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固相抽出法を用いたエアダストに含まれる放射性ストロンチウムの分析
Raidoactive strontium measurement in air dusts using solid-phase extraction

張 子見 [1*], 柿谷俊輔 [1], 二宮和彦 [1], 高橋成人 [1], 山口喜朗 [2], 吉村崇 [2], 齊藤敬 [3], 北和之 [4], 鶴田治雄 [5], 桧垣正吾 [6], 篠原厚 [1]
zi jian zhang[1*], Kakitani shunsuke[1], Ninomiya kazuhiko[1], Takahashi naruto[1], Yamaguchi yoshiaki[2], Yoshimu takashi[2], Saito takashi[3], Kita kazuyuki[4], Tsuruta haruo[5], Higaki shogo[6], Shinohara atsushi[1]

[1] 大阪大学大学院理学研究科, [2] 大阪大学ラジオアイソトープ総合センター, [3] 尚絅学院大学, [4] 茨城大学, [5] 東京大学大気海洋研究所, [6] 東京大学アイソトープ総合センター
[1]Graduate School of Science, Osaka University, [2]Radioisotope Research Center, Osaka University, [3]Shokei Gakuin University, [4]Ibaraki University, [5]Atmosphere and Ocean Research Institute, the University of Tokyo, [6]Radio Isotope Center , the University of Tokyo

On March 12, 2011, a large amount of radioactive nuclides (I-131,Cs-134,Cs-137,Sr-90,etc) have been released into the environment by the nuclear accident at the Fukushima Daiichi Nuclear Power Station. There are many radioactivity measurement results of I-131, Cs-134, Cs-137 and the other radio nuclides from air dust collected using high-volume air sampler by germanium semiconductor detector soon after the accident. Activity of these radioactive nuclides in air is important for estimation of internal exposure. However, in these nuclides, some pure beta emitter nuclides have not been measurement sufficiently because of the difficult on chemical isolation for beta ray counting. Strontium-90 is considered one of the harmful radioactive nuclides. Biological half-life of Sr-90 is about 50 years for accumulating in born and the high energy beta rays are emitted from Sr-90 and its daughter nuclide Y-90. Therefore, measurement of Sr-90 is important for calculating exposure. We developed a new strontium isolation technique using solid-phase extraction for determination Sr-90 by liquid scintillation counter (LSC). The technique is simply and quickly for isolating Sr with high-yield.

In this study, we used 3M Empore^{TM} Strontium Rad Disk to extract strontium ion from acid solution. However, Pb2+ ion is also extracted by the disk and Pb-210 interference in radioactive Sr identification. To separate Pb-210, cation exchange is used. 0.02 M EDTA solution can elute Sr ion from the disk. HNO3 was added to the EDTA solution and passed through cation exchange column with 5% EDTA solution (pH5) to separate Pb. Strontium was eluted by (1+3) HCl. The time of chemical operation for this technique is 3-4 hours without acid treatment and the yield is about 90 %. To determine Sr-90, Cherenkov light of Y-90 has been measured by LSC. With sequential measurement, the growth curve of Y-90 was described to determinate activity of Sr-90.

We measured Sr-90 in air dust samples of Hitachi, Kawasaki and Osaka. The result of Hitachi is shown in Fig.1. In Hitachi, the Sr-90 activity concentration in air is decreased with time and the ratio of Sr-90/Cs-137 is about 10^{-3}. It is possible that after April, Sr-90 has been the same behavior of Cs-137. We will discuss about time variation of radionuclides activity of Sr-90 and proportion of Sr-90 to Cs-137.

Sampling date	^{90}Sr Bq/m^3	error %	^{90}Sr Bq/^{137}Cs Bq	error %
2011/4/9	1.5E-03	2.5%	1.6E-03	10.3%
2011/4/18	3.7E-04	2.4%	1.1E-03	10.3%
2011/5/21	6.3E-05	4.7%	3.7E-03	11.0%

Fig.1. The results of Hitachi air dust samples