Status Report of Project 4, Contract Bi7-047 of the CEC Radiation Protection Research Programme

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II Objectives for the reporting period

The objectives for the reporting period were a) to further develop the experimental facility for radon - aerosol studies, b) to develop alfa-spectrometry using detection over large areas, c) to develop a multi-jet impactor, which combines a low cut-off diameter with a high flow rate and d) to perform introductory controlled studies on the interaction between radon daughters and aerosol particles.

III Objectives for next period

The objectives for next period are to design a five-stage multi-orifice impactor for activity distribution studies, to further develop the technique to measure the size distribution of the activity by using a differential mobility analyzer and c) to apply the techniques for well-controlled conditions and for a limited number of realistic environments.

IV Progress achieved including publications

During the reporting period the experimental facility for radon studies at Lund Institute of Technology has been further developed and introductory studies regarding radon daughter - aerosol particle interaction have been performed. A multi-orifice impactor stage has been constructed and tested.

Figure 1 shows a schematic view of the experimental facility. The room itself (volume = 19.8 m^3) is housed in a trailer. The walls are made of urethane, covered with glass-fibre, plastic and plastic paint. Inside, there are 12 supply and 12 extract terminals along the long-sides of the room.

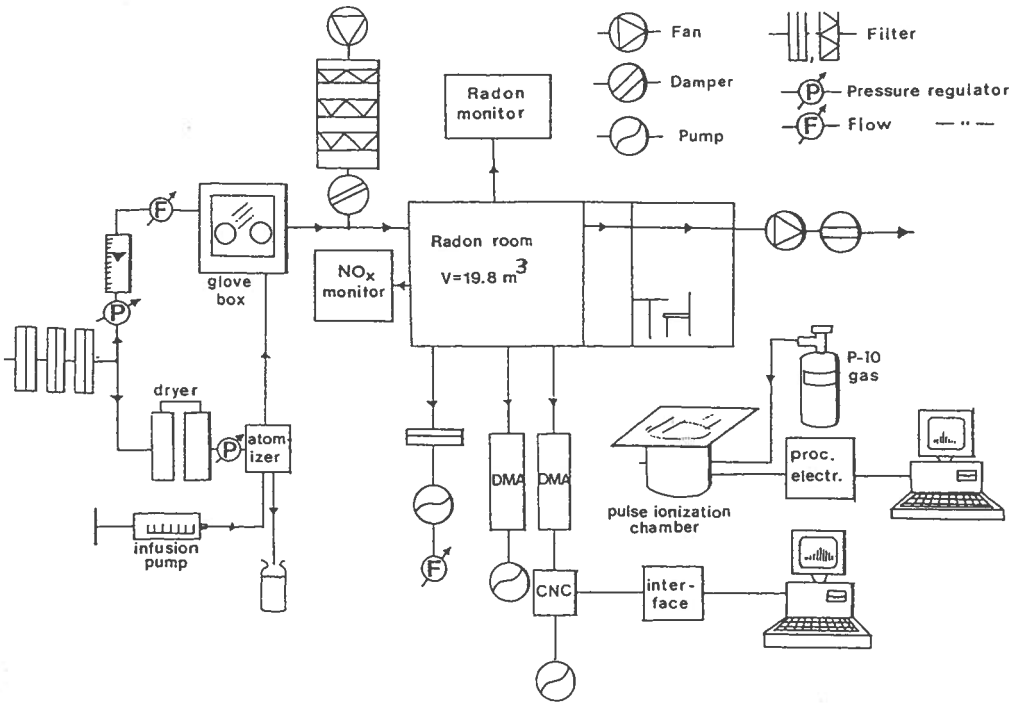

Fig.1 Schematic view of the experimental facility.
Abbr. DMA=Differential Mobility Analyzer.
CNC=Condensation Nucleus Counter

The room has its own ventilation system: Pressurized air from a compressor is filtered and dried and then supplied to the room. Various aerosols can be added and mixed in the glove-box. The instruments for monitoring the concentrations of radon, radon-progeny and NO_x, are located outside the room. The size-distribution of the passive and the active aerosol is also measured. Plate-out is measured with a large-area pulse-ionization chamber. The unattached fraction is measured with the single screen/filter technique.

Measurements show that the room can provide an atmosphere with an unattached fraction ranging from 0 to 100 % (fig. 2) and an equilibrium factor ranging from 0.1 to 0.7 (fig. 3) when the room is ventilated at a rate of 0.5 h^{-1}.

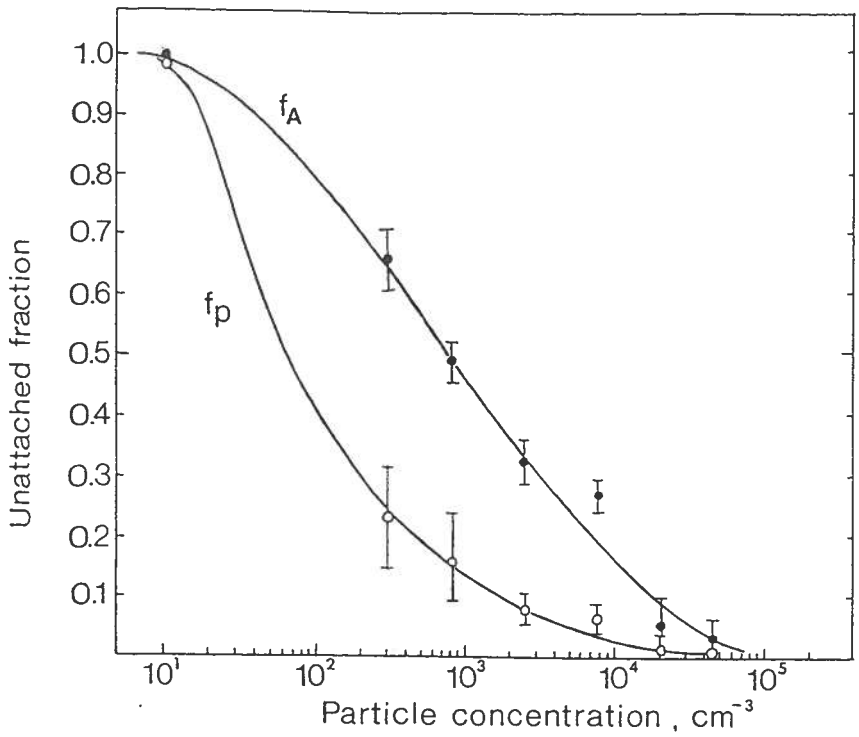

Figure 2. Unattached fraction, fp, and ratio of unattached to total activity of RaA, f_A at various particle concentrations. Ventilation rate = 0.5 h^{-1}. NaCl aerosol: geometric mean diameter = 100 nm, activity, mean diameter = 250 nm, geometric standard deviation regarding diameter = 2.0

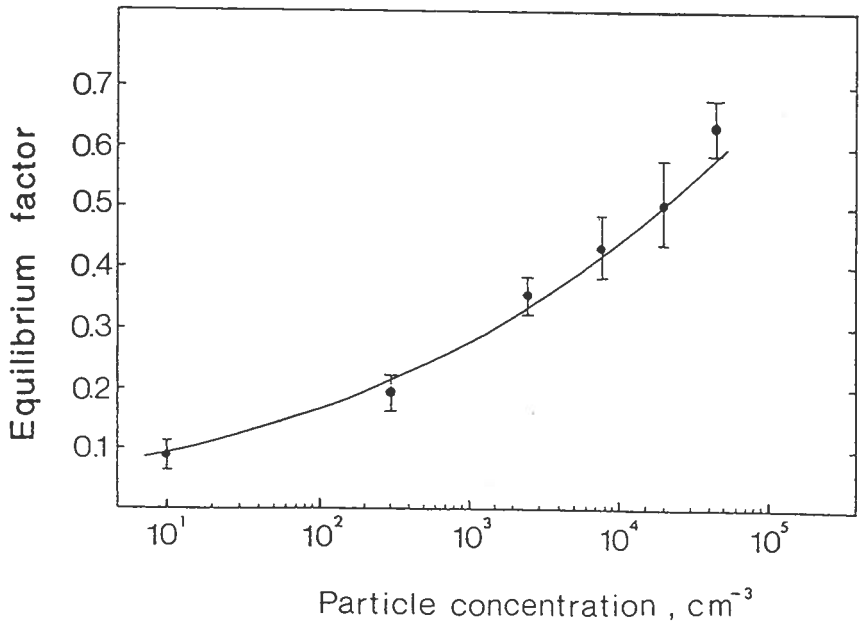

Figure 3. Equilibrium factor at various particle concentrations. Ventilation rate = 0.5 h^{-1}. NaCl aerosol: geometric mean diameter = 100 nm, activity mean diameter = 250 nm, geometric standard deviation regarding diameter = 2.0

An impactor stage has been constructed and an experimental set-up for testing and calibrating impactors for sub-micron particles has been designed.

In order to optimize the impactor design, the collection characteristics have been studied as a function of jet-to-plate distance and of the Reynold's number of the jet. The current impactor stage consists of 2700 laser-drilled orifices. The diameter of the orifice plate is 26 mm. The orifice diameter is 50 µm. A cut-off diameter between 50 and 100 nm can be achieved. The air flow is about 30 l/min. and the pressure drop over the stage is about 20 kPa.

Resulting Publications

An Experimental Facility to Simulate Radon-Progeny Behavior in Dwellings
Proceedings of the 29th Hanford Symposium on Health & the Environment - "Indoor radon and lung cancer - reality or myth?", Richland, Wa, USA, October 1990
Eklund P, Bohgard M

Multi-Jet Impactor with 50 Micrometer Diameter Nozzles for Uniform Deposition of Submicron Particles
Abstract, Proceedings of the Symposium of the Nordic Society for Aerosol Research, Gothenburg, Sweden, November 1990
Gudmundsson A, Bohgard M, Hansson H-C

A Full-Scale Experimental Set-Up for Determining Relevant Parameters for Radon Daughter Behaviour in Dwellings
Abstract, Proceedings of the Symposium of the Nordic Society for Aerosol Research, Gothenburg, Sweden, November 1990
Eklund P, Bohgard M