Calibration measurement of short-lived nuclide of particulate using comparative measurements between HPGe and radon detectors

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1. Introduction

The research aims to identify originate of particulates using the nucleus analysis. In the figures of the particulates matter (PM) analyzed by measuring the samples collected in the Air Sampler, If the proportion of long-lived nuclides is high, it is possible that a significant amount of nuclides from foreign countries and short-lived nuclides have flowed from Korea.

Most of the particulates coming from foreign countries are likely to flow significantly from China due to the strong influence of westerly winds. While particulate originating from China arrives in Korea, radioactive decay will cause changes in the ratio of nuclides.

The long-term goal is to determine the exact originate of the particulate as a sample measurement of the Air sampler of laboratory. This study will use the analysis of short-lived nuclides to confirm that they are consistent with the above predictions.

2. Experimental procedure

We determine the optimized place and time to measure particulate. The PM is then measured within a set period of time, at which time radon is measured with a radon detector.

The short-lived nuclide of the sample collected in the Air sampler is then measured by HPGE detector and the measurement value of the radon detector is corrected.

2.1 Optimization of particulate measurement

Measurements are performed in mid-April to meet the conditions favorable for particulates measurements to confirm the influx of China's inflows. In addition to weather conditions, we will confirm the correlation between PM and temperature by checking the temperature change during mid-April. [1]

It is known that most of the short-lived nuclide come from the surface. When measuring place area of the surface is relatively small, the nuclide from outside can be accurately measured. The ideal location for PM 2.5 and PM 10 measurement is viewed as a mountain.

It is known that it takes 1-2 days for particulate originating from China to arrive in Korea. Among the particulates coming from China, the short-lived nuclide almost decayed before coming to Korea. The percentage of short-live nuclide present in the sample is inversely proportional to the PM of Air sampler (HIvol3000, Ecotech), it would be judged that particulate is coming from China. [2, 3]

2.2 short-live nuclide of particulate

The information of ^{212}Pb, ^{214}Bi, short-live nuclide is listed in the Table 1.

Table 1 : The data of nuclide (^{212}Pb, ^{214}Bi)

Radionuclide	Energy(KeV)	Half-live
^{212}Pb	238.6	10.64 h
^{214}Bi	609.3	19.8 min

^{212}Pb, ^{214}Bi are decaying nucleus of radon and can be caused by domestic environment. It may be the cause of the difference between the short-lived nuclide ratio and the PM measurements. [2, 3]

The radon detector will be placed at the measuring position of the Air sampler to make measurements at the same time. If the measurement value of the radon detector of the same time is corrected to the value of ^{212}Pb, ^{214}Bi detected in the spectroscopy program (Gamma vision) via semiconductor detector, the proportion of ^{212}Pb, ^{214}Bi is likely to be reduced

2.3 Air sampler for PM measurement

Before performing long-term measurements in mid-April, the collected samples are performed comparatively with radon detector, HPGe detectors to calibrate measurements of ^{212}Pb and ^{214}Bi. Air sampler confirms the change in the weight of the filter before and after collecting particulate by mass measurement method and measures PM. [4]

PTFE (Polytetrafluoroethylene)-based mesh filters produced by high purity nano-fiber manufacturing methods were used to improve the mass measurement of the filter.

Since the filter is fiber-based in nm size units, the surface area per size has superior adsorption performance.

Fig. 1 Air sampler (Hivol3000, Ecotech)

2.4 Calibration measurements of short-lived nuclide

The PM will be measured from 140 data by measuring every three hours at the Laboratory's Air sampler. The measurement period is expected to take 3-7 days. The measurement value of the radon detector is also monitored at the same time.

The PTFE-based mesh filter collecting particulate in the Air sampler is checked with the HPGE detector (with Gamma vision) for a peak of ^{212}Pb and ^{214}Bi to determine the ratio of the nuclides in the particulate. [5]

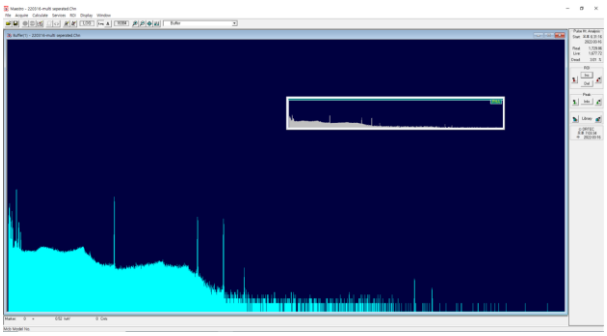

Fig. 2 Gamma Spectroscopy (Gamma vision)

Estimating ^{212}Pb, ^{214}Bi from the measurement value of the radon detector, the ratio of the nuclide of particulate will be modified and the PM measurement results and the change in proportion of particulate are checked in real time.

3. Conclusions

If the sample measurement results in mid-April are somehow consistent with the predictions, it will be possible to trace the movement of external particulate to Korea under the influence of a westerly wind. By collecting the nucleus analysis of the measurement data, the algorithm will be performed through deep learning (Deep Neural Network), By comparing the distribution of nuclide in Korea, we will be able to determine the domestic and foreign proportion of particulate.

The expected outcomes are that the location particulate contamination can be determined using radioactive nuclides. In addition, it is likely that the particulate components will be able to predict rapidly changing depending on weather conditions.

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