[Research Title]

Implementation of Target Screening Analysis for "Items to be Surveyed" in Water Environment

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[Abstract]

The Ministry of the Environment's list of items requiring investigation for conservation of the water environment (so called "items to be surveyed") currently consists of 207 items that include several hundred compounds, so efficient investigation is required. Therefore, this study proposed the introduction of screening analysis to first discriminate between substances of high and low priority for investigation, and developed, verified, and written up the analytical methods so that the Ministry can introduce screening analysis.

We expanded the number of substances that can be screened by high-resolution LC/MS by adding the results of screening methods based on time-of-flight analysis to the method for screening substances using the orbitrap mass spectrometry that we developed with the earlier ERTD funds. We tested the large-volume direct injection method and the evaporation concentration method as alternatives of solid phase extraction pretreatment. The large-volume direct injection method could evaluate more substances than pretreatment by solid-phase extraction. We also demonstrated the use of a retention index to enable analysis using a different LC/MS. We used the AIQS-GC method for the analysis of semi-volatile organic compounds by GC/MS, and studied pre-treatment by derivatization to increase the number of substances that can be assayed. It is now possible to analyze 126 items, or more than $\frac{3}{3}$ of the 187 organic items among the current 207 items.

Using the screening analysis method developed in the study, we conducted a year-round survey of river water and treated sewage. Substances of high and low priority for investigation were screened in terms of ecological risk to aquatic organisms and human health. We identified, for example, malathion and bentazone as high priority and isophorone as low priority for further investigation.

We prepared an LC/MS analysis manual based on the results of the investigation that can be outsourced to analytical laboratories. We added substances that can be assayed to the Ministry's provisional manual for screening analysis. Furthermore, we further create a manual on checking for GC/MS misidentification to increase identification reliability by GC/MS analysis.

[References]

Pandey, A., Kasuga, I., Furumai, H. and Kurisu, F. (2022) Concurrent analysis of 84 compounds among emerging contaminants listed by the Ministry of Environment, Japan, in domestic wastewater treatment plants using liquid chromatography and high-resolution mass spectrometry (LC-HRMS). Journal of Water and Environment Technology, 21(2), 108-118. DOI: 10.2965/jwet.22-076.

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