PERFLUORINATED COMPOUNDS (PFCs) CONTENT AND ELUTION OF WASTE SAMPLES

Yoshida M[1], Takemine S[1], Matsumura C[1], Nakano T[1],Takata M[2] ,Tokai A[3],Morioka T[4] ; [1]Hyogo Prefectural Institute of Environmental Sciences, 3-1-27,Yukihira-cho, Suma-ku, Kobe, Hyogo, Japan, 654-0037. [2] Osaka Bay Regional Offshore Environmental Improvement Center,[3] Division of Sustainable Energy and Environmental Engineering, Graduate School of Engineering, Osaka University, [4] Department of Civil, Environmental and Applied System Engineering, Faculty of Environmental and Urban Engineering, Kansai University

Abstract

Perfluorinated compounds (PFCs) content and elution in waste samples were measured using sensitive method. The PFCs in waste content were extracted in methanol, and were separated, concentrated with nitrogen-gas and was analyzed by LC/MS/MS determination. In elution examination, the 10 times more amount purified water was added to waste samples. After shaking about 6 hours, the eluate was adsorbed in a cartridge, and extracted in methanol, concentrated with nitrogen-gas and was analyzed by LC/MS/MS determination, similarly for all samples.

The content concentration of various kind waste samples showed different PFCs abundance ratio. The elution ratio for the content was different by compounds. The short carbon chain compound had high elution rate about 40%, but long compound was low.

From this investigation result, it was suggested that countermeasures about outflow of the short carbon chain PFCs from waste that prospected increase in future to the environment would be important.

Introduction

As already reported in these studies[1)], high sensitivity analysis for determination of PFCs in waste by LC/MS/MS has been confirmed.

In the case of examination for PFCs content in waste by this technique, it was found that different kind high concentration PFCs was detected in various kind wastes.

Although the waste disposal ground that is indispensable for a social life is located in the most down stream, the various wastes that discharge source and properties are different in the places that are finally accumulated for a long term. Therefore the elution examination on the same waste sample have been carried out and investigated influence on environment.

Materials and Methods

Target PFCs Reagents and Reagent preparation, Waste samples, Equipment and instrumentation, LC/MS/MS analytical condition

The substances which were the targets of PFCs were covered PFCAs：10, PFASs：4 substances, Isotopic compounds(MPFCs) were used MPFCAs：６,MPFASs：２ for surrogate. The PFCs are PFAC-MXB, and the MPFCs are MPFAC-MXA, there were all products. The both mixture solutions are all products of Wellington Laboratories Inc. The PFOA–$^{13}C_8$ used as internal standard was the product of Cambridge Isotope Laboratories. All compounds were linear chains.

The waste samples in this study are dewatered sludge, automotive shredder residue, shredded solid residue from effluent treatment facility, incineration treatment and so on. Water content and pH value of each sample were different respectively in range of 0.9-58%, 6.9-8.0.

The solid phase extract cartridge adopted Precep-C agri (Wako Pure Chemical Industries, Ltd.). The measurement target substance was adsorbed to the cartridge using a Sep-Pak Concentrator System Controller Plus (Waters). The extraction solution was concentrated with nitrogen-gas. The LC/MS/MS and another details such as reagents, equipment, the appearance of the waste, sample were already shown in the previous report[1)].

The preparation of the content and elution in waste samples

The content and elution of PFCs in waste samples were analyzed. The method flow chart is shown in Fig.1.
The extract was centrifuged and analyzed with LC/MS/MS after concentration using nitrogen gas. The 0.2% acetic acid and 0.05% ammonia solution were added as pH adjustment reagent, waste sample solution were offered to elution examination after adjustment to pH 3-4 and pH 9-11 The PFCs in waste content were extracted in methanol, and were separated, concentrated with nitrogen-gas and was analyzed by LC/MS/MS determination.
In elution examination, the 10 times amount purified water was added to waste samples.
After shaking for about 6 hours, the eluate was adsorbed in a cartridge and extracted in methanol, concentrated with nitrogen-gas, analyzed by LC/MS/MS determination, similarly for all samples.

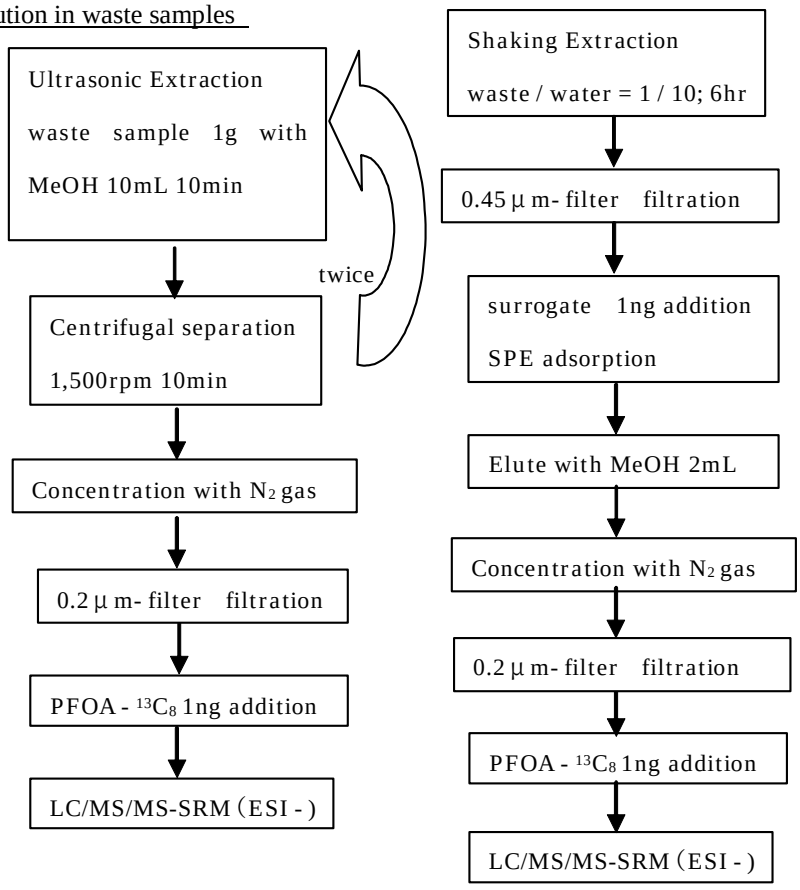

Fig.1 PFCs analytical procedure of the content(left) and elution test(right) with waste samples

Results and Discussion

The result of the content and elution in waste samples

The content was different depend on a waste sample greatly as well as in the previous report[1)].
All target PFCAs was detected several to dozens of ng/g-wet in waste sample1, the other hand PFASs was not detected at all. In another waste sample, only PFOA is detected in high concentration, and PFNA and PFOS were detected just a little. By a sample, there were different tendency.
In waste sample1 was detected all target PFCAs, elution results with the acidity, neutrality, alkalinity aqueous solution were shown in Fig.2.

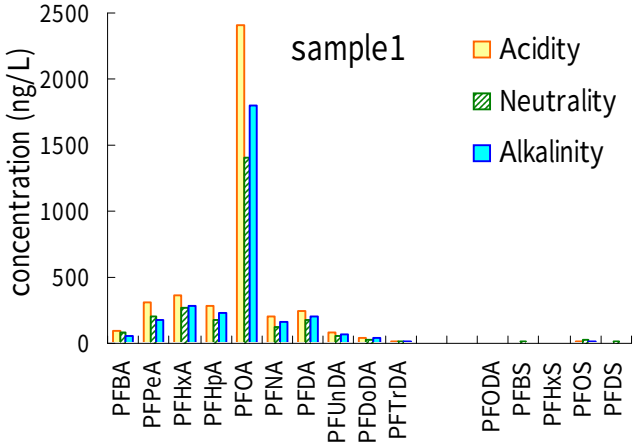

Fig.2 PFCs concentration in waste sample 1 (elution)

Because the recovery of the SPE-cartridge which I used improves under an acid condition, the tendency that the elution concentration with acidity solution rose was seen. The chromatogram of content and elution in sample 1, respectively are show at left and right in Fig.3. In chromatogram of elution (right), PFCAs was detected approximately likewise with content and isomer, the other side the intensity is different from the chromatogram (left) of the content. And it was confirmed that the PFCAs included isomer existing in waste were eluted all over the environment.

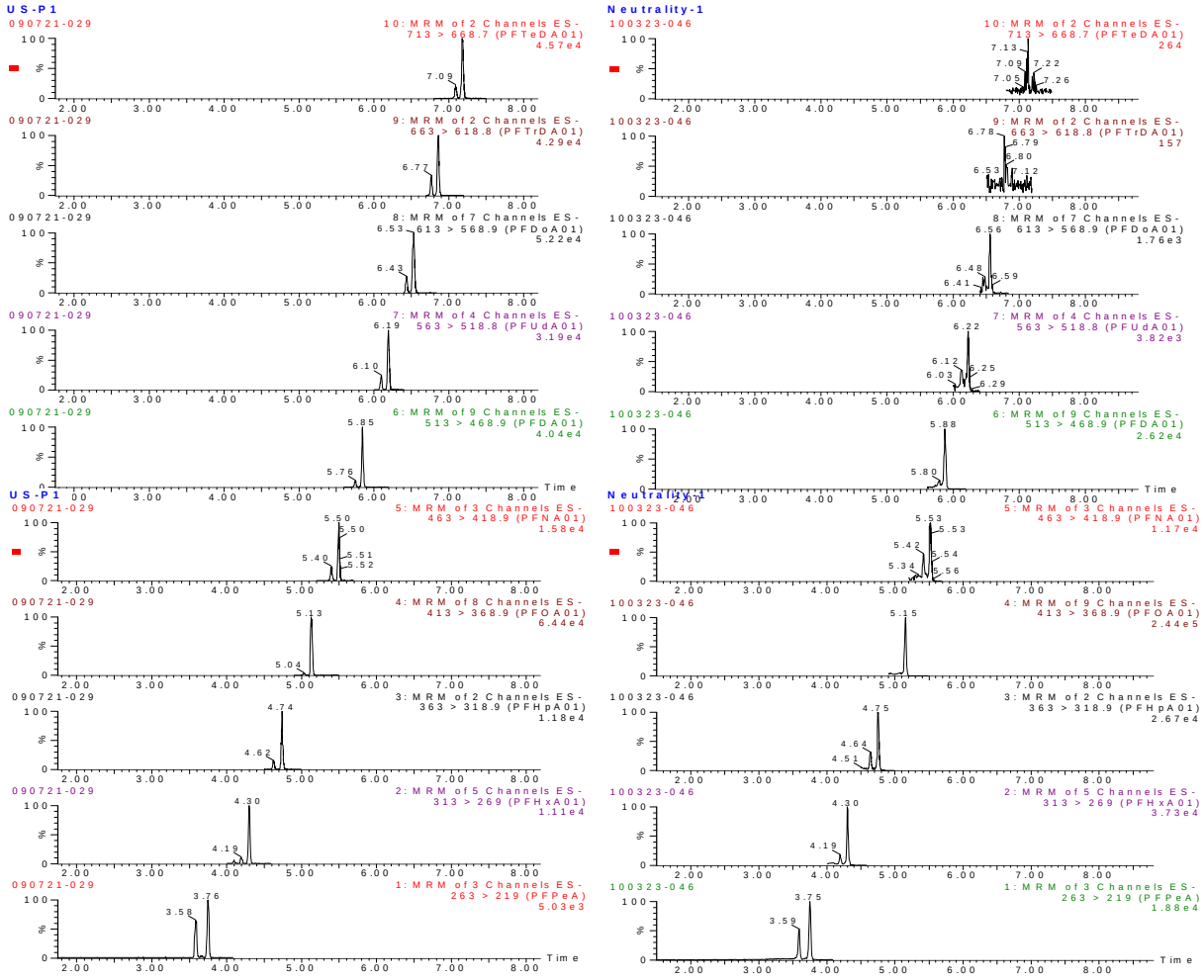

Fig.3 PFCs chromatogram (LEFT: waste sample content , RIGHT: waste sample elution)

The ratio of the elution rate for the content

The elution ratio per the content in sample 1 in Fig.2 was shown in Fig.4.

The elution amount of a short carbon compound until the number of C8, it continues being eluted around 40% for content, on the other side the tendency that long chain PFCAs more than C9 was hard to be eluted was shown.

As for this, PFCAs detected in a sea area is guessed with the cause of less than C9 being the main compounds in Yagi [2] and Takemine's [3] study.

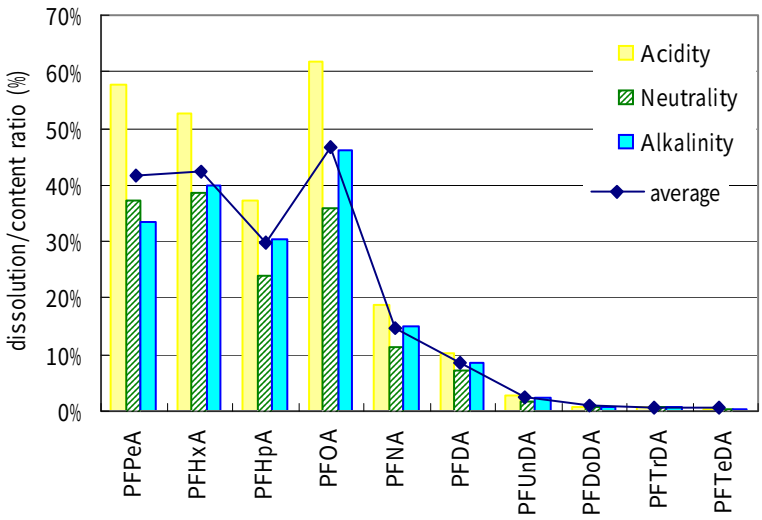

Fig.4 Dissolution ratio for the content amount

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