South Australia’s Environment Protection Authority

Radon chamber for simulation of occupational and environmental exposure conditions in mining projects

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Radon Progeny Coordination Group

- Currently SA EPA radon chamber is used in the first stage of measurements for the Radon Progeny Coordination Group
- Radon Progeny Coordination Group established by ARPANSA and includes the uranium mining industry and State and Territory regulatory authorities
- New radon progeny dose conversion approach - ICRP 115 (2010)
Radon Chamber

- Current chamber design was established in 2008 from a previous designs (1984, 2001) used at earlier locations
- This model has improved radon injection and control of concentrations
Radon source

- Source of radon is Radium-226 dissolved in HCl.
- Radium-226 activity is ~400 000 Bq.
- Source is contained in a glass flask covered by a polyethylene film (permeable to radon).
- Radon source is continually flushed at the rate of 1 L/min to maintain constant radon concentration.
- The radon flux can be proportioned between the chamber and the exhaust duct to control chamber concentrations.
Combination of oil particle generator and continuous recirculation/filtering system based on HEPA 7112 filter

Recirculation rates: 20, 40, 60 or 80 provide effective exchange of particle as well as stable value for particle concentration
Variation of particle concentration
Radon concentration

- Radon is injected at 0.00586 Bq/min ± 0.00016 with full source flow 6 L/min
- Desired level is maintained with 0.1 L/min source flow
- The radon activity is measured using AlphaGUARD
Continuous counting method WLM-30 Working Level Monitor

The air within the chamber is drawn onto the filter paper at ~5 L/min, allowing the radon decay products to be collected
Borak method

- PEAC determination is based on collecting of RDP on the filter (5 min)
- Counting (for 5 min) after interval of time (3 min) allowing in-growth of all three radon decay products
Modified Tsivoglou (Thomas) method

\[
\begin{bmatrix}
A_c \\
B_c \\
C_c
\end{bmatrix} = 
\begin{bmatrix}
0.127892 & -0.062077 & 0.058691 \\
-0.004229 & -0.008582 & 0.023892 \\
-0.012406 & 0.018993 & -0.022702
\end{bmatrix}
\begin{bmatrix}
C_1 \\
C_2 \\
C_3
\end{bmatrix}
\]

LabView based software for automated counting and simultaneous Borak/Tsivoglou

ARL/TR011, June 1979 Monitoring Employee exposure to Radon and its daughters in Uranium Mines
V.A. Leach and K. H. Lokan

A Formulation of the linear equations of the Thomas Method into Simple Matrices. B.M. Harley Radiation Protection in Australia (1989), Vol.7, N 2
PAEC and equilibrium factor

![Graph showing PAEC (μJ/m³) and equilibrium factor for different recirculation rates. The graph includes lines for TSVG, Borak, F, and F No particles. The y-axis represents PAEC, and the x-axis represents recirculation rate. The equilibrium factor is also plotted on the right y-axis.]

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Influence of ventilation rate on proportion of decay products

RDP concentration varied by changing filtration/circulation (age of mine air)
Summary

- The EPA SA radon chamber is used to replicate the conditions of many real-world situations e.g. outdoor environment and underground mines

- This is achieved by:
  - Using a known radon source
  - Controlling flow-rates of radon into the chamber
  - Measuring radon activity concentration with the AlphaGUARD detector
  - Measuring PAEC with the Tsivoglou method

- Radon Progeny Coordination Group - Monitoring Of Radon Progeny And Calibration Of Equipment For Mining Projects  David Kruss, EPASA