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ESTABLISHMENT OF A RADON TEST CHAMBER

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ABSTRACT

A walk-in type radon test chamber of 23 m^3 has been built for testing and calibration of radon measurement instruments. The environmental conditions of the test chamber can be varied within a wide range of values. The design objectives specification, monitoring instruments and testing results of this chamber are discussed. This test chamber is avaliable for domestic radon researchers and its accuracy can be traced to the international standard. A routine intercomparison study will be held annually by using this chamber. Other tests like radon progeny and thoron standard may also be performed in this chamber.

INTRODUCTION

Environmental radon problem has become a much concerned issue recently. The 1988 UNSCEAR report indicates that the annual effective dose equivalent per capita incurred from inhalation of radon and radon progeny amounts to 1.23 mSv, which is equal to 52% of the total amount of radiation dose received from both natural and man-made radiation sources. This implies that radon and its progeny are the major contribution of natural radiation to human beings. Several radon test chambers already exist in the world [1-6] that supply radon standards for instrument calibration and research purposes.

The radon measurement project in Taiwan Radiation Monitoring Center (TRMC) first started in 1980 and has continued till tokay. The need for a radon test chamber is quite urgent in Taiwan. Recently, some researchers from other research institutes contacted TRMC and requested help in instrument calibration, prompting the design and construction of a radon test chamber in Taiwan. This project started in April 1992 and finished in April 1993. Basically, this radon test chamber is a multipurpose one that can be used for both research and calibrations for routine radon measuring instruments. This radon chamber was designed and constructed domestically. The design criteria and functions are described below.

Essentially, a radon (or thoron) chamber consists of a large container (23 m^3 in this case) where a radon (or thoron) air mixture is injected at one side of the chamber and exhausted from the other side. During the time that the gas remains inside the chamber, it

partially decays into its progeny, resulting in a gas/decay products mixture. The level of radioactive gas and its decay products, and the activity ratios of the decay products can be controlled by varying the input and output flow rates, the addition of aerosols and water vapor, and other means such as ion generator and electrostatic aerosol collector.

DESCRIPTION OF THE RADON TEST CHAMBER

The radon test chamber was built in an air-conditioned laboratory to avoid the interferences by the environment. The approximate internal dimensions of the chamber are 3.50 m(W) × 3.10m(L) × 2.12m(H) with a total internal volume of about 23 m^3 as shown in Fig.1. An anteroom is provided to enclose the chamber entrance door to prevent radon escape during entrance and exit of personnel. All the chamber walls were built with an outer and inner layers of 1mm thick stainless steel. PU material and wood rods of 50 mm length were filled between the two stainless steel layers for thermal insulation and structural reinforcement. Silicone sealant was applied at steel plate seams to avoid leakage of gas.

Two double layer glass viewing windows were located on the upper part of the front wall. There are one pair of glove holes and two sampling ports of 10 cm diameter. To the right side, there are six pairs of small circulating sampling ports for different sensors and monitors. Every sampling port is equipped with a regulatable flow meter by way of which flow rate can be varied between 0 ~ 250 ml/min.

Two radon sources and one thoron source supplied by Pylon Company, Canada were installed near the anteroom. Properties of the those sources are available from the manual. Radon concentrations in the chamber can be varied between 25 to 40,000 Bq m^{-3},with normal normal value set around 2,000 Bq m^{-3}.

Temperature in the chamber is controlled by an air-conditioner and a heater. Temperature range can be adjusted between 10 ~ 39.9 ℃ with precision under ± 0.1 ℃ . Humidity is controlled by a vibrating wet adder and dehumidifier. Controllable range is between 30% ~ 90% RH with precision under ± 1%. The chamber is kept at a slight negative pressure to avoid leakage of radon. All the parameters of temperature, humidity and atmospheric pressure are measured continuously and recorded by a personal computer.

The concentration of radon gas in the chamber is monitored continuously by a scintillation cell of flow-through type in association with a Model AB-5 counter (manufactured by Pylon Co., Canada). The concentration of radon and thoron progeny are measured by a working level monitor Model WLM monitor and a Model WLM-1A reader (both manufactured by Eberline company, U.S.A.). Aerosol concentration and particle size distribution are measured by a Model Las-X-CRT passive monitor (manufactured by P.M.S Co., U.S.A). Its measuring range is between 0.1 ~ 7.5 μ m, with 4 overlapping size

ranges avaiable within each sizing parameter. Three of the size ranges are divided into 15 linear size intervals providing up to 45 size channels. Its resolution can reach 7 nm. All the monitoring instruments are calibrated periodically according to the instructions of operation manuals.

This radon chamber can be extensively used in

1. Testing and calibration of radiation instrumentation including enviromental radon and radon progeny monitors;
2. Plate-out effect of daughter products on walls, e.g., under the influence of mixing fans and ionizers;
3. Testing of radiation measuring techniques;
4. Radiation simulation studies;and
5. Equilibrium factor (F value) measurement studies.

CONCLUTIONS

Thus far we have performed some radon measurements for various environmental conditions using this chamber. Correct measurement comes from reliable calibration procedures and facilities. An adjustable radon calibration chamber is very important especially in research work. This radon/thoron calibration chamber is the first one designed and built domestically. Its functions are similar to those of radon chambers in other countries. We will host domestic intercomparison study and participate in the international intercomparison study of radon, thoron and their progeny in the near future. Results of functional tests will be shown on poster in detais. This radon calibration chamber will open to any users. Future improvements on its capabilities may be carried out as required.

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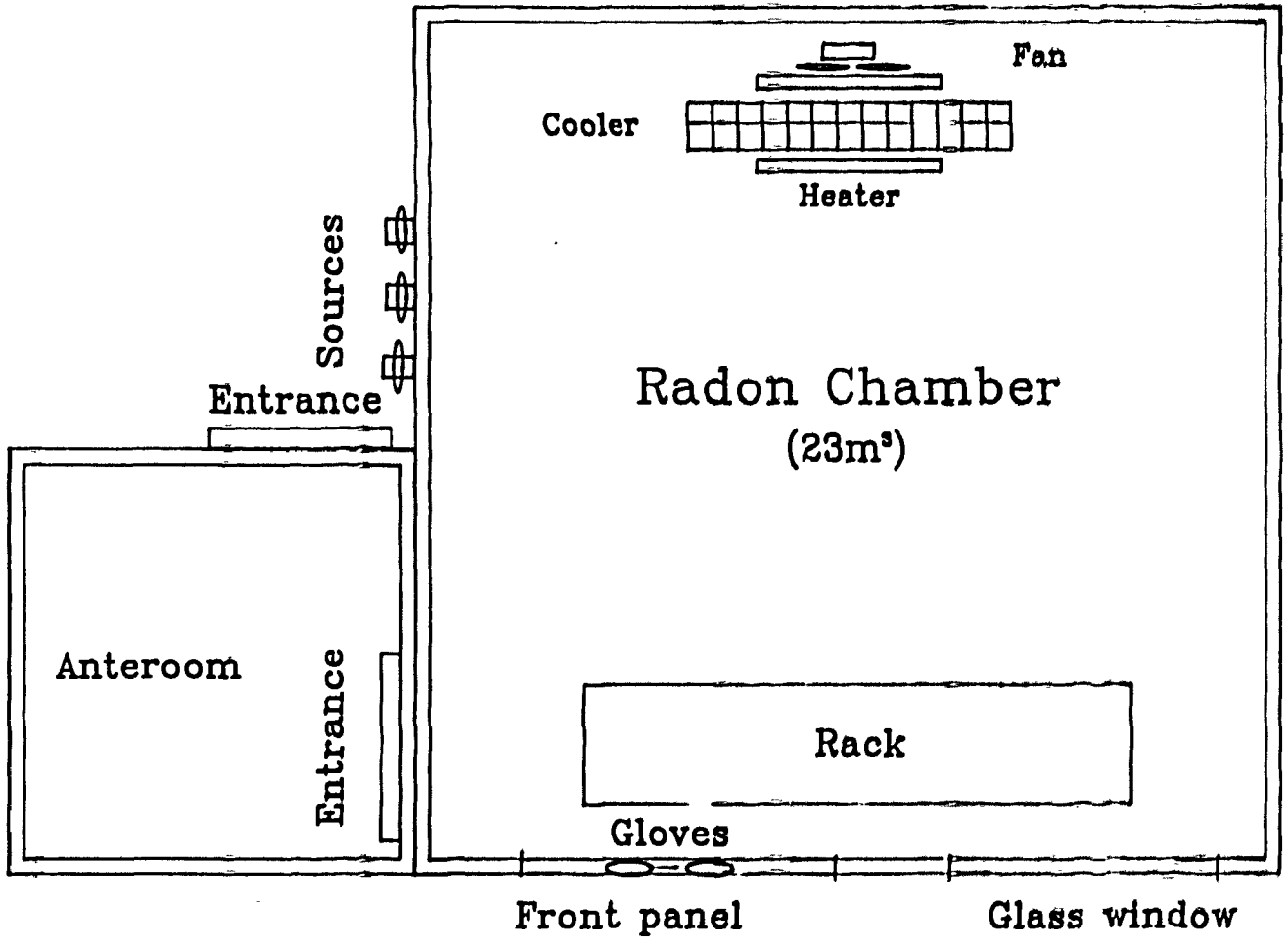

Fig. 1 Plan view of radon/thoron test chamber