CHARACTERISTICS OF RADON DECAY PRODUCTS IN A TYPICAL DWELLING IN BRITTANY. COMPARISON BETWEEN EXPERIMENTS AND *PRADDO* MODEL.

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KEYWORDS

radon daughters, indoor measurements, modelling

INTRODUCTION

It is well known that inhalation of radon decay products is responsible for about 40% of human natural exposure. It is then important to understand the behavior of radon daughters in a closed room. Field measurements and model calculations are complementary approaches. Nevertheless, few theory-experiments comparisons have been made to check the models. In this paper, experiments carried out in a dwelling under typical indoor conditions are compared to results obtained with PRADDO model.

EXPERIMENTAL PROTOCOL

During one year, from May 1997 to April 1998, measurement were carried out in a dwelling, with high radon activity concentration, located in Brittany. Experiments were performed in the living-room situated on the ground floor. Radon activity concentration was measured continuously by electroprecipitation of the positively charged $^{218}Po^{+}$ ions. Moreover, unattached fraction and equilibrium factor were determined continuously with an original system designed in our laboratory (Huet et al., 1998). It consists of simultaneous measurements of the attached fraction using an annular diffusion channel and measurements of the total radon decay products using an open filter, both equipped with an alpha detector. Spot measurements of the size distribution of unattached and attached radon daughters were also performed using a granular bed diffusion technique and the SDI-2001 (Tymen et al., 1992). Particle concentration and number size distribution were determined using a diffusion battery TSI 3040 associated to a CNC TSI 3022. All these parameters were investigated under different aerosol conditions (natural aerosol, cigar smoke, cooking…).

PRADDO MODEL

The first model to describe the behavior of radon daughters in uranium mines was developed by Jacobi in 1972 and extended to indoor atmospheres by Porstendörfer et al. (1978). More recently, PRADDO (Gouronnec, 1995) was developed to simulate a multi-storey habitation and has already been experimented in a basement (Gouronnec et al., 1996). With such a model, activity concentrations of free and attached radon decay products, equilibrium factor, unattached fraction, Potential Alpha Energy Concentration (PAEC) and attached size distribution are calculated from balanced between inputs and losses of radioactivity by radioactive decay of radon and its daughters, ventilation, surface deposition, attachment to airborne particles and recoil.

COMPARISON BETWEEN EXPERIMENTS AND CALCULATION

The input parameters of the models such as attachment rate, ventilation rate, outdoor and indoor radon activity concentration were determined using measured values. Then, free and attached radon daughters activity concentrations, PAEC, unattached fraction and equilibrium factor were calculated and compared to our measured values. Results of the calculation are in good agreement with experimental values as shown on table 1 where the mean measured and calculated values are compared and on figure 1 where the calculated and measured activity concentrations of Po-218 are plotted.

Parameters	Measured	Calculated
Total PAEC ($\mu J/m^{-3}$)	3.3	3.5
Unattached fraction	0.03	0.04
Equilibrium factor	0.41	0.45

Table 1: Measured and calculated mean values of total PAEC, unattached fraction and equilibrium factor obtained with aerosol sources for a set of 30 data.

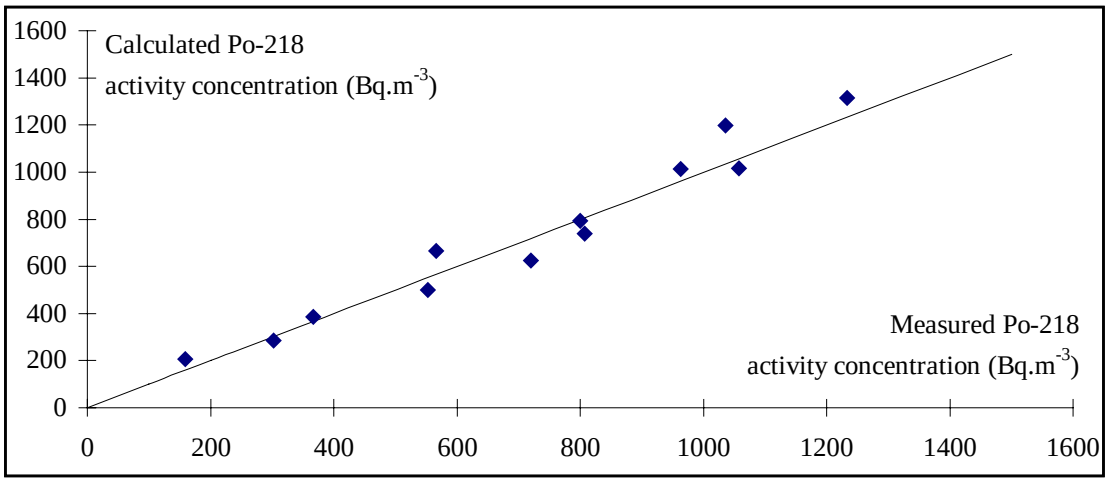

Figure 1: Theory-experiments comparison for Po-218 activity concentration.

The first results of theory-experiments comparison obtained for the PAEC, unatttached fraction and equilibrium factor show a good agreement. Preliminary results concerning the size distribution of attached radon daughters are also comparable.

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