§6. Development of a Simplified Method for Tritium Measurement in the Environmental Water

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Introduction

Liquid scintillation counting is now the most popular method to measure the tritium concentration in the low level water samples such as environmental water samples. However, it takes much time with a lot of doing to distill off the impurities in the sample water before mixing the sample with the liquid scintillation cocktail. In the light of it, we investigated the possibility of an alternative method with membrane filters for purification. As published before, the filtration method was proved to be available to be alternatively used for tritium measurement [1][2]. In the present environment water in Japan, the tritium concentration has become nearly 0.5-1.0Bq/kg-H_2O which is within the detective limit by the low background liquid scintillation counter. As for the samples lower than the detective limit they will be treated by electrolysis enrichment with liquid scintillation analyzer. Recently an electrolysis tritium enriching method using a solid polymer electrolyte has been developed [3][4]. According to the method, there is no need to add any electrolyte, neither is the neutralization after concentration. If we could replace the distillation process with the filtration, the procedure would be simplified very much. We investigated the procedure and we were able to prove that the filtration was available.

Experimental and discussion

Based on the research result, the new measuring method was compared with the conventional method, using 4 environmental samples. The distillation before the electrolytic accumulation was replaced for the filtration in order to simplify the operation. The filtration was carried out using the RO filtration equipment made by Seiren Co. & Ltd. The distillation after the electrolytic accumulation was omitted, because electrolytic accumulation equipment using the polymer electrolyte membrane did not need to add the electrolyte. The tritium concentration measurement used the Aloka LB3 belonging to RI Research Center, Nagoya University. The tritium enrichment factor was decided by measuring the heavy water enrichment by the mass spectrometer.

The measurement result is shown for table 1. The result agreed in the fault tolerance, even if the RO filtration was done, even if it distills it in order to prove at present. The error decreased further than the result that it did not concentrate and measured the result measured by concentrating.

Conclusion

(1) The filtration is the alternative to distillation for environmental water samples before electrolysis.

(2) No filtration and distillation is necessary for water samples after electrolysis enrichment using a high polymer electrolysis membrane.

References

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[3]M.SAITO et al., Radioisotopes, 45(5),(1996)258-292.

[4]M.SAITO et al., Radioisotopes, 45(8),(1996)483-490.

Table 1 ESCR, Duetrium Concentration and Tritium Concentration with Different Treatments

sample	Treatment	B.E. ESCR	B.E. Deutrium[%]	B.E. Tritium[Bq·L^{-1}]	A.E. ESCR	A.E. Deutrium[%]	A.E. Tritium[Bq·L^{-1}]
Well Water	Distillation	26.17	0.01486	1.3 ± 0.4	24.92	0.09020	0.5 ± 0.2
	RO Filtration	-	0.01488	-	25.92	0.09497	0.7 ± 0.2
	0.1ì m Filtration	-	0.01487	-	25.96	0.10167	0.4 ± 0.1
	0.45ì m Filtration	26.12	0.01487	0.7 ± 0.4	-	-	-
Rain Water	Distillation	26.21	×	0.9 ± 0.5	26.06	0.07013	0.7 ± 0.2
	RO Filtration	-	0.01483	-	25.97	0.06913	0.8 ± 0.3
	0.1ì m Filtration	-	0.01493	-	26.17	0.06972	0.7 ± 0.2
	0.45ì m Filtration	26.23	0.01527	1.3 ± 0.4	-	-	-
River Water	Distillation	25.60	0.01483	1.1 ± 0.7	25.86	0.06708	0.5 ± 0.2
	RO Filtration	-	0.01485	-	26.01	0.06832	0.8 ± 0.2
	0.1ì m Filtration	-	0.01485	-	26.09	0.06632	0.8 ± 0.2
	0.45ì m Filtration	26.05	0.01487	1.3 ± 0.4	-	-	-
Lake Water	Distillation	26.04	0.0151	2.2 ± 0.7	26.01	0.0739	1.8 ± 0.4
	0.1ì m Filtration	-	0.0157	-	25.94	0.0690	2.2 ± 0.4
	0.45ì m Filtration	25.86	0.0152	2.4 ± 0.7	-	-	-

N.B.: B.E.=Before Enrichment, A.E.=After Enrichment