Environmental Management Science Program

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Measurements of Radon, Thoron, Isotopic Uranium and Thorium to Determine Occupational & Environmental Exposure & Risk at Fernald Feed Materials Production Center

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Research Objective

1. To develop an accurate personal radon/thoron monitor to quantitate exposure during remediation. This personal monitor is a miniaturization and modification of our area ^{222}Rn monitor that has proven accuracy and precision.

2. To develop a personal aerosol particle size sampler, based on the principles of the novel sampler we have developed. The sampler measures not only ^{222}Rn decay product aerosol size but long lived nuclides. There are, as yet, no size distribution data on the aerosol particle size distribution of these nuclides during remediation, yet the aerosol particle size is the major determinant of lung dose.

3. To develop the sequential radiochemistry necessary to measure any environmental sample for ^{228,230,232}Th, ^{226,228}Ra, ^{234,235,238}U and ^{210}Pb. To utilize the radiochemistry to accurately trace and delineate these nuclides in the environment. To obtain historic and present radiochemical data to understand the need for supplemental soil/water etc. measurements.

Research Progress and Implications

1. As of June 1998, we have designed the personal radon/thoron monitor and it is being fabricated at a commercial molding facility. It contains 3 separate entry ports for 3 alpha track films, each port is gas sealed and contains a specific gas entry diffusion barrier. The radon versus thoron gas concentration is obtained by signal differencing, using different diffusion barriers for radon and thoron gas. The alpha track film area is 1 cm^2 and has only few background tracks on the pristine film. The detection limit for either radon and thoron is 3 pCi/L day. The exterior shape is triangular and the overall dimensions small enough so that it can be worn on a lapel without worker interference.

This personal monitor can be used either as an area monitor or a personal monitor.

2. As of June 1998, we have performed research using a personal aerosol particle sampler, modified to measure 3 particle size regions. The sampler is a lapel monitor using a belt pump. The original commercial sampler used an impactor entry to eliminate particles greater than 2.5 micrometers. Particles less than 2.5 micrometers are measured on the backup filter. Our modification uses ZnS alpha phosphor on the impactor stage, followed by several 500 mesh wire screens, then followed by the backup filter. This design permits actual measurement of the alpha particle radioactivity on particles greater than 10 micrometers, the screens permit the measurement of ultrafine and fine particles and the backup filter 0.05 to 2.5 micrometers size particles. These multiple stage alpha particle radioactivity measurements permit the use of our size deconvolution program to determine the aerosol particle distribution with high accuracy.

To measure the alpha particle radioactivity on filters, screens, etc. we use our high efficiency (50%), low background (5 count per day) alpha counters that were designed in house.

We have tested the modified aerosol particle size sampler in the basement of a suburban home. The alpha particle radioactivity measured on the screens and filters is the natural airborne radionuclide ^{212}Pb present from the decay of ^{220}Rn (thoron). These tests show that even at normal environmental low activity concentrations, it is possible to measure the size distribution accurately. During the next year we plan to fully calibrate the monitor in the NYU Test Aerosol Facility, and further

modify the input impactor stage to permit a smaller size cutoff. This permits more detailed information in the 0.05 to 0.2 micrometer size range. These very small aerosol particles deposit efficiently in the bronchial airways, and in general deliver the major radiation dose to the airways in any exposure situation.

Both the personal radon/thoron monitor and the personal aerosl size sampler can be adapted for use at any DOE facility.

Planned Activities

We have established our first visit to the plant for mid June 1998. At this time all of the DOE and FERMCO individuals in charge have agreed to guide us in the research, and explain the work that has been accomplished. They plan to discuss and set up the new work areas and environmental locations that are of interest to monitor for radon thoron concentrations and aerosol particle size, using the new instruments described above.

Also during this visit the USDOE consultant on our project (Dr. Isabel Fisenne, Environmental Measurements Laboratory) will accompany on this field trip and will be given access to the existing environmental radiochemical sampling and analysis data. She will assist in the QA/QC during remediation and locate the areas where research and additional radiochemical sampling will assist the overall Fernald project.

During the next year we plan at least 2 data gathering field trips to begin actual concentration measurements using the newly designed personal monitor, and aerosol particle sampling with the personal aerosol particle size sampler. These data will provide background information so that we can plan for best sampling times and locations.

Other Access To Information

Information concerning radon measurements using the original radon monitor design may be viewed at **http://charlotte.med.nyu.edu/faculty/harleyN.html**