**Proton Exchange Membrane (PEM) electrolytic enrichment system for tritium analysis in seawater**

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To ensure public safety, numerous countries have regulations to monitor radionuclide levels in the environment. Among these radionuclides, tritium, predominantly in the form of tritiated water (HTO), is subject to regular surveillance due to its behavior analogous to that of water. With Japan’s recent decision to discharge radioactive wastewater into the ocean, the necessity of monitoring and assessing global environmental impacts has become increasingly critical. It is noteworthy that the Advanced Liquid Processing System (ALPS), a multi-nuclide removal system, is ineffective in removing tritium. Consequently, a more extensive and rapid analysis of seawater samples from diverse locations is imperative to ensure comprehensive safety.

The average tritium concentrations in seawater are notably low. For instance, in the Republic of Korea, the annual average concentration of tritium in surface seawater ranges from 0.0872 to 0.448 Bq/L.[1] This low concentration signifies that the direct distillation method is insufficient for accurate measurement, necessitating an additional concentration process. Tritium enrichment using Proton Exchange Membrane Water Electrolysis (PEMWE) presents a promising method for the rapid pre-treatment required for tritium analysis.

In this study, we selected commercially available PEM stacks suitable for the electrolytic enrichment of tritium. We examined the enrichment properties of these stacks based on the type of membrane electrode assembly (MEA) and the number of electrolysis cells. The efficiency of the electrolytic enrichment was assessed under varied conditions. Under optimal conditions, utilizing a triple-cell PEM stack, the tritium enrichment factor exceeding 20 was achieved, reducing the initial sample volume from 2000 mL to 30 mL within four days.

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[1] Marine Environmental Radioactivity Survey. KINS/ER-092, 2022; 18, 1-95.