Polycyclic aromatic hydrocarbons in sediment

UniversalExtractor E-800: Soxhlet warm extraction of a sediment sample for the determination of polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds that consist of fused aromatic rings and do not contain heteroatoms or carry substituents.

PAHs occur in oil, coal and tar produced by carbonization of coal, but not in bitumen. They can also be found in grilled meat, cigarette smoke and automobile exhaust. PAH are persistent, ubiquitous and some of them have carcinogenic, mutagenic and teratogenic properties. There are more than 100 different PAH, but usually the 16 PAH defined by the United States Environmental Protection Agency (EPA) are analyzed. These are acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenz(ah)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene. Benzo(a)pyrene is often used as a lead substance.

1. Introduction

This Short Note describes the extraction and determination of these EPA-PAH in a dried sediment SETOC sample according to EPA 3541 [1]. The sample was extracted with the UniversalExtractor E-800 in the Soxhlet warm mode. The quantification was done by Labor Veritas Zurich, an ISO 17025 accredited laboratory.

2. Experimental

Equipment: UniversalExtractor E-800, Syncore® Analyst with 1 mL appendix vessels, GC-MS/MS.

Samples: sediment sample, SETOC 777 (61), dry sample. 10 g sample was weighed into an extraction thimble and mixed with 10 g sodium sulfate. 1 mL Internal Standard was added. The thimble was placed into the extraction chamber of the UniversalExtractor E-800 and the optical sensor was adjusted to the sample height. The sample was extracted using the parameters shown in Table 1.

Table 1: Extraction method for UniversalExtractor E-800.

Parameter	Value
Extraction method	Soxhlet warm
Solvent	n-Hexane / Acetone (1:1)
Solvent volume	150 mL
Extraction time	180 min
Extraction heating level	11
Chamber heating level	3
Rinse time	5 min
Rinse heating level	11
Drying time	5 min
Drying heating level	10

After extraction, the extract was transferred into 1 mL appendix vessels and concentrated using the Syncore Analyst. The analysis was carried on GC-MS/MS.

3. Results

The results of the PAH determination in a sediment sample are shown in Table 2. The results correspond to the values of the round robin testing and show good recovery and low variation.

Table 2: Results of the PAH determination using the UniversalExtractor E-800 and GC/MS (n=3).

	Mean µg/kg	RSD %	Recovery %	SETOC µg/kg
Naphthalene	421	2		-
Acenaphtylene	77	10		-
Acenaphthene	134	16	**82**	164
Fluorene	138	8	**82**	168
Phenanthrene	1253	5	**105**	1190
Anthracene	363	4	**131**	278
Fluoranthene	1927	8	**98**	1960
Pyrene	1447	8	**100**	1450
Benz(a)anthracene	1017	4	**112**	908
Chrysene	1207	2	**115**	1050
Benzo(b)fluoranthene	1377	5	**112**	1230
Benzo(k)fluoranthene	580	5	**103**	562
Benzo(a)pyrene	953	1	**110**	865
Indeno(1,2,3-cd)pyrene	890	2	**120**	742
Dibenzo(ah)anthracene	193	7	**112**	173
Benzo(ghi)perylene	587	1	**121**	708

4. Conclusion

The method presented in this Short Note demonstrates that the extraction by UniversalExtractor E-800 using the Soxhlet warm mode is a fast and reliable way to extract PAHs from sediment samples.

5. Acknowledgement

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6. References

[1] U.S. Environmental Protection Agency. Method 3541, Automated Soxhlet Extraction.
[2] SETOC Round Robin, http://www.wepal.nl/website/products/SEToc.htm

For more detailed information refer to Application Note 358/2019