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Simultaneous Quantification of Chosen Organic Micropollutants in Drinking Water †

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† Presented at Innovations-Sustainability-Modernity-Openness Conference (ISMO'19), Bialystok, Poland, 22–23 May 2019.

Published: 12 June 2019

Abstract: An analytical method that can allow one to determine simultaneously chosen organic micropollutants has been developed to measure their concentrations in water. Standard mixture of 16 polycyclic aromatic hydrocarbons (PAH) and nine polychlorinated biphenyls (PCB) was added to distilled water in a specific amount. The solid phase extraction (SPE) method was applied. Isopropyl alcohol and methanol were used to precondition SPE extraction columns. PAH and PCB were eluted from the column fillings using dichloromethane. Extracts were condensed to a volume of 2 mL. Prepared samples were analyzed with the use of gas chromatography and mass spectrometry. The achieved percent recovery of PAH was from around 7% in the case of chrysene to 100% in the case of naphthalene. The achieved percent recovery of PCB was from about 51% in the case of PCB 101 to 92% in the case of PCB 156.

Keywords: organic micropollutants; polycyclic aromatic hydrocarbons; polychlorinated biphenyls; drinking water; surface water

1. Introduction

The aim of the research was to develop an effective analytical method that can allow one to determine simultaneously 16 PAHs and nine PCBs, in order to measure their concentrations in water prepared for drinking taken from a water treatment plant located in Silesian Voivodeship. The priority was to shorten the time needed for the micropollutant extraction and to reduce the amount of used reagents and other materials, which leads to a reduction in the costs of preparing samples for analysis.

2. Materials and Methods

Distilled water and water from the water treatment plant in Silesian Voivodeship were used for this study. The standard mixture of 16 PAH and 9 PCB was added to the distilled water in a specific amount. The water treatment plant belongs to the Upper Silesian Water Supply Company. For PAH and PCB extraction from the water, the solid phase extraction method was applied, using 500 mg Octadecyl C_{18} 6 mL Bakerbond columns. For this purpose, 0.5 L of water was taken. Isopropyl alcohol and methanol were used to precondition SPE extraction columns. After the water samples were passed through them, the columns were dried in vacuum for 30 min. PAH and PCB were then eluted from the column fillings using dichloromethane. Extracts were condensed to a volume of 2 mL. Prepared samples were analyzed with the use of gas chromatography and mass spectrometry (GC-MS) [1–3]. Extract (0.002 mL) was injected on a DB-5 column. PAH and PCB determination was performed in triplicate.

3. Results and Discussion

To establish the efficiency of the extraction, the percent recovery was calculated for each compound. The results of the percent recovery of PAH are presented in Figure 1. The achieved percent recovery of PAH amounted to about 7% in the case of chrysene to 100% in the case of naphthalene.

In case of phenanthrene, the percent recovery amounted to 125%, which might be caused by the release of this compound from the chromatography column. In the case of acenaphthylene, acenaphthene, fluorine, fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(a)pyrene, the recovery amounted to 25%. Recovery of anthracene and benzo(a)anthracene amounted to 50%. Indeno(1,2,3,-cd)pyrene, dibenzo(a,h)anthracene and benzo(ghi)perylene were not detected.

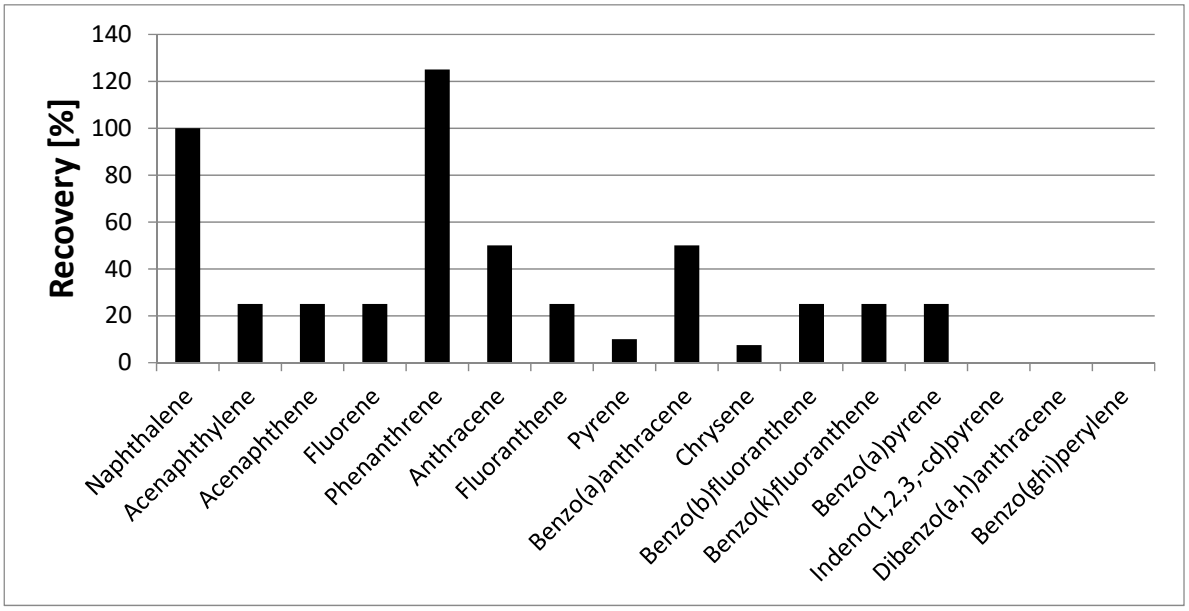

Figure 1. Recovery of PAH (polycyclic aromatic hydrocarbons).

The results of the percent recovery of PCB are presented in Figure 2. The achieved percent recovery of PCB amounted to about 51% in the case of PCB 101 to 92% in the case of PCB 156. Recovery of all compounds from this group was above 50% except for PCB 180, which was not detected.

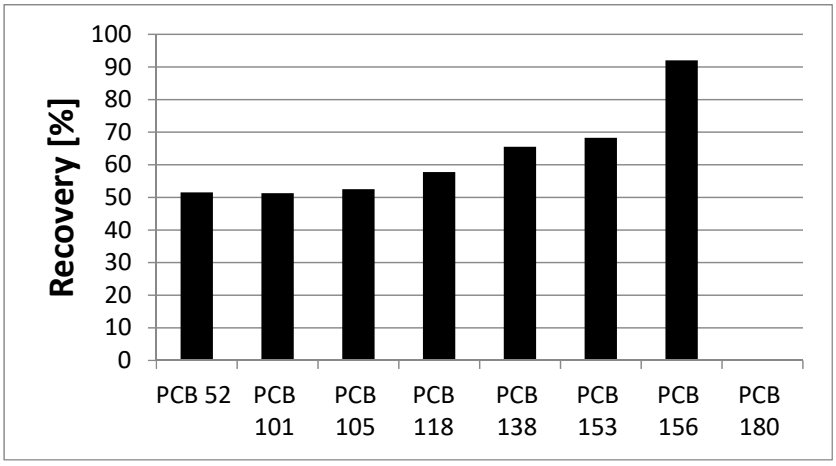

Figure 2. Recovery of PCB (polychlorinated biphenyls).

4. Conclusions

According to the literature, recovery in the case of PCB was satisfying. In the case of PAH there needs to be further research conducted to increase the recovery percent.

Author Contributions: P.S. and A.R. conceived and designed the experiments; P.S. performed the experiments; P.S. and A.R. analyzed the data; P.S. and A.R. contributed reagents/materials/analysis tools; P.S., wrote the paper.

Acknowledgments: The research was supported by BS/MN 402-301/18.

Conflicts of Interest: The authors declare no conflict of interest.

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