CONSTRUCTION OF RADON/RADON DAUGHTER CALIBRATION CHAMBER

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In addition to constructing a radon/radon daughter test chamber, the design of a similar chamber for thoron/thoron daughter calibration has been planned. Both chambers are copper lined rooms of dimension 1.65 x 1.75 x 2.75 m with an effective volume of 8000 litres. A schematic for the first chamber which is used for radon/radon daughter measurements and tests is shown in Figure 1. The air residence time, and hence the relative radon daughter concentrations, are controlled by circulating the air in the chamber through absolute filters which remove 99.9% of particulates (HEPA filters). There are two separate pumping systems for this:

(1) Two Rootes blowers with combined maximum capacity of 3000 litre/minute. One blower has a continuous variable speed control, while the other blower has two speeds. This gives a continuous flow range of 3000 litre/minute to 400 litre/minute.

(2) Two Thomas compressors with combined maximum output of 400 litre/minute. By controlling the air flow with a straight-through valve the flow rate can be varied continuously down to 30 litre/minute.

Radon is drawn into the chamber from a 17 μCi ^{226}RaCl source (in solution) using the pressure differential across the blowers (<3 psi). This low pressure differential combined with the length of the connection to the source ensures negligible ^{226}Ra contamination to the chamber.

Having established the radon concentration in the chamber, the daughter concentrations and F factor (ratio radon activity to WL) are controlled by the air flow through the absolute filters. An air flow range of 3000 litre/min to 30 litre/min corresponds to an "age of air' range of ≈3 minutes to ≈180 minutes. At this stage no attempt is made to keep the radon concentration constant. The air flow is determined from the pressure drop across a number of orifice plates and a feed back system controlling a motorised valve is used to maintain a constant air flow.

At present there is minimal ability to control temperature, humidity and aerosol concentration. At low rates of air flow an ultrasonic nebuliser is used to inject water aerosol into the chamber. The air for this purpose is drawn through a by-pass circuit from the main air flow. The nebuliser is controlled by a humidity sensor so that the humidity may be set to a predetermined value. This system is ineffective at very high flow rates (very young air), leading to relatively dry clean air. We have measured condensation nuclei (CN) concentrations of less than 30 cm^{-3} and unattached fractions for RaA of >99% in this system. A number of aerosol generators are being examined and it is planned to use the CN counter* in a feed back loop to control the aerosol generator.

Access to the radon chamber is through an air tight hatch on the east wall. Beside the main hatch is located a small airlock. A pair of rubber gloves are mounted above the air lock to allow equipment to be removed and placed on the equipment racks in the chamber. A second set of gloves are located on the north wall, below a large perspex window. All electrical and sampling connections are located on this north wall of the chamber. There is provision for AC and DC power and a substantial number of signals and central lines. A two filter tube can be inserted through a port in the perspex window. This enables air samples to be collected away from the walls. The activity on the front filter on this tube can be analysed using the Rolle method to measure WL,[1] while the activity on the back filter can be analysed to determine the radon concentration. (Two Filter Method).[2] As well, radon concentrations in the chamber are measured by means of Lucas cells,[3] for comparison purposes.

The system is flushed by venting the air in the chamber to the atmosphere, through an absolute filter. Since the chamber operates with a single charge of radon, the total amount of radon vented to air is relatively small compared with a test chamber using a continuous source of radon.

Although the radon chamber is not yet completed it has been extensively used for the testing and calibration of monitoring equipment. An intercomparison with Terradex track etch detectors was made using this chamber with good results. The chamber was also used to assess plate-out on the inlet ports to a number of radon daughter monitors.

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* (Environment One Rich 200 CN Monitor).

A second chamber for thoron and its daughters is located in the same room as the radon test chamber. This chamber which is not yet operational, is less complex than the radon chamber. A quantity of thorium containing material will be used as a constant source of thoron within the chamber and the thoron daughter concentration will be controlled by adjusting the rate at which the chamber air is vented to the atmosphere.

REFERENCES

1. Rolle R, (1972) Health Physics 22:233.

2. Thomas J W, and LeClare P C, (1970) Health Physics 18:113.

3. Lucas H F Jr, (1957) Radiology 68:258.

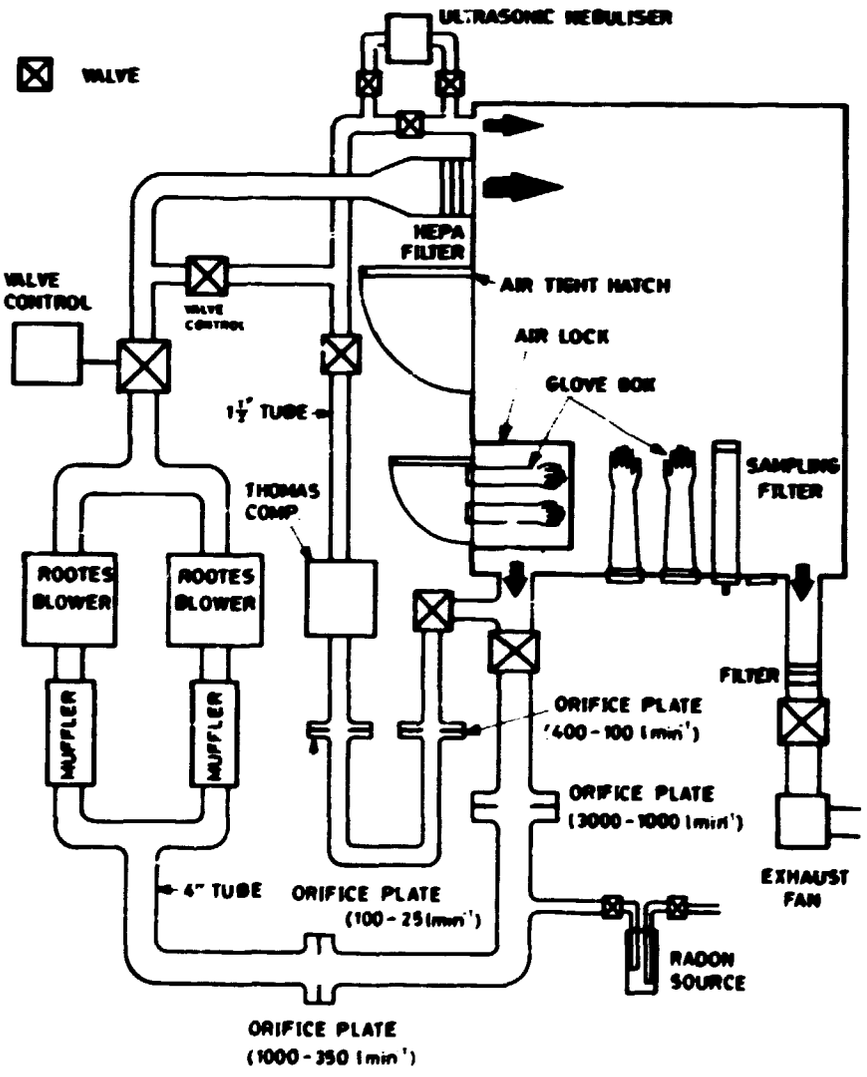

Figure 1. Schematic diagram of radon/radon daughter test chamber.