

Radioactive Materials Monitoring on Superficial Layer Soils in Gyeongsangnam-Do

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1. Introduction

In this paper, for the purpose of investigating the effects of artificial radioactive materials between 2012 and 2013 year, analysis on 80 superficial layer soils in total collected in industrial estates, farmlands, mining areas located in Gyeongsangnam-Do were conducted by using HPGe(High Purification Germanium Gamma-ray Spectrometer). Before investigation, the calibrations on the HPGe detector were conducted twice a year with a view to confirming the normal operation of measuring equipment. And, based on the calibration results, the effects of artificial radioactive materials were analyzed. Also, to ensure reliability on analysis results, a comparative analysis was conducted using the analysis results presented by KINS(Korea Institute of Nuclear Safety), and using the MDA(Minimum Detectable Activity) values specified by related regulations. In this investigation, ^{131}I , ^{134}Cs , ^{137}Cs , and so on, were selected as examination nuclides.

2. Methods and Results

This section describes the calibration methods and results on measuring instrument, sampling and pre-treatment methods on soil samples. Also, analysis results on soil samples were described

2.1 Equipment Calibrations

To confirm the normal operation of measuring instrument, energy and efficiency calibration using a 450 mL Marnelli Beaker was carried out twice a year, and calibration results[1] were included in the table 1 below. As table 1 below shows, the error range of all of the calibration results is within 5%, and on the base of these results, it was judged that calibration results are reasonable in this paper

Table 1. Calibration result(Radioactive material error)

Nuclide	2012 Year		2013 Year		Criterion
	March(%)	August(%)	March(%)	August(%)	
^{241}Am	-0.04	0.03	-0.05	-0.05	Suitability
^{109}Cd	0.03	-0.12	0.41	0.49	Suitability
^{57}Co	1.78	-1.86	-0.26	0.00	Suitability
^{139}Ce	2.74	-1.79	1.63	1.90	Suitability
^{51}Cr	2.46	-2.67	1.87	2.26	Suitability
^{113}Sn	0.10	1.30	0.68	1.71	Suitability
^{85}Sr	-3.04	0.34	-2.55	-3.54	Suitability
^{137}Cs	-3.30	3.69	-3.08	-4.97	Suitability
^{60}Co	1.64	-1.45	2.59	3.84	Suitability
^{88}Y	0.28	0.16	-2.15	-3.34	Suitability

2.2 Soils Sampling and Pre-treatment

After calibration, with a view to surveying whether the effect by artificial radioactive materials exists or not, superficial layer soils were collected at the industrial estates, farmlands, mining areas located in Gyeongsangnam-Do. The superficial layer soil samples collected at the industrial estates in 2012 year were 22, and at the mining areas were 7. In case of 2013 year, soils collected at the industrial estates were 22, and at the farmlands were 22, and at the mining areas were 7. All of the soils collected were dried in a drier for 48 hours at 105°C. After the dried soils were grinded with a grinder, they were filtered by the sifter whose mesh size is 20 μm . And the soils filtered were measured for 80,000 sec using a HPGe detector, after poured into 450 mL Marnelli Beakers. After measurement, the concentration and the kind of radioactive materials included in the soil samples was grasped by applying calibration results

2.3 Measurement and Analysis

By analyzing the results of total 80 superficial layer soil samples collected, the obtained MDA range of ^{131}I was 0.215~2.54 Bq/kg-dry, and that of ^{134}Cs was 0.193~0.777 Bq/kg-dry, and that of ^{137}Cs was 0.220~0.765 Bq/kg-dry respectively. And all of the analysis results satisfied the MDA requirements specified in the Nuclear Safety Committee Notification No. 2012-5[2]. ^{131}I in all of the soils was not detected, and ^{137}Cs in 59 soil samples about 74% was detected. ^{137}Cs concentration range detected was 0.450~9.58 Bq/kg-dry, which was within the range of MDA~16.0 Bq/kg-dry which KINS presents[3,4,5]. The detected ^{137}Cs distribution trend was displayed on Figure 1 below. As Figure 1 shows, it can be seen visibly that the ^{137}Cs concentration of the mining areas is high compared with that of other regions. We reasoned in this paper that these results are due to the physical phenomenon that the altitude of mining areas is relatively high compared with that of other regions.

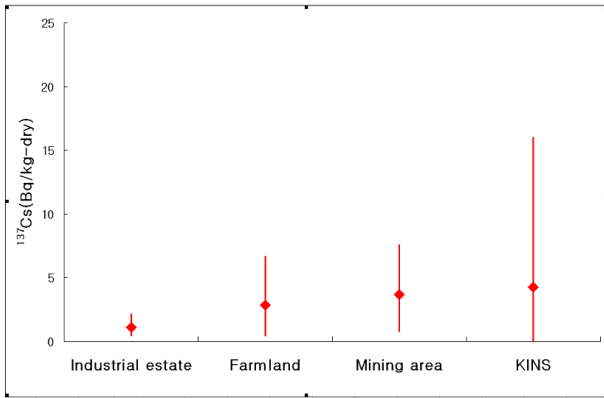


Fig. 1. The ^{137}Cs distribution trend detected in the superficial layer soils of Gyeongsangnam-Do

^{134}Cs was detected only in the soil sample collected at the industrial complex of Tongyeong region in 2013 year, and the ^{134}Cs detected there was the infinitesimal concentration of the MDA level as 0.57 ± 0.044 Bq/kg-dry. In case of the industrial estate of Tongyeong region, because ^{134}Cs and ^{137}Cs whose behavior characteristic in the natural environment is similar were detected simultaneously, we supposed that there is still influence related to the Fukushima Nuclear accident. The ^{134}Cs spectrum detected in the industrial estate soil of Tongyeong region was displayed on below Figure 2. As Figure 2 shows, it can be confirmed visibly that peak at 604.70 keV(97.6%) and 795.81 keV(85.04%) of the highest yield are created respectively[6,7].

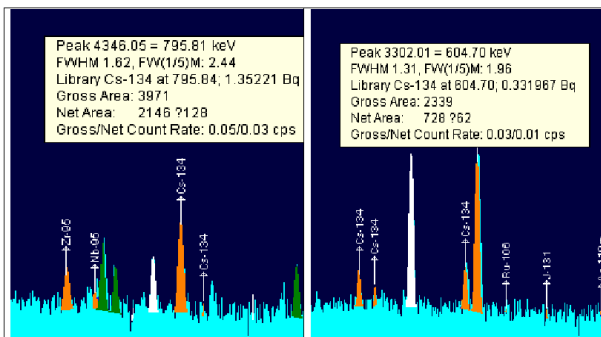


Fig. 2. The ^{134}Cs spectrum detected in the industrial estate soil of Tongyeong region

On the basis of these results, we reasoned that there is no problem in regard to deciding the kind of nuclide. Also, but all of ^{134}Cs analysis results which KINS presented after the Fukushima Nuclear accident emergency response in 2011 year were not detected, the MDA range presented was 1.62~ 4.16 Bq/kg-dry[3], and was very low compared with the MDA which this paper presents. We reasoned that these results are based on the fact that KINS measured soil samples in a short time for an emergency response after the Fukushima Nuclear accident.

3. Conclusions

By analyzing results on total 80 superficial layer soils, because all of nuclides satisfied the MDA requirements specified in the Nuclear Safety Committee Notification No. 2012-5, it is judged that there is no problem related with the reliability of the analyzed results. Also, ^{134}Cs was detected infinitesimally only in the industrial complex soil sample of Tongyeong region. Therefore, it is judged that continuously monitoring on the soil samples of Gyeongsangnam-Do is required from now on.

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