§5. Study on Environmental Tritium: Collection and Measurement of Environmental Samples and Analysis of Factors Affecting Tritium Concentrations

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Behavior of tritium in the environment is necessary to be elucidate before starting fusion experiments using tritium because the ITER is planed to use a few kg of tritium. Tritium is originally a naturally occurring radionuclides and the amount in the environment is estimated to be about 3 kg at equilibrium conditions. The quite large amounts of tritium planed to use in the ITER has a potential to release considerable amounts of tritium to the environment near experimental site during normal operation and by an accident.

We have studied tritium levels in various environmental materials those were collected at Toki, Gife prefecture where the LHD is under construction by NIFS. The concentration of tritium in plants would be a good indicator of the environmental tritium level. The water in tissue reflects that of environmental water, which is rather variable depending on meteorological conditions and represents the level of a relatively short period, while organ of plants represents an average environmental tritium level of a fairly long period, for example one year or longer years.

We analyzed tritium concentrations in tissue water and organ in plants collected at NIFS in Toki and at Higashiyama in Nagoya to examine environmental level and their seasonal variation. In Table 1 and 2 the tritium concentrations in free water tritium (FWT) and organically bound tritium (OBT), and their specific activity ratio (SAR) in pine needles are summarized. The concentration of FWT ranges 1.2-3.7 Bq/l in Toki and 1.6-6.6 Bq/l in Nagoya. The concentration seems to be slightly higher in the samples of Nagoya. The samples of Nagoya collected in the campus of Nagoya university. Although both sampling places are considered to be general environment, the slightly higher concentrations in Nagoya may suggest local effects such as facilities in the campus using radioisotopes. The OBT concentration ranges 1.6-6.5 Bq/l in Toki and 2.3-12 in Nagoya, showing slightly higher level in Nagoya as FWT. Although the tritium level in Nagoya is slightly higher than that in Toki, the SAR is distributed in a similar range in both sampling places. Since no biological accumulation of tritium is likely to occur during photosynthesis, the SAR of unity is expected. The variation in SAR could be attributed to variable FWT concentrations with meteorological conditions.

Table 1. Tritium concentrations in pine needles at NIFS in Toki

Sampling Date	H-3 (Bq/l) FWT	OBT	SAR
Nov-88	2.0±0.2	-	
Feb-89	3.7±0.2	-	
May-89	3.6±0.2	6.5±0.2	1.8±0.1
Aug-89	2.2±0.2	1.8±0.2	0.8±0.1
Nov-89	2.0±0.2	2.0±0.2	1.0±0.1
Feb-90	2.9±0.2	1.9±0.2	0.7±0.1
May-90	2.5±0.3	2.5±0.3	1.0±0.2
Aug-90	2.9±0.3	2.5±0.3	0.9±0.1
Nov-90	2.8±0.3	1.6±0.3	0.6±0.1
Feb-91	2.7±0.3	2.5±0.3	0.9±0.1
May-91	1.2±0.3	2.7±0.3	2.3±0.5

Table 2. Tritium concentrations in pine needles at Higashiyama in Nagoya

Sampling Date	H-3 (Bq/l) FWT	OBT	SAR
Nov-88	5.1±0.2	-	
Feb-89	2.3±0.2	-	
May-89	5.1±0.2	12±0.2	2.3±0.1
Aug-89	1.6±0.2	2.3±0.2	1.4±0.1
Nov-89	2.2±0.2	2.6±0.2	1.2±0.1
Feb-90	2.1±0.2	6.8±0.2	3.2±0.3
May-90	2.6±0.2	2.5±0.3	1.0±0.1
Aug-90	3.0±0.2	2.7±0.3	0.9±0.1
Nov-90	3.3±0.2	3.3±0.2	1.0±0.1
Feb-91	6.6±0.2	4.1±0.3	0.6±0.1
May-91	4.6±0.2	5.7±0.3	1.2±0.1