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GAC AS A METHOD FOR RADON ABATEMENT

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Perhaps one of the most mysterious abatement procedures is that of the remediation of waterborne radon contamination in residential structures. Many mitigators have been led to believe that the use of GAC as an abatement technique is in appropriate due to the potential creation of a hazardous waste disposal problem. This paper sheds light on the use of GAC as a true alternative to costly aeration mitigation techniques, and can be used as a resource tool for mitigators who need to understand the limits of activity surrounding GAC, and what, if any, shielding may be needed for the protection of residential occupants.

It is important, in light of the recently proposed MCL statement from EPA, that mitigators and professional testers involved in the radon industry understand some facts surrounding the proposed EPA limits.

-If enacted, the MCL of 300 pCi/L will effect 31,000 municipalities nationwide.

-If enacted, the MCL of 300 pCi/L will become the de facto standard for over 13 million private wells.

The proposed MCL for waterborne radon contamination is going to open an entire new field of radon mitigation and testing.

This new field, however, is coupled with several other professions, and may in some states, require that the mitigator or testing firm hold certifications/licenses from public health officials who have direct control over public and private drinking water supplies.

When determining the best alternative for the mitigation of a waterborne radon problem, the engineer must determine the following:

- -The number of users of the water system
- -The waterborne radon concentration
- -Contamination from other organics
- -Cost considerations

It has generally been considered that municipal supplies are "exempt" from contamination by radon due to the turbulance of the fluid as it travels from the ground water supply to the end user. EPA, through its own risk/benefit research, has determined that there will be 3 deaths in 10,000 caused by radon concentrations associated with the MCL of 300 pCi/L.

EPA has also found, as has private industry, that the potential for the contamination of large municipal water supplies from radon is a real and present danger.

Clearly, for large municipal supplies, an appropriate mitigation technique is that of the packed tower aeration method. Several suppliers are currently in the maketplace, and reliability is high. One major disadvantage is that of cost to the individual consumer. Ranging in cost from $3,000 to $10,000 per unit, the homeowner with his/her own private well may easily become financially exhausted if a system were needed.

An alternative in low level contamination regions (<10,000 pCi/l) is GAC. The affinity for radon afforded by granular activated carbon has long been documented. What is not widely known outside of strict technical circles is how carbon performs under radioactive loading, and whether or not the carbon will itself become a radioactive substance.

(SLIDE)

Radon decay is easily and graphically understood through this slide. Once radon is trapped by the carbon bed and removed from the drinking water supply, the radionuclide of intrest is that of lead-210, as it is the longest lived decay product in the scheme.

As scientists, we can calculate a worst case grow in of lead-210 on any carbon bed. A few assumptions can make the calculation easier, and more conservative. The major assumption is:

-We can assume 100% retention of bismuth-214 and lead-214

It would help, however, if we were to be able to know at what activity of lead-210 does the radionuclide become a problem.

The answer is simple and straightforward:

> The EPA has set a level above which disposal of carbon contaminated with lead-210 should be performed with a low-level radioactive waste facility.
> That limit is 2000 pCi/gm (lead-210), and is called the Naturally Occuring Radioactive Guidance Value.

Further, as an engineer, I would like to know what exposure level limit is applicable to residential structures. In 1971, the National Council on Radiation Protection (NCRP) published report number 39, which recommended the Residential Exposure Gudeline Limit of 170 mR/yr. We can collapse the Guideline limit to a MAXIMUM exposure during an 8 hour day (the time you generally spend in you home). The result is the number 0.058 mR/hr (58 micro-R) exclusive of background.

You may design your own shielding system; however, it is nice to be able to calculate the distance at which a person needs to be from the tank to be below NCRP guidlines.

For a standard two cubic foot carbon bed installed for a family of four, and treating water with an influent activity of 10,000 pCi/L, what would be the length of time the filter medium will last? How much shielding will I need?

(SLIDE)

NOT THIS FAR!

Our basic assumption is that the filter is only filtering radon. THIS, IN ITSELF IS A FLAW. Water always contains more than what we either want to know, or care to know.

(SLIDE)

However, assuming that radon is the only thing filtered, it would take in excess of 12 years for the carbon to be considered low level radioactive waste. In practical terms, this means that you would want to schedule a filter bed change out some time prior to it becoming a low level waste. Further may want to consider some margin for safety, and change the filter bed at some time 5 to 7 years in the future.

What would the lead-210 activity be at 5 years?

900 pCi/gm.

How far away from the tank do the occupants of the dwelling need to be?

With no installed shielding, the occupants need to be 34 inches away from the tank to be below NCRP guidline levels of 0.058 mR/hr.

The tank of this size, appropriately installed, should reduce the concentration of waterborne radon to below the EPA proposed MCL for a cost of less than $1,000.

To recap:

-GAC works, an has worked

-One does not install a GAC column, and straddle it during operation, therefore the percived radiation exposeure due to the presence of GAC is incorrect.

-You do not instantly inherit a low level waste problem with GAC if properly monitored.

-Practically speaking,one can tell if a GAC column fails...the radon levels will rise. At that time one only needs to replace the carbon for a cost of about $100.00.

REFERENCES

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4. Chart of the Nuclides, Knolls Atomic Power Laboratory, General Electric Company, NY, 1981.