, one or more mitigation strategies may be implemented to decrease radon concentrations indoors. The best choice of a strategy depends on how much radon was detected, the design and air flow patterns in the house, cost considerations, and appearance. All strategies involve keeping radon from seeping into the house, and removing radon once it enters the house. Specific strategies may include:

- Sealing cracks and openings, including water and sewer lines and electrical conduits, in and around the foundation and concrete slab under the house;
- Increasing natural ventilation by opening windows to facilitate the flow of outside air into the house, especially to the basement and lower floors;
- Forced ventilation (fans) with or without heat recovery into (never out of) the house on the lower levels;
- Soil ventilation to draw soil gas away from the foundation of the house.

Air flows in the direction of least resistance. Consequently, if fans are used to ventilate the house, it is important to blow the air into, never out of, the house because radon is pulled into the house with the creation of a slight vacuum in the lower areas of the house.

References and Suggested Reading

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