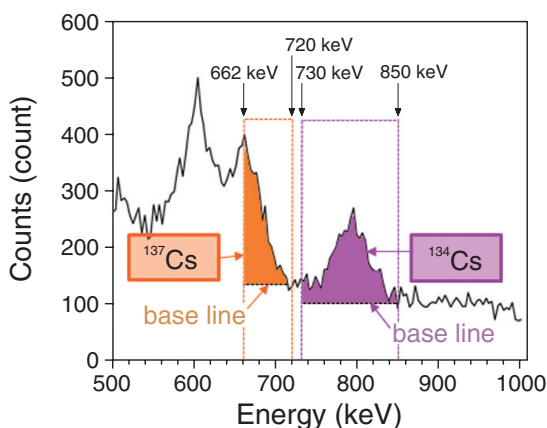
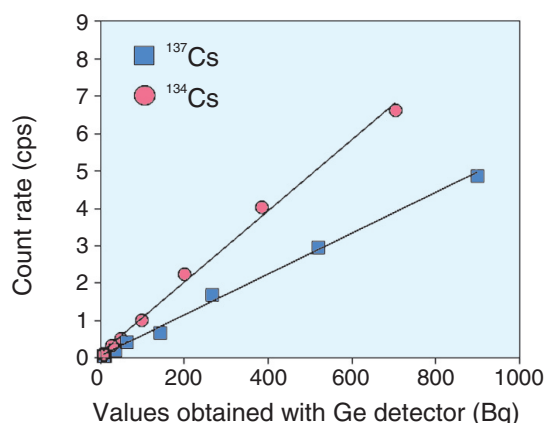


# 1-13 A Simple Method for Selective Measurement of Cesium 134 and 137 – Utilization of Common NaI(Tl) Scintillation Spectrometers –



**Fig.1-26 Scheme for selective quantification of  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$**   
The colored parts were specified for use in the analysis in this method. The regions under the baselines were considered as parts that represent  $\gamma$ -rays from natural radiation sources and were omitted.



**Fig.1-27 Correlation between nuclide concentrations in standard 100 mL-container and areas of specified parts**  
It was confirmed that the areas of the specified parts are proportional to concentrations of  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$  in dilution series.

**Table 1-4 Results of environmental samples**

Measurement was conducted in January-February 2012. It should be noted that the abundances and their ratios change because both nuclides decay year by year according to their own half-lives.

	$^{137}\text{Cs}$		$^{134}\text{Cs}$	
	NaI (Tl) spectrometer (Bq kg <sup>-1</sup> )	Ratio to results with Ge detector	NaI (Tl) spectrometer (Bq kg <sup>-1</sup> )	Ratio to results with Ge detector
Leaf mold	$6.0 \times 10^3 \pm 60$	0.98	$4.4 \times 10^3 \pm 38$	0.95
Grassland soil	$1.7 \times 10^4 \pm 72$	0.97	$1.3 \times 10^4 \pm 47$	0.98
Cow manure	$5.9 \times 10^2 \pm 11$	0.87	$4.8 \times 10^2 \pm 7.4$	1.06

There is an increasing demand for analysis of the huge numbers of foods, soils, fertilizers, and so on contaminated by radiocesium ( $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ ). The NaI(Tl) scintillation spectrometer (NaI(Tl) spectrometer) and germanium semiconductor detector (Ge detector) are typical devices used for this purpose. The NaI(Tl) spectrometer has many merits, such as its lower price, smaller size, and easier handling compared to the Ge detector; as a result, its use is becoming common. However, it has a critical disadvantage in that it cannot distinguish completely between the  $\gamma$ -rays emitted by  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$ . In this study, we aimed to establish a simple and open method by which producers and consumers can measure amounts of  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$  separately using a NaI(Tl) spectrometer. We consider it is important to provide a common basis for more reliable analysis for use by many nonprofessional people.

Common NaI(Tl) spectrometers exhibit energy spectra with overlapping gamma ray peaks for  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$  when a contaminated sample is analyzed (Fig.1-26). We determined two regions within the peaks, each specific to either  $^{134}\text{Cs}$  or

$^{137}\text{Cs}$  (Fig.1-26, colored parts). It was theoretically estimated that, approximately, the area of each region is affected by neither the other nuclide nor  $^{40}\text{K}$ , a natural radionuclide. The output of the spectral data file is available as a spreadsheet in many commercially produced NaI(Tl) spectrometers. We summed the total counts in the specified regions and calculated the count rate (cps) by dividing the total counts by measurement time (seconds), and found that the results accurately reflected the amounts of  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$  in the sample (Fig.1-27). Several environmental samples were subjected to this method and the results exhibited high consistency with values obtained using a Ge detector for the respective nuclides; this demonstrates the applicability of our method (Table 1-4).

The linearity of the dilution series (Fig.1-27) and the abundance ratio between  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$  (Table 1-4) may reflect the accuracy of the measurements; thus, users can check their preparation procedures. We expect the method described here to contribute to reliable analysis conducted by a wide variety of people.

## Reference

Yin, Y.-G. et al., A Simple Method for Selective Measurement of Cesium 134 and Cesium 137 by NaI(Tl) Scintillation Spectrometer, Nippon Dojo HiryoGaku Zasshi, vol.83, no.3, 2012, p.296-300 (in Japanese).