Analysis Techniques for Radon Testing

Most of the radon measurement techniques do not measure radon. Each of the techniques described below measure an aspect of radon; but none of the techniques measure radon directly.

When radon decays, it produces a decay chain, with its own daughters. During its decay, it releases a "large" atomic alpha particle and the atom is transmuted into polonium. An alpha particle is essentially a helium atom stripped of its electrons. It is at this point that the real hazards associated with radon are encountered. It is not the radon which is responsible for the health problems; but rather the Short Lived Radon Daughters (SLRDs) and their decay products, such as the ALPHA PARTICLES.

Charcoal Canisters

The charcoal canister (CC) method of radon concentration estimation is widely used for home owner screening. The CC method measures the gamma radiation associated with the SLRDs. Several assumptions as to relative humidity, equilibration ratio, transient peaks and others are then incorporated in the final analysis.

The advantages of using the CC method are they relatively cheap, usually costing about $25.00 to $40.00.

There are disadvantages associated with the CC method.

The CC method has a VERY HIGH SAMPLING ERROR because it is results are weighted over the last 12 hour period.

The CCs are erroneously thought to integrate the radon concentration over the sample period (usually three to five days), but this is not true. The CC will bias the results to reflect the last 10 to 12 hours of sample time. Therefore, if during the last 12 hours of sampling time a rain storm has occurred, or the outside temperature has dropped or the wind was particularly strong, then it is likely that the results will be biased high. If on the other hand, the day was calm, unusually dry and warm; the results may be biased low.

The analysis of canister requires mailing to a laboratory for results.

Because of the potential errors associated humidity variables, a single CC reading (or indeed several) cannot be used to estimate the annual radon exposure in a house.

NOTE: Carbon Canister sampling is not approved for Residential Transaction Radon Testing.

Alpha-Track Monitors

Alpha-track monitors are typically small cylindrical containers (about 5 cm high) which contain a

piece of plastic film. The opening to the cylinder is often covered with a dust cover.

During the decay of the radon and its SLRDs, the alpha radiation strikes the film and creates microscopic areas of damage which mark the path of the alpha particle. These paths are referred to as "alpha-tracks". After a period of not less than one month (shorter if the radon is particularly high), the film is removed and etched with a solvent to enhance the tracks and the tracks are optically counted under a microscope (there are some automated counting devises). The number of alpha tracks is a function of the radon concentration.

The advantages for alpha-track include:

- The alpha-tracks are as easy to use as charcoal canisters and are small and unobtrusive. They are not affected by either temperature or humidity.
- Alpha-tracks can be used for long periods of time, integrating the exposure over that time. Typically, they are set for a period of three months to one year.

One disadvantage of the alpha-track method is the fact that they are slow. Generally, they should be exposed for a two to three month period. They are slightly more expensive than the charcoal canisters.

The Alpha-track method is traditionally used in the lower level of apartment complexes, retirement centers, hospitals and commercial buildings where a large number of rooms or apartments are to be tested for radon.

Continuous Reading Monitors (CRM)

In a CRM, air is drawn through a filter which traps and retains the SLRDs but allows the radon to pass. The alpha from the SLRDs is counted in a preselected energy window (typically 2 to 8 MeV) over a specified period of time. The counts are automatically converted to a Radon Level of Picocuries per Liter of air (pCi/L) by means of a calibration factor. The report will give a value for each segment of the time analyzed. For example; a sample rate over an hour will generate 24 readings per day.

The advantages of the method include the ability to determine the actual extent of the true hazard; i.e. the SLRDs. The method can evaluate the efficacy of mitigation techniques which aim at reducing the SLRDs. Sources of radon such as showers, (Radon in Well Water) floor drains, sumps et cetera can be determined using CRM. The results are relatively quick, and are obtained on-site without need for laboratory analysis allowing for real-time monitoring of SLRDs.

Some of the disadvantages include the high initial cost of the instrument. The instruments are not simple black-boxes and require the use of a trained operator and the instruments need to be calibrated.

DEFINITIONS:

SLRDs - short lived radon daughters

MeV – 1,000,000 eV – one million electron volts or the voltage of one million electrons

pCi/L - Picocuries per Liter of Air or Water

American Environmental Laboratories uses Continuous Reading Monitors.