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Assessment of Soil and Soil-Gas Radon Activity using Active and Passive Techniques for Radon Measurement

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ABSTRACT

From the late 1980's, increased awareness of radon (^{222}Rn) as a significant carcinogenic pollutant to public health has made it necessary to extend the understandings of soil-gas radon distribution and radon measuring techniques. The purposes of this study are to compare the soil and soil-gas radon concentrations according to active and passive techniques for radon measurement, and to determine the radon potential of ground where is under construction for houses and buildings.

Study areas of Sanbook (Precambrian banded gneiss), Gangcheon (Jurassic biotite granite), Jikyeong (Unknown-age metamorphosed sandstone), Geumsung (Unknown-age limestone), Choojung (Unknown-age Phyllite) and Homyoung (Precambrian banded gneiss) were selected and classified according to their bedrock types in order to investigate soil-gas radon concentrations. Each study area is also divided by target area and local area. The target area is the construction site having about 10,000m^2 size with 10-50m sampling interval and local area is around the target area having about 100,000m^2 size with 100-1,000m sampling interval. Soil-gas samples typically were collected by augering a hole and placing steel probe 50 to 70 cm below the soil surface of the study sites. Soil-gas sample of 160 ml was extracted into the RDA-200 radon detector and the radon concentrations were calculated by use of the Morse (1976) 3-minute method.

In autumn season (Sep. to Nov., 2003), the mean concentrations of soil-gas radon

for each target area decreased in the order of Jikyeong (731 pCi/L) > Homyoung (565 pCi/L) > Gangcheon (345 pCi/L) > Choojung (325 pCi/L) > Sanbook (309 pCi/L) > Geumsung (303 pCi/L), and for local area in the order of Homyoung (616 pCi/L) > Jikyeong (538 pCi/L) > Gangcheon (506 pCi/L) > Choojung (420 pCi/L) > Sanbook (312 pCi/L) > Geumsung (265 pCi/L). To minimize daily variations of soil-gas radon concentrations and collect the monitoring data, integrating passive method with SSNTDs (Solid State Nuclear Track Detectors) was applied to the study areas. The plastic detector called TDR (Time integrated Detector for Radon, Hanil Co., Ltd., Korea) was placed inside a cylindrical tube (PVC material) of 50mm diameter and 500mm in length. The empty space (50mm in length) between TDR and top of the cylindrical tube was filled with silica gel and styrofoam to avoid humidity effects on detector's surface. Cylindrical tube with TDR was inserted to the ground at depth of 50-70cm and after exposure of 2-3 weeks, soil-gas radon concentration was analyzed by track etching method using NaOH solution. Results of statistical correlation analysis for 114 data sets between active (soil-gas extraction) and passive methods showed positive correlations in two methods with significance (R^2=0.35, $p<0.05$).

Measurement of the emanation coefficient is important in the study of radon flux or exhalation from soils and dwelling materials. For passive instrument (vessel test), the well-known "can technique" was used for the long-term measurements of radon emanation coefficient from soil sample from each study area. In this technique, a TDR was placed at 3cm height on the soil matrix, which sealed in the cylindrical vessel during 2 weeks. For active instrument (chamber test), soil samples were analyzed for Rn by radon monitor (RM-1024, SUN NUCLEAR, Co., Ltd), which placed in a chamber standardized to the temperature and humidity. The result of comparing the radon emanation coefficients between passive and active methods were as follows;

Radon emanation coefficient (by vessel test)

= 0.8 × Radon emanation coefficient (by chamber test) – 3.9 (R=0.95).

Key words: Soil-gas, Radon, Active method, Passive method, Emanation coefficient

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