APPLICATION NOTE

Extractable Petroleum Hydrocarbon (EPH) Analysis in Water by GC-FID

AN173v2; January 2026, SCION Instruments

Introduction

The spillage and release of petroleum fuels is one of the largest sources of environmental contamination. Extractable Petroleum Hydrocarbons (EPHs) pose a risk to human health. Some EPHs have been known to cause headaches, dizziness and numbness in the extremities.[1] They are also capable of affecting the blood, immune system, respiratory system and skin. EPH exposure may also affect organ function.[1] Understandably, this means that EPH testing of our drinking water is important in order to ensure that only safe levels of these compounds are present.

Solid Phase Extraction (SPE) is used in sample preparation to separate target analytes from the sample matrix. A common way to perform SPE is using cartridges containing solid adsorbent. EPHs can be separated into aliphatic and aromatic compounds using fractionation by SPE which uses a silica sorbent phase. For more information see our technical note on EPH Fractionation using SPE on the SCION knowledge centre.

This application can be performed on either the SCION Instruments 8300 GC or 8500 GC platforms equipped with an 8400 Pro Autosampler, S/SL injector, and FID detector.

Experimental

The tap water samples were extracted by adding 100 mL of each sample to a Duran flask with 20 mL of hexane. The solution was then stirred for 15 minutes. 10 mL of hexane was extracted from each sample and the samples were blown to dryness under nitrogen gas. Each sample was then reconstituted in 0.5 mL of hexane.

A reference oil sample was prepared by adding 0.5 mL of diesel fuel no. 2 to a Duran flask containing 100 mL of tap water and 20 mL of hexane. The solution was then extracted as above.

The tap water samples and reference oil samples then underwent fractionation by SPE to separate it into aliphatic and aromatic compounds before being submitted for analysis.

The first step for EPH fractionation using SPE was to condition the SPE cartridge. For this application note a 2 g, 6 mL silica sorbent phase cartridge was used. To condition the cartridge, 3 mL DCM was added and gravity used to pull through the solvent until the meniscus hit the top of the frit of the cartridge. The cartridge was allowed to soak for 5 minutes. Approximately 1 mL hexane was added to the cartridge and again allowed for gravity to pull the solvent through until the meniscus hit the top of the frit. A further 5 mL hexane was added following the same process.

The next step was to load the sample. A clearly marked collection vessel was placed under the cartridge and 0.5 mL sample was added to the cartridge and then allowed to flow through the cartridge until the meniscus hit the top of the frit.

Once the cartridge was conditioned and the sample loaded, the fractionation and elution of the aliphatic compounds was conducted. To do this 4 mL hexane was added to the cartridge and was allowed to flow through the cartridge at approximately 4 mL/min until the meniscus hit the top of the frit. The collection vessel containing the aliphatic compounds was put to the side.

To elute the aromatic compounds a clean collection vessel was placed underneath the cartridge. 6 mL DCM was added to the cartridge and allowed to flow through at approximately 4 mL/min until the meniscus hit the top of the frit. The collection vessel containing the aliphatic compounds was put to the side.

The aromatic and aliphatic fractions were concentrated down to approximately 1 mL under nitrogen.

Linearity samples were prepared in hexane at 6 concentrations, 100, 60, 30, 10, 5 and 1 µg/mL. The Linearity samples were made from a 300 µg/mL stock solution which was prepared with a purchased EPH mix standard.

10 instrument precision samples were also prepared at concentration level of 30 µg/mL.

Instrument parameters can be found in Table 1.

Table 1 Instrument parameters

Part	Settings
Autosampler	SCION 8400 PRO
Injector	275°C Split ratio 20:1
Injection Volume	1 µL
Column	SCION-5 30 m x 0.32 mm x 0.25 µm SC30233
Carrier Gas	Helium 1.0 mL/min
Oven Program	100°C (hold 0.1 min), 10°C/min to 250°C, 5°C/min to 280°C, 10°C/min to 325°C (hold 1.4 min)
Detector	FID (ceramic jet) 350°C, Air : 300 mL/min, Hydrogen : 30 mL/min, Make up (N_2): 25 mL/min
Run Time	27 min
Software	Compass CDS

Results and Discussion

The instrument method stated in Table 1 gave excellent specificity. Figure 1 shows an example chromatogram of the mid concentration linearity sample (30 µg/mL) overlaid on the blank runs of DCM and Hexane.

This zoomed chromatogram clearly demonstrates the specificity of the method, showing good resolution between all compounds as well as good peak shapes of all of the EPH compounds.

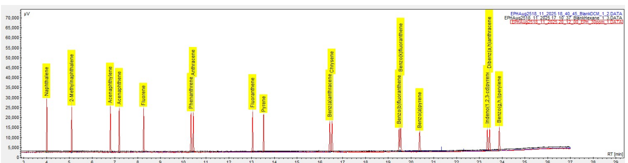

Figure 1 Zoomed chromatogram of EPH mix 30 µg/mL overlaid on blank runs of DCM and Hexane.

Table 2 shows the correlation coefficient and system precision (n=10) results for all compounds present within the EPH mix.

The r^2 values of all compounds demonstrate excellent linearity. Many regulations only require an r^2 value of ≥0.99.

System precision values of all compounds demonstrate good repeatability with all results well below the 2% which is generally considered acceptable for method validation.

Figures 2 and 3 show example chromatograms of the reference oil sample after fractionation into aliphatic and aromatic compounds by SPE. These chromatograms have been overlaid over the EPH mix at 30 µg/mL.

Results were calculated using the average response factors from the mixed EPH standard linearity samples. The reference oil was shown to consist of EPHs from Naphthalene to Chrysene (C10 – C18) with a total concentration of 14191.18 µg/mL.

Table 2 Correlation coefficient results for all compounds

Compound	Carbon Number	RSD (%)	Correlation Coefficient (r^2)
Naphthalene	C10	0.99	0.9993
2-Methylnaphthalene	C11	1.09	0.9990
Acenaphthylene	C12	0.76	0.9982
Acenaphthene	C12	1.29	0.9988
Fluorene	C13	0.55	0.9986
Phenanthrene	C14	1.36	0.9991
Anthracene	C14	1.14	0.9989
Fluoranthene	C16	1.48	0.9980
Pyrene	C16	1.04	0.9973
Benz(a)anthracene	C18	1.21	0.9975
Chrysene	C18	1.06	0.9975
Benzo(b)fluoranthene	C20	1.35	0.9981
Benzo(k)fluoranthene	C20	1.46	0.9983
Benzo(a)pyrene	C20	1.23	0.9985
Indeno(1,2,3-cd)pyrene	C22	1.35	0.9984
Dibenz(a,h)anthracene	C22	1.18	0.9988
Benzo(g,h,i)perylene	C22	1.28	0.9992

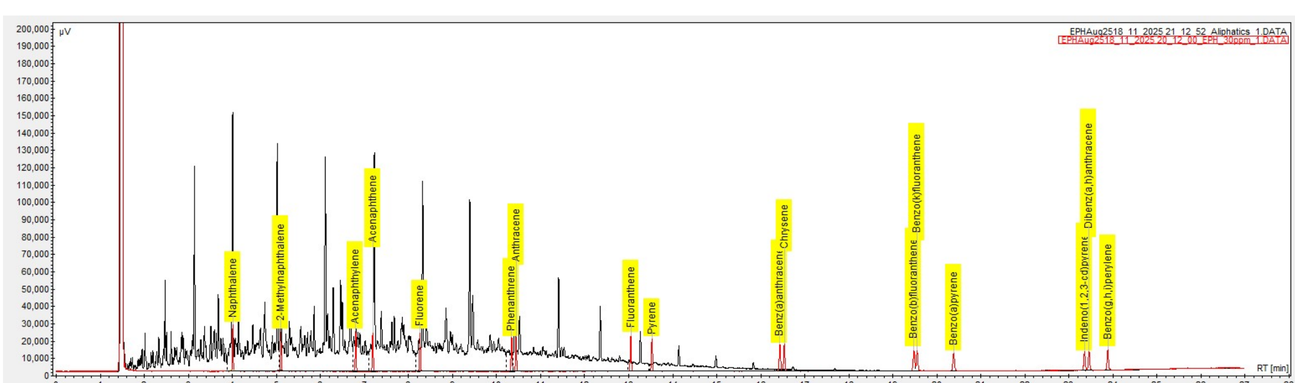

Figure 2 Chromatogram of EPH mix 30 µg/ mL overlaid on aliphatic fraction from reference oil sample.

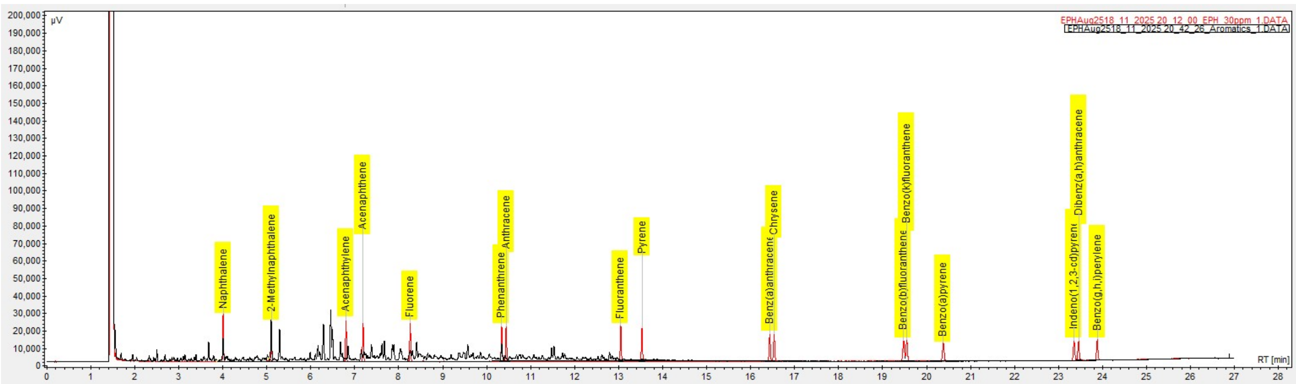

Figure 3 Chromatogram of EPH mix 30 µg/mL overlaid on aromatic fraction from reference oil sample.

Table 3 EPH results for the Reference Oil Sample

Compound	Carbon Number	Aliphatic Fraction (µg/mL)	Aromatic Fraction (µg/mL)
Naphthalene	C10	1775.07	1707.80
2-Methylnaphthalene	C11	2479.94	5673.50
Acenaphthylene	C12	460.92	615.90
Acenaphthene	C12	1614.35	3491.20
Fluorene	C13	2786.25	5527.30
Phenanthrene	C14	138.44	337.20
Anthracene	C14	2098.91	4902.40
Fluoranthene	C16	215.35	361.00
Pyrene	C16	613.62	937.50
Benz(a)anthracene	C18	8.14	N/A
Chrysene	C18	96.76	N/A
Benzo(b)fluoranthene	C20	N/A	N/A
Benzo(k)fluoranthene	C20	N/A	N/A
Benzo(a)pyrene	C20	N/A	N/A
Indeno(1,2,3-cd)pyrene	C22	N/A	N/A
Dibenz(a,h)anthracene	C22	N/A	N/A
Benzo(g,h,i)perylene	C22	N/A	N/A
Total	N/A	**12287.74**	**1903.44**

Results for the reference oil for both aliphatic and aromatic fractions can be seen in Table 3.

The extracted tap water sample was shown to have no EPH present as expected as seen in Figure 4.

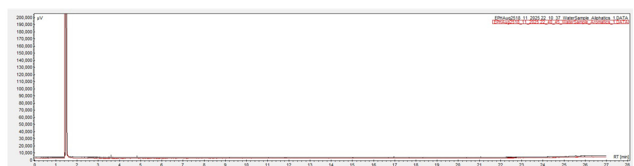

Figure 4 Chromatogram of overlaid tap water sample from both aliphatic and aromatic fractions from fractionation by SPE.

Conclusion

A method has been successfully developed and validated for the determination of extractable petroleum hydrocarbons (EPH) in water.

The reference oil and tap water samples were extracted by liquid-liquid extraction (LLE) and then went through the process of fractionation using SPE to separate into aliphatic and aromatic compounds. Check out the SCION knowledge centre on our website where we have multiple technical notes on sample preparation including LLE and SPE.

SCION instruments recommends checking with local regulatory authorities to ensure all testing and reporting requirements are met, or contact the SCION applications team for assistance.

For more information, please contact:

E: sales-eu@scioninstruments.com

W: www.scioninstruments.com

Ordering Information

Ordering Information for the 8300 GC	
Part	**Part Number**
8300-GC, with S/SL inlet and FID detector (120V)	839001701
8300-GC with S/SL inlet and FID detector (230V)	839001702
8400 PRO Autosampler for 8300 and 8500 GC	840000001
Suggested Consumables	
Part	**Part Number**
SCION-5 30 m x 0.32 mm x 0.25 µm	SC30233
Liner STR QW PK/5	41312100
15% Graphite/85% Vespel Ferrule 1/16" with 0.5 mm hole pk/10	41312149
BTO Septa 9 mm, pk/50	CR298713
10 µL fixed needle syringe, 5 cm, 0.47 mm OD, 26 g conical needle	41312133
Vial, 9-425 Screw Thread, 2 mL Clear Glass 12 x 32 mm Flat Base with Label, pk/100	41311000

For ordering info on the SCION 8500 GC, which offers greater functionality with the option of up to 4 detectors (including MS), please contact your local SCION sales representative

References

1. Total Petroleum Hydrocarbons (TPHs) - The Center for Health, Environment & Justice (chej.org), https://chej.org/total-petroleum-hydrocarbons-tphs, (Accessed March 2024)