RADON/RADON-DAUGHTER MEASUREMENT METHODS AND INSTRUMENTATION

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Radon-daughter measurement equipment and techniques have been continuously improved over the last 25 years. Improvements have been in the areas of accuracy, time and convenience. We now have miniaturized scalers and detectors available for measuring the alpha particle count rates from aerosol samples collected on filter papers. We also have small light weight efficient pumps for conveniently collecting samples and we have various counting methods which allow us to choose between making very precise measurements or nominal measurements.

The standard radon-daughter measurement method still generally used in mines and mills is the Kusnetz method which I'm sure everyone here is familiar with. This method offers the advantage of being simple and reasonably accurate.

Where haste is important in sample analysis, we can employ the Rolle method without a significant loss in measurement accuracy but with some disadvantage in that the elapsed time after the end of sampling must be watched carefully. If we desire to analyze the sample carefully for the different daughter components making up the working level, we can utilize the Tsivoglou or one of several modified Tsivoglou methods. The Tsivoglou measurement method requires a scaler and at least 30 minutes of attention immediately following sampling in order to obtain the necessary data for making calculations which are relatively complex.

Several special instruments have been designed to allow "instant" working level measurements. These instruments each have their own individual advantages and disadvantages. Although they are not now widely used, it is likely that they will be in the near future.

MESA does not have a formal Approval system for radiation measurement instruments but it is in the process of trying to formulate such a system for radon-daughter monitoring equipment. Until such a system is developed, we in the Radiation Branch, Denver Technical Support Center, test instruments and attempt to define their accuracy parameters under various environmental conditions within present budget and personnel constraints. We have found this necessary to satisfy the queries made by manufacturers of new types of radon-daughter measurement equipment and potential customers. We are assisted greatly in this effort by U.S. Bureau of Mines personnel in Denver.

Radon gas measurements are not required to enforce MESA's current radiation standards, however, we have had experience in making radon gas measurements using Lucas flasks and "two-filter" sampling devices. Lucas flasks are simple to use and accurate however they require special counting equipment. The "two-filter" device which we designed employs standard 1-inch-diameter filters and can therefore be used with standard alpha detectors. The device is not very sensitive to flow rate variations and could be used with a standard 2 lpm sample pump. We, however, normally use a higher volume pump. We have experienced some problems with maintaining the calibration of these devices which I attribute to variable diffusion characteristics.

We have taken a considerable number of free-ion samples using the 60-mesh screen method developed by Adreas George here at the HASL laboratories. These samples were taken primarily to assess whether the percentages of free ions were increasing significantly with the increasing amounts of ventilation being provided today's mines. We have found the free-ion percentages generally well below 10 percent wherever actual mining operations have been underway for any appreciable length of time.

We have been working on developing and testing a practical personal radon-daughter-exposure integrating device which can be worn by miners. In the laboratory, we first developed read-out equations which allow us to relate thermoluminescence to Working Level-Hours of exposure. This did not prove to be too difficult. The greatest difficulty has proven to be in finding a satisfactorily dependable air mover. We believe we now have such an air mover and more than six separate tests with miners wearing the devices have yielded favorable results.

As with the use of most measurement devices, the proper calibration of radiation measurement equipment is critical in obtaining satisfactory results. We routinely calibrate MESA's and other governmental agencies radon-daughter monitoring equipment which is used in monitoring radiation levels in our nation's mines and mills. In addition to this we give special training and assistance to industry officials in the various aspects of radiation monitoring and control.