



GC/MS-Screening for Evaluating Biodegradation of Petroleum Hydrocarbons

Besides physical processes, such as the evaporation of volatile components into the soil air or atmosphere and the leaching of water-soluble components into the groundwater, biodegradation leads to characteristic changes in the composition of petroleum hydrocarbons. The *n*-alkanes are degraded first. The methyl-branched, isoprenoid compounds are more persistent. The biodegradation of alicyclic and polyaromatic compounds is even slower. This sequence of biodegradability can be used for evaluating biodegradation of petroleum hydrocarbons. The analytical basis for this is the exact detection of the composition for individual or group-specific petroleum hydrocarbons using high-resolution gas chromatography / mass spectrometry (GC/MS).



Sampling



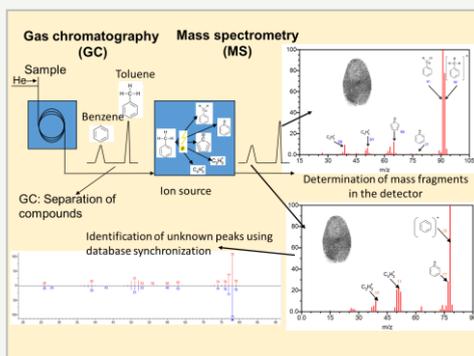
Sample pretreatment



Analysis

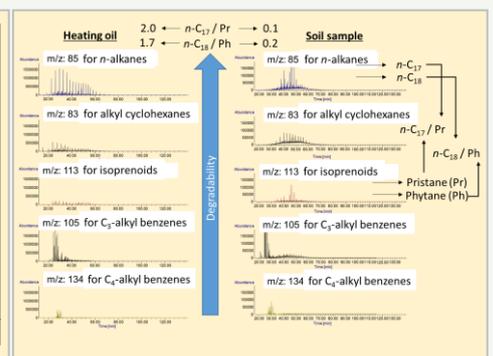


Expertise



Fuel Type	Level of Biodegradation	Chemical Composition
Gasoline Diesel Bunker C fuel	1	Abundant <i>n</i> -alkanes
	2	Light-end <i>n</i> -alkanes removed
	3	Middle range <i>n</i> -alkanes, olefins, benzene & toluene removed
	4	More than 90% of <i>n</i> -alkanes removed
	5	Alkylcyclohexanes & alkylbenzenes removed Isoprenoids & C ₁₀ -naphthalene reduced
	6	Isoprenoids, C ₁ -naphthalenes, benzothiophene & alkylbenzothiophenes removed C ₂ -naphthalenes selectively reduced
	7	Phenanthrenes, dibenzothiophenes and other polynuclear aromatic hydrocarbons reduced
	8	Tricyclic terpanes enriched Regular steranes selectively removed C ₂₁ to C ₂₈ -homohopanes reduced
	9	Tricyclic terpanes, diasteranes & aromatic steranes abundant

↑ Increasing level of biodegradation



The precise determination of the composition for individual or group-specific petroleum hydrocarbons is carried out using GC/MS.

Biodegradation leads to changes in the composition of petroleum hydrocarbons, since individual substance classes are faster degraded than others.

The level of biodegradation for petroleum hydrocarbons is determined on the basis of specific patterns of individual substance classes and diagnostic ratios.

Workflow

- We develop an investigation concept taking into account the site-specific field conditions.
- We provide sampling flasks and protocols.
- We carry out the GC/MS-Screening for different sample matrices (water, soil, NAPL).
- We interpret the GC/MS data to evaluate the biodegradation of petroleum hydrocarbons.

Result

Direct evidence of *in situ* biodegradation

Cost

320 – 500 € per sample

TAT

3 - 4 weeks

Further reading

Wang Z, Fingas M, Blenkinsopp S, Sergy G, Landriault M, Sigouin L, Foght J, Semple K, Westlake DWS (1998): Comparison of oil composition changes due to biodegradation and physical weathering in different oils. J. Chromatogr. A 809: 89-107.

Prince RC, Parkerton TF, Lee C (2007): The primary aerobic biodegradation of gasoline hydrocarbons. Environ. Sci. Technol. 41: 3316-3321.

Turner DA, Williams M, Sigman MA, Goodpaster JV (2018) A comprehensive study of the alteration of ignitable liquids by weathering and microbial degradation. J. Forensic Sci. 63: 58-65.

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