

Organic Analysis of Environmental Samples Using Liquid Chromatography with Diode Array and Fluorescence Detectors: An Overview

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Organic Analysis of Environmental Samples Using Liquid Chromatography with Diode Array and Fluorescence Detectors: An Overview

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ABSTRACT

This overview is focused to provide an useful guide of the families of organic pollutants that can be determined by liquid chromatography operating in reverse phase and ultraviolet/fluorescence detection. Eight families have been classified as the main groups to be considered: carbonyls, carboxyls, aromatics, phenols, phthalates, isocyanates, pesticides and emerging. The references have been selected based on analytical methods used in the environmental field, including both the well-established procedures and those more recently developed.

KEYWORDS

Fluorescence; liquid chromatography; organic pollutants; visible-ultraviolet

Introduction

As Samanidou points,^[1] Liquid chromatography is the workhorse in routine analysis. In combination with ultraviolet (UV) and fluorescence (FLD) detectors, high performance liquid chromatography (HPLC) operating in reverse phase is considered as consolidated for the determination of numerous organic compounds. In spite of the limitation to confirm the analyte identity, UV and FLD detectors have significant advantages to continue being widely used.

Aspects such as marked reproducibility, robustness, low consuming costs, portable equipment, easy-to-use and widely available technique continues to be priority for laboratories. This is especially true when a large number of samples are handled, for instance, during monitoring programs in environmental studies.

Despite the requirement of fluorescent compounds is the main limitation to apply FLD detection, its sensitivity and selectivity remain remarkable. This type of detection is also advantageous because it is not very susceptible to matrix effects. A review of different types of luminescent spectrometric methods from 1990 to 2010 to determine pollutants in the environment was carried out by Vega Morales et al.^[2] The determination of polycyclic aromatic hydrocarbons (PAHs), pesticides (carbamates, organophosphorus and benzimidazole), anti-inflammatory and antibiotics in different environmental matrices were documented.

Regarding UV detection, the interest to use this analytical tool lies in its universality and simplicity. In spite of its limited sensitivity and selectivity, HPLC/UV continues to be widely applied in environmental analysis.

Although, the development of direct analysis plays nowadays an important role in analytical studies, sample pre-treatment is still mandatory in most analytical protocols. Hence, the continuous development in extraction step can

lead to significant improvements. Moreover, life cycle concept is gaining great interest too. In definite, green analytical chemistry, low cost and minimized solvent consumption is giving to interesting changes in extraction step.

It is, therefore, necessary to make a point in this article about the main microextraction techniques that currently participate in the analytical methodology. Regarding liquid samples, these techniques are very briefly cited below.

- Liquid phase microextraction (LPME).^[3,4] Only several microliters of solvent are required to concentrate analytes from liquid samples.

Hollow fiber liquid phase microextraction (HF-LPME). A porous polypropylene hollow fiber is used for immobilization of organic solvent in its pores. Analytes are extracted from the donor phase (i.e. water sample) into the acceptor phase (i.e. organic solvent) that fills the inside of the hollow fiber.

Static mode: sample is stirred for extraction

Dynamic mode: small volumes of aqueous sample are repeatedly pulled in and out of the hollow fiber.

Dispersive liquid-liquid microextraction (DLLME). Extraction requires an extraction solvent, disperser solvent and aqueous sample. A cloudy solution is formed, which can or not be centrifuged for separation. Modifications using extraction solvents:

With higher or lower density of water

IL: Ionic liquids^[5]

SMS: Supra molecular solvent, i.e. surfactants (variant: *Cloud Point Extraction*, changes on temperature and surfactant

concentration produce to move aqueous analytes into a micelle phase for separation.

DES: Deep eutectic solvents,^[6] with similar properties to IL.

Homogeneous liquid-liquid extraction. Initial condition for extraction is a homogeneous solution. Phase separation depends on temperature, salt effect, using a ternary solvent system and so forth.

- Miniaturized solid phase extraction (Miniaturized-SPE)^[7]

Solvent-dispersive micro solid phase extraction (D- μ SPE). Solid sorbent particles are dispersed into the sample solution. Phase separation can be achieved via centrifugation or filtration

Solvent free-solid phase microextraction (SPME). The method involves the use of a small microfiber to sorb analytes. The HPLC system requires an additional device as interface for solvent desorption of analytes.

Stir bar sorptive extraction (SBSE). Stir bars are coated with an apolar polymeric phase as sorbent to extract analytes while stirring.

Magnetic solid phase extraction (MSPE). Magnetic particles are coated with silica or alumina oxides to extract analytes by adsorption. Separation with an external magnetic field, without the need centrifugation or filtration

Micro extraction in a packed syringe (μ SPE). Approximately 1 mg of sorbent as conventional SPE columns is packed into a syringe or cartridge. Small particle size, i.e. 3 μ m, are used, while 50–60 μ m are used in traditional SPE.

For solid or semisolid samples, extraction methods based on more conventional techniques such as microwave assisted extraction (MAE), pressurized liquid extraction (PLE), ultrasonic extraction (US) remain being used by minimizing solvent consumption. In this sense, some modifications such as *Matrix solid phase dispersion (MSPD)* are reported. The sample is dispersed and blended in a solid support material, i.e. a derivatized silica. The mix is then transferred and packed into a syringe or cartridge for elution.

Among some of the most recent developments in sample treatment for HPLC analysis can be pointed:

- Developments of LPME are leading to approaches such as headspace to implement microscale mode.^[8] Requirements of automation and design of special instrument are considered as future researches focused to eliminate the disadvantage to hold extraction solvent drop. Air bubbles, vortex or ultrasound assisted DLLME are of the most used microextraction techniques.^[9] Among their advantages, simplicity, low cost and short time are well known. However, for complex matrices, the technique presents limitations of selectivity and clean up efficiency. DLLME in combination with other techniques aims to eliminate associated drawbacks. Sajid and Alhooshani^[10] recently reviewed most of the combined DLLME based methods. The article emphasizes the

improvement with respect to individual technique applications.

- Otherwise, DESs are emerging as novel green alternative with high potential to conventional extractants and ionic liquids.^[11] Although, the application of these solvents for the determination of organics in environmental matrices is early reporting for now, its wide potential will lead to increase the number of published papers.^[6]

The use of surfactants as disperser solvent for extraction^[12,13] or component of mobile phase^[14] are being also interesting alternatives for environment friendly and simple HPLC analysis. Micellar liquid chromatography using new types of sorbents such as monolithic columns can also improve the development of asequible analytical methods.^[15] These columns provide a lower pressure drop which is advantageous to compensate the pressure increases caused by surfactants mobile phases. The use of ILs as new monomers to fabricate versatile monolithic columns are being widely reported based on its improved separation efficiency.^[16] The increasing concern on automated procedures and online coupling will lead to make more attractive the use of HPLC/UV/FLD as analytical tool. Improvements such as low solvent volumes, handling reduction and reproducibility parameters will have to lead to its implementation in routine sample analysis, main analytical objective.

This review is focused to provide an useful guide on the families of organic pollutants which can be determined using reverse phase HPLC with UV or FLD detectors. We think this practical guide can help to the readers interested in knowing the potential of their analytical resources.

References where to find the information on the analytical methods have been compiled based on available literature from abstracts using Web of Science and the open literature. No online methods or interface, i.e. SPME-HPLC, which imply additional dispositive coupled to HPLC system have been included. For some family of compounds, analyses of other matrices have been considered when information of analytical methods was scarce.

Carbonyls

HPLC/UV coupled to chemical derivatization is one of the most widespread analytical techniques to determine this kind of volatile organic compounds. Carbonyls commonly measured include: formaldehyde, acetaldehyde, acetone, propionaldehyde, butyraldehyde, acetone, acrolein, valeraldehyde, hexaldehyde, tolualdehyde, crotonaldehyde, 2-butanone, benzaldehyde, glyoxal, methylglyoxal, being most of them aldehydes.

Analytical method have been highlighting by a previous derivatization with 2,4-dinitrophenylhydrazine (DNPH) and subsequent UV detection.^[17,18] Determination of Carbonyls from C-1 to C-12 at trace levels in air and emission samples have been extensively studied by researchers, such as Possanzini et al.^[19] Some studies were applied to water and wet deposition samples.^[20] To date HPLC/UV analysis with DNPH derivatization is recognized as a standardized

method, especially for the most volatile carbonyls.^[21] In fact, most of the found papers on the determination of carbonyls by DNPH are focused during intensive environmental studies (Table 1).

Blank contaminations are the main limitation of this reagent. As it happens with other methods of derivatization, there are associated issues in the measurement quality that analyst must consider.^[31] Alternative hydrazine reagents have been rarely applied in environmental measurements.^[32–34] The most recent papers continue to be focused for evaluating other hydrazine reagents to use with FLD^[35] or UV detection.^[36]

Carboxylic acids

They are usually present together with aldehyde forms. Unlike carbonyl compounds, they are rarely analyzed by reverse phase HPLC. The major disadvantage for HPLC analysis under reversed-phase conditions is when organic acids are ionized and, thus, difficult to retain. This leads to the need to use buffered mobile phases at low pH. Derivatization of the carboxyl is then necessary. Moreover there are two additional reasons. First, this step is required

to measure at wavelength above 250 nm to avoid UV monitoring of many interference substances. Second, fatty acid derivatives are decreased in polarity, therefore, increasing both its retention and selectivity for HPLC analysis in reverse phase.

2,4-Dibromoacetophenone and trimethylamine have been used as derivatization reagents for UV detection.^[37] In the case of FLD detection, 9-Chloromethyl anthracene^[38] and 2-(11H-benzo[a]carbazol-11-yl) ethyl 4-methyl-benzene-sulfonate,^[39] monobromobimane^[40] are included as derivatization reagents.

Some polyphenolic compounds without a previous derivatization have been also determined using HPLC/UV.^[41,42] In detail, eight phenolic compounds were studied, i.e. gallic, caffeic, 4-hydroxy benzoic, vanillic, p-coumaric, syringic, ferulic and sinapic acids. They are frequently analyzed by HPLC, although, specific literature on the analysis of environmental samples to quantify fatty acids by UV or FLD is very limited. Among them, 4-hydroxy benzoic, vanillic, syringic are of environmental interest due to their role as biomass burning tracers.

Analytical applications for the determination of carboxylic acids by HPLC/UV/FLD are summarized in Table 2.

Table 1. HPLC/UV analysis of carbonyl compounds: environmental applications.

Aldehydes (number)	Sample treatment DNPH technique, solvent (mL)	Matrix (m ³ , mL)	UV detection	
			LOD (μg m ⁻³ , ng mL ⁻¹)	Ref
(10)	SPE, acetonitrile(2)	Air: gas ^a	0.28–1.38	[22]b
(2)	US, DNPH/acetonitrile (5)	Air: PM (90) ^a	10–20	[23]
(10)+ acetone	SPE,acetonitrile(5)	Air (0.12) ^a	0.005	[24]b
+ acetone	IL-SDME, 1-octyl-3-methylimidazolium hexafluorophosphate (0.010)	Water (10)	0.25–2.03	[25]b
carbonyls(24), PAHs+ (16)	US, US: H ₂ O (10), DNPH: (0.2)	Air: PM	2.4–10	[26]
(1)	SPE, acetonitrile	Indoor (0.08) ^a	0.5	[27]b
(2)+ acetone	Passive	Air ^a	7.6–8.8	[28]b
(14)+ acetone	SPE, acetonitrile (1)	Wet deposition (13–44 × 10 ³) ^a	7–79	[29]b
(9)	Passive, Radiello [®]	Indoor/outdoor ^a	0.010–1.5	[30]b

^aRoutinely analysis of real samples during environmental study.

^bArticle available online.

Table 2. HPLC/UV/FLD analysis of carboxylic compounds.

Carboxylic (number)	Sample treatment Derivatization reagent	Matrix (m ³ , mL)	Detection Technique	LOD	
				LOD	Ref
(19) C8-C18	2,4-dibromoacetophenone and trimethylamine. (2 chromatographic columns)	Biological	UV	>0.005 ng	[43]a
(11) C7-C18	Direct (MAE/SPE for extraction)	^a Plants	UV	0.17–2.2 ng	[42]a
(2) C1-C2	Direct	^a Indoor, museum	UV	650–8 μg mL ⁻¹	[44]a
(1) C1	DNPH	Air	UV	0.8 μg m ³	[45]a
C2 –C6	2,4-dibromoacetophenone and trimethylamine	Biological	UV	0.04 ng mL ⁻¹	[37]a
C1-C6	9-Chloromethyl anthracene	Soil	FLD	0.18–2.5 pmol	[38]a
(20) C10-C24	2-(11H-benzo[a]carbazol-11-yl) ethyl 4-methyl-benzene-sulfonate	^a Plants	FLD	0.56–1.59 ng mL ⁻¹	[39]a
(1) C3	Monobromobimane	Sediment	FLD	0.46 ng mL ⁻¹	[40]
C7-C11	Direct	Plants	UV	Not available	[41]a

^aRoutinely analysis of real samples during an environmental study.

^bArticle available online.

Table 3. HPLC/UV/FLD analysis of PACs: environmental applications.

PACs	Sample		Detection		Ref
	Technique, sorbent	Matrix (g, mL)		LOD (pg mL ⁻¹ , pg g ⁻¹)	
PAHs (number)					
(3)	MSPE, Fe ₃ O ₄ magnetic nanoparticles + IL	Lake, river waters (300)	FLD	0.33–8.33	[47]a
(4)+PAEs(4)	MSPE, Fe ₃ O ₄ magnetic nanoparticles caged into hydrophilic barium alginate	Waters (500)	FLD UV	2–5 19–59	[48]a
	μSPE, Titanate Nanotube array modified by CetylTriMethylAmmonium Bromide	Natural water	FLD	26–820	[49]
(6)	MSPE, Fe ₃ O ₄ magnetic nanoparticles	Water (200)	FLD	0.04–3.75	[50]a
(10)	μSPE, Sulfur μparticles	Sea,wastewaters (100)	UV	7–48	[51]
(6)	SBSE	Lake water	FLD	0.03–3.75	[52]
(5)	MSPE, Metal-Organic Framework,	Lake water (20)	UV	2.8–27	[53]a
(16)	LLME	Rain water	FLD		[54]
(6)	MSPE, Fe ₃ O ₄ /polydopamine	Tap,river water (500)	FLD	0.5–1.9	[55]a
(6)	USE-SPE, Titania Nanotubes/Titanium plate modified	Soil		1.5–400	[56]
(6)	MISPE, Graphene functionalized Silica gel	Water	UV	2.9–52	[57]
	IL-DLLME	Water	UV	0.5–880	[58]
	SBSE, Graphene-Stainless Steel Wir	Soil		0.2–50	[59]
(5)	MM-ILMSPE, Fe ₃ O ₄ magnetic nanoparticles + IL + Methyl Orange NanoParticles	Water (150)	FLD	0.1–2	[60]
(6)	SBSE-US, Polydimethylsiloxane and Metal-Organic Framework	River,lake water	FLD	0.05–2.94	[61]
(7)	ZIF-US	Water	FLD	0.08–1.6	[62]a
(4)	HF-LPME, carbon	Water	FLD	0.4–4	[63]
(13)	SPE, Styrene/DiVinylBenzene/Glycidyl MethAcrylate	Water (500)	FLD	0.004–0.23	[64]
(12)	SPE, N-Acetyl-L-Cysteine modified CdS Quantum Dots	Tap water (500)	FLD	1–100	[65]a
(5)+NAr(6)	MSPE, Tetraazacalix[2]arene[2]triazine coated Magnetic NanoParticle	Natural waters	FLD UV	0.09–0.15 6–11	[66]
(3)+fluoroquinones + sulfanamides	CPE, Triton X-100	Tap,surface,wastewater	UV	40–380	[67]a
	SFD-DESS, tetra-n-butyl ammonium bromide + carboxylic acids	Water	FLD	0.7–6.6	[68]
OHPAHs (number)					
(1)+PAHs(2)+Acides (2)	Agitation	Soil (5–10)	UV, FLD	3–4 μg mL ⁻¹	[69]a
(3)	US	PM	FLD	6–190 fmol	[70]a
(2)+PAHs (10)	US, methanol (10)	^b PM (135)	FLD	1 ng mL ⁻¹	[71]a
NPAHs (number)					
(2)	Soxhlet, sodium sulfide	PM		67–81 pg	[72]a
(3)	Titanium (III)	Water		68–629 pg	[73]
(4)	US, sodium borohydride	^b Soil (0.5)	FLD	14–1000	[74]
(5)+	MAE, dichloromethane (20)	^b PM (225)	FLD	4	[75]a
PAHs(12)+ OHPAHs(2)	US,methanol(10)			1	
BTEX (number)					
(6)	N ₂ gas drag	Water (100)	UV	180–600ng mL ⁻¹	[76]a
(5)+PAHs (3)	Direct	Water	UV		[77]

^aArticle available online.^bRoutinely analysis of real samples during an environmental study.

Aromatics

Polycyclic aromatic compounds (PACs) can be divided into PAHs and derivatives of these such as nitro-derivatives (NPAHs), hydroxy-derivatives (OHPAHs) and quinone-derivatives (PAHQ). The substitution, alkylation and hydrogenation of the molecules of PAHs result to their formation. Sixteen priority pollutant PAHs according to United States Environmental Protection Agency^[46] can be analyzed using either UV or FLD, while derivatives are preferably quantified by FLD (Table 3). Other aromatics such as benzene, toluene, ethylbenzene, and o-m- and p-xylenes (BTEX), have been also included in this section for organization issue. They can be detected by UV (Table 3).

Polycyclic aromatic hydrocarbons

The determination of the 16 PAHs considered as priority is well documented in literature, especially in atmosphere.^[78,79] Naphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz[a]anthracene, chrysene, benz[b]fluoranthene, benz[k]fluoranthene, benz[a]pyrene, dibenz[a,h]anthracene, benzo[g,h,i]perylene, 1-methyl-naphthalene, 2-methyl-naphthalene are usually determined.

The analysis by means of HPLC in reverse phase by using both detectors is quite usual, applying very conventional chromatographic conditions. FLD detection is the most recommended for the analysis of PAHs by HPLC due to its high selectivity and sensitivity. However, higher extraction

efficiency should be searched when HPLC/DAD is used for the analysis of trace PAHs. Advances in this field include the enrichment of PAHs from environmental samples prior to HPLC analysis by using novel adsorbents to be applied as micro solid phase extraction (μ SPE). Because this kind of HPLC analysis is really extensive, only papers from 2010 have been considered of interest in this review. The most recent reports are focused on the analysis of waters.

Hydroxy polycyclic aromatic hidrocarbons

While PAH determination have been broadly documented in environmental analysis, the quantification of hydroxy polycyclic aromatic hidrocarbons (OHPAHs) is actually rare, mainly in water and sediments. For extraction, these polar PAH metabolites need the addition of salts, i.e. Na_2SiO_3 ,^[80] or polar solvents such as methanol^[81] to effectively recover. Regarding HPLC/FLD determination, it is carried out with high sensitivity and without previous derivatization.^[70,81] However, depending on the isomer to be analyzed, the selectivity of the technique may not be sufficient.

Hydroxyl derivates such as 1-hydroxy-pyrene and 2 hydroxy phenanthrene have been determined by HPLC/FLD.

Polycyclic aromatic hidrocarbons quinones

The presence of these compounds in atmosphere has been related to photo-oxidation of PAHs. A review of analytical procedures was carried out by Kishikawa and Kuroda in 2014.^[82] The authors include analytical applications using UV to detect a few ng of naphthoquinone, 9,10-phenanthrenequinone and 9,10-anthraquinone in airborne particles. Regarding FLD analysis, bibliographic references based on the reduction of quinone to fluorescent hydroquinone using chemical reductants such as sodium borohydride, zinc, benzaldehyde and platinum are also included. In this case, reached detections were up to femtogram level.

Nitro polycyclic aromatic hidrocarbons

HPLC analysis with FLD detection has been frequently used to determine **nitro polycyclic aromatic hidrocarbons** (NPAHs).^[83,84] Some of them include nitro-naphthalene, nitro-phenanthrene, nitro-pyrene and nitro-fluoranthene. High selectivity of FLD quantification is advantageous on the presence of interferences produced, for example, by the original PAHs, which are much more abundant in samples. However, when not enough selectivity for proper separation of isomers is achieved, drawbacks are associated to limitations for identifying isomers.

The analysis requires a previous stage of derivatization for the reduction of the nitro group to the amino producing compounds with high fluorescence. Derivatization by sodium borohydride is economically affordable compared to others such as those using Pt columns.

There is a shortage of methodology to determine NPAHs by HPLC in waters.

Benzene, toluene, ethyl benzene and xylene isomers

HPLC is very rarely applied to determine BTEX in environmental analysis. However, some applications using UV detection have been reported in other fields, such as occupational exposure and tars production from biomass gasification.^[85,86] From an analytical point of view, HPLC could be chosen for analysis because facilities a simultaneous separation of BTEX and other polar compounds, phenols or aromatics.

Phenols

The term *phenolics* refer to an extremely large number of compounds and many classifications can be established. These compounds can be chlorinated, nitrated, methylated or alkylated. They have been divided into at least ten groups depending on their basic structure: phenols, phenolic acids, hydroxyamic acids, naphthoquinones, xanthenes, stilbenes, anthraquinones, flavonoids and lignin. Either they can be also divided as industrial and natural phenolics by including more than 100 types of compounds.^[87] It would encompass practically all the organics that may be of interest in this review. To address organization, we have considered including in this chapter the works devoted to the analysis of priority phenolics by the EPA and some relevant alkylphenols, such as nonylphenol and octylphenol. The list of 11 phenolic compounds includes: phenol, 4-nitro-phenol, 2,4-nitro-phenol, 2-chloro-phenol, 2-nitro-phenol, 2,4-dimethyl-phenol, 2-methyl-4, 6-dinitrophenol, 4-chloro-3-methyl-phenol, 2,4-dichloro-phenol, 2,4,6-trichloro-phenol and penta-chloro-phenol.

Bisphenol A (4,4'-(propane-2,2-diil) diphenol) (BPA) has been also included in this chapter. Analytical applications for the referred phenols in different environmental matrices are summarized in Table 4.

Phenols and alkylphenols

The relatively low level of concentrations of phenols as water pollutants leads to the need of a pre-concentration stage to reach the trace levels. Thus, more recent studies are focused to develop previous treatment step to HPLC quantification and improving extraction efficiency (Table 4). Regarding detectors, UV detection has been commonly employed as the preferred detector of HPLC when phenol concentrations are above $1\ \mu\text{g}\cdot\text{mL}^{-1}$. Literature on FLD detection is mainly devoted to determine octylphenol and nonylphenol. A detailed review on pre-concentration step for the determination of chlorophenols in real environmental samples was carried out by de Morais et al.^[116] The authors stress the importance of sampling, storage and pre-concentration stages for chromatographic analysis. In general, among the latest advances in the development of microextraction techniques, the most recent papers on the determination of phenols and alkylphenols, mainly water, stand out.

Table 4. HPLC/UV/FD analysis of phenols and alkylphenols: environmental applications.

Phenols (number)	Sample treatment		Detection		Ref
	Technique, sorbent/solvent (mL)	Matrix (mL,g)		LOD (ng mL ⁻¹ , ng g ⁻¹)	
(11)	SPE, PSDB	Tap water	UV,	10–900	[88]a
(3)	MM-IL-MSPE, IL modified on Fe ₃ O ₄ nanoparticles	River, tap water (200)	UV	0.20–0.35	[89]a
(3)	LLE, dichloromethane (15)	Tap water	UV	5–15	[90]a
(2)	LLE, dichloromethane (1:20,water)	River, wastewater ^b	FLD	50–75	[91]a
(1)	SBSE, polydimethylsiloxane	Natural waters (30) ^b	FLD,	0.4–1.8	[92]a
(5)	DLLME-SDME, toluene	Environmental water	UV	0.016–0.084	[93]
(2)	SPE, Oasis [®] HLB	River,drinking Water (250)	UV,	25–30	[94]a
(2)	HF-LPME, dihexylether	Drinking, river, urban waste water	FLD	0.5	[95]a
(5)	Derivat.,coumarin-6-sulfonyl chloride	Tap,recycled water	FLD		[96]a
(2)	US-SPE, water/methanol-C18	Sediment (2) ^b	FLD	0.08	[97]a
	SBSE, polydimethylsiloxane + covalent triazine framework	Environmental water	UV	0.080–0.30	[98]
Bisphenol A + phenols (number)					
(3)	IL-DLLME, 1-octyl-3-methylimidazolium hexafluorophosphate	Water	FLD	0.23–0.48	[99]
(1)	MAE-SPE	Wastewater(100) Sewage	UV	0.1 100	[100]
	HF-LLME	Sediment	UV	0.055–1.46	[101]
(7)	SBSE, metal organic framework	Water	UV	0.15–0.35	[102]
(2)	DLLME, chlorobenzene (0.2)	Water	FLD	0.002–0.0065	[103]
(6)	US-DLLME, chloroform (0.025)	Water (5)	UV	0.13–0.63	[104]a
(4)	DLLME, chlorobenzene (0.1)	Snow,tap Water (10)	UV	0.11–0.62	[105]a
(3)	μSPE,TiO ₂ nanotubes	Water	FLD UV	0.012–0.036 0.022–0.093	[106]
	IL-HF-LPME, 1-octyl-3-methylimidazolium hexafluorophosphate	River water ^b	UV	0.03–0.1	[107]
(1)	MMSPD-DLLME, Fe ₃ O ₄ nanoparticles	Water	FLD	0.002	[108]
(1)	μSPE, IL based surfactants on Fe ₃ O ₄ nanoparticles	Water (100)	UV	0.20–1.3	[109]a
(1)	SPE-DLLME, solidification of floating drop/undecanol (0.03)	Water (100)	FLD	0.002	[110]a
(1)	dispersive-SPE, dummy molecularly imprinted Fe ₃ O ₄ nanoparticle	Water	UV	0.3	[111]
(1)	US- μSPE, molecularly imprinted polymer	Drinking Water (20)	UV	0.07	[112]
(5)	HF-DLLE, membrane based μextraction	Water	UV	0.5–4.6	[113]
(1)	Surfactant coated TiO ₂ ,based nanoparticles	Water	UV	0.5	[114]
(1)	SBSE, carbon nanotubes in polyamide	Water (10)	UV	300	[115]

^aArticle available online.

^bRoutinely analysis of real samples during an environmental study.

Bisphenol A

The environmental interest to monitor Bisphenol A (4,4'-(propane-2,2-diyl) diphenol) (BPA) is based on its estrogenic activities. Many papers are also focused to its determination and other estrogens such as 17 β-estradiol, estriol, 17 α-ethynylestradiol, ethylhexyldiphenyl phosphate, estrone, diethylstilbestrol, 2-ethylhexyl-4-methoxy Cinnamate, benzophenone and brominated BPA derivatives (Table 4). In relation to environmental applications through both detectors, there is a rebound in the number of publications in recent years. The most found articles corresponded to environmental measures in aqueous matrices. BPA can be determined by HPLC using UV detection.^[117,118] A poor resolution with the HPLC/FLD in high BPA levels has been noted.^[119]

Phthalates

Literature on environmental monitoring of phthalic acid esters (PAEs) using HPLC with UV and FLD detectors is rarely

found.^[120] This is especially so for phthalic acid di-esters, which are the most commonly monitored based on their widely environmental distribution.^[121] However for determination of phthalic acid mono-esters (MPEs), primary metabolites of the di-esters, HPLC would be more suitable because the free fatty acid group makes the compound more polar.^[122] Thus, HPLC analyses don't require previous derivatization, even direct analysis of aqueous samples could be carried out.

Among the scarce found literature, mono- and di-ethylhexyl phthalates have been determined using HPLC/UV for biological monitoring.^[123–125] More recently, Fernández-Amado et al determined six EPA PAEs in low volume rain-water samples, using simple equipment based on monolithic columns and low reagent volumes.^[126]

The main analytical problem comes for minimization of blanks. Errors are very common since their ubiquitous character. There is mostly a shortage of documentation regarding well-validated and suitable methods for the analysis of phthalate esters. Furthermore, there are no adequate reference materials for these compounds.^[127]

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Table 5. HPLC/UV/FD analysis of phthalates esters: environmental applications.

PAEs (number)	Sample treatment		Detection Technique	LOD (ng mL ⁻¹)	Ref
	Techn, Sorbent/solvent	Matrix (g, mL)			
(6)	MAE, methanol	Sediment (2)	UV,FLD	Not found	[127]a
(3)	CPE, non ionic surfactant	Water (10)	UV	1.0–3.8	[128]a
(4)	SPE, titanate nanotubes	Water (1000)	FLD	0.019–0.039	[129]
(5)	IL-SPE, 1-dodecyl-3-methylimidazolium bromide	Water (300)	UV	0.12–0.17	[130]a
(4)	SPE, bamboo charcoal	Rain, tap water	UV	0.35–0.43	[131]
(5)	SPE, nylon nanofibers	Water	UV	0.002–0.033	[132]
(9)	PLE, subcritical water	Soil	UV		[133]
(4)	LLE, chloroform + methanol + salt	Water	UV	0.18–0.25	[134]
(4)	MSA-DLLME, dodecane & stirring	Water	UV	130–380	[135]
(4)	MSPE, Graphene-Fe ₃ O ₄	Water (300)	UV	10–40	[136]a
(6)	DLLME, carbon tetrachloride	Water	UV	10–30	[137]
(6)	LLE, dichloromethane + petroleum ether	Mineral water	UV	0.12–0.50	[138]a

^aArticle available online.

^bRoutinely analysis of real samples during an environmental study.

Table 6. HPLC/UV/FD analysis of isocyanates: environmental applications.

Isocyanate (number)	Sample treatment		Detection		Ref
	Sample/derivatizing reagent, solvent (mL)	Matrix (L)	Techn	LOD (µg m ⁻³)	
(4)	Impinger/tryptamine, dimethyl sulfoxide	Air	FLD	0.1–0.3 µg	[143]
(1)	Diffusive sampler, 4-nitro-7-piperazinobenzo-2-oxa-1,3-diazole, acetonitrile	Air	FLD	0.15–3	[144]
(5)	Adsorbent tube/a piperazine derivative reagent, acetonitrile (3)	Air (15)	UV FLD	15–40 pmol 13–25 pmol	[145]a
(1)	XAD-7 tubes/pyridyl piperazine, acetonitrile	Air	FLD	3.3	[147]
(4)	PTFE filters/ pyridyl piperazine, acetonitrile + dimethyl sulfoxide (2)	Air (200) ^b	FLD	0.14–0.80	[139]a
(4)	Filter/ pyridyl piperazine, acetonitrile + dimethyl sulfoxide (2)	Air ^b	UV	1.1–2.9	[148]a

^aArticle available online.

^bRoutinely analysis of real samples during an environmental study.

Table 5 includes a summary of the few works found for the determination of phthalates by HPLC/UV/FLD in environmental samples, mainly waters.

Isocyanates

The evaluation of occupational exposure of workers has been investigated frequently during environmental studies. Commonly studied compounds are phenylisocyanate, toluene-2,4-diisocyanate, toluene-2,6-diisocyanate, hexamethylene-diisocyanate and methylenebisphenyl-4,4-diisocyanate.

The analysis is carried out by a simultaneously derivatization and sampling. Derivatization is usually based on the group $-N=C=O$, which can react with water, alcohols or primary amines to give a urea or urethane derivative (carbamate). For sampling workplace air, filters against impingers are recommended. The main reason is to avoid the use of organic solvents for personal sampling. The formed derivatives allow generally both FLD and UV detection. Although, FLD detection is commonly preferred, both detectors operating in series increase selectivity of the analysis.

Therefore, filters are coated with fluorescent reagent prior to collection of air samples. After sampling, filters are extracted and analyzed.^[139] A comparison between methods from National Institute for Occupational Safety Health (NIOSH) and Occupational Safety & Health Administration (OSHA) of USA to determine different isocyanate in workplace environment was reported in 1998.^[140] Dahlin also reported in 2007 a detailed review on sampling and analysis of aerosol to determine isocyanates.^[141] Piperazine derivatizing reagents are frequently used.^[139,142–145]

The main limitations of sampling and analytical methods to determine isocyanates using fluorescent reagents for workplace exposure were compiled by Streicher et al.^[146] In this sense, few advances have been reported since then to improve determination of isocyanates by FLD detection.

Analytical determinations regarding isocyanate using FLD and UV detection have been included in Table 6.

Pesticides and degradation products

The literature related to the use of liquid chromatography for determination of pesticides is certainly extensive. This is mainly due to the polar characteristics, low volatility and thermal instability of many pesticides. A complete monograph in the environmental analysis to determine pesticide residues by HPLC was published by Tuzimski and Sherma in 2015.^[149] We have found the most recent review in 2018.^[150] The article compiles available analytical methods in a more briefly way. With the purpose of summarizing, we refer to the major families of pesticides susceptible for analyzing by HPLC with UV and FLD detection, trying to bring the studies published in the last decade.

The QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) sample preparation methods have been mainly developed to monitor pesticides in different kind of samples by its simplicity and efficiency. These methods do not use to involve pre-concentration step of analytes. Thus an attractive alternative is the combination of QuEChERS extraction and pre-concentration methodology such as DLLME^[151] to UV and FLD detection. Once again, it is worth mentioning the influence of the most recent techniques of sample treatment

Table 7. HPLC/UV/FD analysis of pesticides: environmental applications

Pesticide (number)	Sample treatment		Detection		
	Technique, sorbent/solvent (mL, mg)	Matrix (mL)	Tech	LOD (ng mL ⁻¹ , ng g ⁻¹)	Ref
Carbamates					
(5)	DLLME	Water	UV	0.1–0.5	[153]
(1)+OP (1)	DLLME, acetonitrile(1)+tetrachloroethane (0.015)	Tap,river water (5)	FLD	0.012–0.016	[154]a
(2)	DLLME, tetrahydrofuran (0.75)+chloroform (0.080)	Water (5)	FLD	0.5–1.0	[155]a
		Soil (20)		1–1.6	
(6)	US + surfactant, chlorobenzene + chloroform	Water	UV	0.1–0.3	[156]
(3)	LLME + low temperature, acetonitrile	Water (2)	UV	5–10	[157]
(1)	LLE+derivatization, hexane(20)	Wastewater (500)	UV	13	[158]a
	μSPE + solid sorbent, Zeolite(40)	Water (7)	UV	4–4000	[159]
(3)	SBSE, zinc sulfide + activated carbon + IL	Tap,river mineral water	UV	0.3–0.5	[160]
Organophosphorus					
(4)	IL-DLLME, alkyl-methylimidazolium hexafluorophosphate (0.035)	Water (5)	UV	0.1–5	[161]a
(7)	US, surfactant	Water	UV	0.1–0.3	[162]
(3)	DLLME, methanol (1.5)+chloroform (0.25)	Tap water (5)	UV	2–3	[163]a
(1)	IL-DLLME, tetrahydrofuran(0.26)+butyl methyl imidazolium hexafluorophosphate (0.065)	Water (8)	UV	0.2	[164]a
(2)	SPE, Anionic resin	Tap water (100)	UV	90–200	[165]a
(4)	DLLME, acetonitrile + dodecanol	Water (10)	UV	0.25–1	[166]a
(4)+PAHs(2)	IL-MSPE, acetonitrile (0.5)+dodecanol (0.1)	Water (8)	UV	0.25–1	[167]
(2)	SPE	River water	UV	0.003	[168]
(3)	SPE, carbon nanofiber (15)	Water (1)	UV	0.090–0.22	[169]a
(3)	MSPE, nanoparticles (150)/tetrahydrofuran	Water (100)	UV	0.01–0.25	[170]a
(2)	MSPE, silica coated Fe ₃ O ₄	Water	UV	0.09–0.14	[171]
Phenylureas					
(3)	IL-DLLME, butyl methylimidazolium hexafluorophosphate (0.065)	Snow,tap,lake waters (10)	UV	0.04–0.43	[172]a
	DLLME, acetone + toluene/carbon sulfide(0.148)	Tap,river (5) waters	UV	0.01–0.5	[173]a
				01	
(5)	SPE, C18/acetonitrile(1.5)	Tap water	UV	0.84–1.35	[174]a
(4)	Thin film μextraction, poly(vinylidene) fluoride	Natural water (20)	UV	0.1	[175]a
(4)	Agitation/methanol (10)	Soil (5)	UV	10–50	[176]a
Pyretroids					
(5)	IL-DLPME, hexyl-methylimidazolium hexafluorophosphate	Clean water	UV	0.28–0.60	[177]
Triazines					
(3)	MISPE, titanate nanoparticles	Water Soil	UV	3.00 nmol L ⁻¹ 4.8 nmol kg ⁻¹	[178]a
(7)	DLLME, 1-octanol (0.3)	Seawater (25)	UV	0.19–1.12	[179]
(9)	MSPD, graphitized carbon black/ethyl acetate (20)	Marine sediment	UV	22–37	[180]
(6)	HF-IL-MISPE, [hexyl-methylimidazolium hexafluorophosphate	Water (10)	UV-	0.14–0.48	[181]
(6)	SBSE, polydimethylsiloxane	Lake water	UV	0.021–0.079	[182]
Multiclass pesticides					
(3)	SPE	Soil	UV	25–50	[183]
(4)	SPE, C18 (200)	Water (250)	UV	0.2	[184]a
(6)	IL-DLLME, hexyl- methylimidazolium hexafluorophosphate (118)	Soil	FLD	<10	[185]
(4)	MEPs, C18	Soil (2) Tap water	UV	0.050–0.58	[186]a
(4)	IL-DLLME,	Water	UV	0.1–1.8	[187]
(3)	SDME, hexyl- methylimidazolium hexafluorophosphate ZnO nanoparticles	Water (10)	UV	0.13–0.19	[188]a
(5)	Agitation, dichloromethane-ethyl acetate(40)	Soil (5) Wastewater (200)	UV	Not found	[189]a
(4)	LPME, DEs (0.05)+salt(0.5)	Water (10)	UV	0.05–0.5	[152]a

^aArticle available online.

^bRoutinely analysis of real samples during an environmental study.

in the improvement of the analytical methods for the determination of pesticides.

Similarly to the study of phenols and alkylphenols, the literature found focuses on the development of analytical methods based on the most advanced micro extraction. For instance, a first application of LPME and the freezing of deep eutectic solvent (FLDES) has been developed to determine pesticide in environmental water samples.^[152] Two or three green and affordable extractants are mixed to act as hydrogen bond donor or acceptor. The proprieties for extraction are similar to ionic liquids, but cheaper, easier to

produce and less toxic. The results were very promising to determine organic compounds in water samples.

Table 7 lists representative analytical applications to determine pesticide using UV/FLD in environmental samples.

Benzimidazole

Some of the best known benzimidazole pesticides include: benomyl, carbendazim, tiabendazole, fuberidazole. HPLC has been widely used for the analysis of these compounds. However, HPLC-based methods often require a more

Triazines

Determination of triazines is easy by UV because of their strong absorbance at 220 nm. A relatively recent review on chromatographic methods for analysis of triazine herbicides was performed by Abbas et al.^[195] The article reported analytical methods between 2011 and 2014 described by using DLLME, graphen, SPE, dynamic MAE, US assisted emulsification microextraction, resins XAD4 for the analysis in environmental matrices. Later papers are included in Table 7.

Emerging

Currently, many works focus on the determination of chemicals in environmental analysis that are not commonly monitored but can be or are present due to their continued use. The term encompasses very different families of

compounds such as surfactants, pharmaceuticals, personal care products, flame retardants, amine derivatives.^[196]

Complex matrices of samples and extremely trace/subtrace concentrations are the main limiting factors to apply UV and FLD detectors in the analysis of emerging. Related literature is extremely limited compared to more sophisticated and expensive liquid chromatography.^[197,198] However, they can be an alternative in samples with higher concentrations and the analysis of large set of samples during environmental monitoring studies. Once again novel developments involving microextraction stages should make up more research lines for using these affordable detectors in routine laboratories. For instance, Shishov et al.^[199] have developed a very interesting effervescence tablet-assisted approach for microextraction of water samples. This promising method involves dissolution of two effervescent tablets for on-site pretreatment reaching high enrichment factors. The authors used

Table 8. HPLC/UV/FD analysis of emerging contaminants: environmental applications

	Sample treatment		Detection		Ref
	Technique, sorbent (g) /solvent (mL)	Matrix (g, mL)	Tech	LOD (ng g ⁻¹ , ng mL ⁻¹)	
PPCPs					
SAs,TC(1),FQ(1),penicillin G	SPE, Oasis [®] HLB	Wastewater (100)	UV	0.1–40	[200]
SAs	HF-LLME, nitro-xylene + diisobutyl ketone (0.007)	Lake water (12)	UV	0.11–0.77	[201]a
TC	SPE, anion exchange	Wastewater	UV	100	[202]
FQ(1),TC(1),TMP(1)	SPE,	Water	UV		[203]
SAs(4)	MSPE, mixed hemimicelles on nanoparticles	Water (500)	UV	0.24–0.33	[204]
PPs(13)	SPE, C18	Wastewater (50)	UV	1.0–50	[205]a
		Soil (0.5)			
Cephalosporin antibiotics	SPE, Oasis [®] HLB	Clean, wastewater (500)	UV	0.026–0.059	[206]
FQs(4), SAs(5)	Agitation	^b Soil (2)	UV, FLD		[207]a
Endocrine disrupters (9)	SPE, Oasis [®] HLB	Polluted waters (2000)	UV	0.004–0.018	[208]
Endocrine disrupters(5)	MISPE,	Clean waters	UV		[209]
Endocrine disrupters (9)	SPE, Oasis [®] HLB	^b Estuarine waters(2)	UV	0.003–0.012	[210]a
PPs(9), steroids(3)	SPE, Strata [®] X	Water (500–1000)	UV	0.01–1.1	[211]a
			FLD		
PPs(3)	Specific sampler, Oasis HLB	^b Waste water (150)	UV	0.2–4.1	[212]a
PPs(2)	DLLME + single drop, Undecanol (0.08)	Water (20)	UV	0.33–0.56	[213]
FQs(11)	SPE, cation exchange	^b Wastewater	FLD	20–100 pg	[214]
SAs(4)	DLLME + single drop, octanol/MeOH	Lake, wastewater (10)	UV	0.22–1.92	[215]
Nitroimidazole(3)	SPE, triazine framework	Water	UV	0.11–0.13	[216]
SAs(3),FQs(4),PAHs(4)	CPE, Triton X100 + hexafluoro isopropanol	Clean,wastewater (5)	UV	0.04–1.3	[67]a
Antidepressant (1)	DLLME	^b Wastewater	FLD	0.024	[217]
Parabens					
Fullerenes (C ₆₀)	PLE	Soil, sediment	UV	20	[218]
(8)	US-MISPE	Soil,sediment	UV	<1	[219]
(1)+3 PAHs + BPA	IL-MAE, hexadecyl methyl imidazolium bromide	Sediments (0.1)	UV	40	[220]
	HF-LPME	Water	UV	0.2	[221]
(7)	D-μSPE, metal organic framework	Waters	UV	0.1	[222]
(1)	MISPE	Wastewater	UV	2.4	[223]
Surfactants					
NPEO, NP	MAE-SPE, hexane:acetone (1 mL H ₂ O)	^b Sludge (0.03–0.3)	FLD	1820–2860	[224]
NPEO, NP	US-SPE, methanol:water/C18	Soil (2)	FLD	60–520	[225]
LAS(4)+PAHs (16)	US-SPE, methanol	Sludge (1)	UV	6000–37000	[226]a
			FLD	2000–9000	
LAS(4)	MAE, methanol	Sludge (0.5)	UV	250–2500	[227]a
			FLD	330–1830	
LAS(4)	SPE, carbon nanotubes	River waters (500)	UV	0.02–0.03	[228]a
LAS(4)	Soxhlet-SPE/anion exchange	Waste water (10)	FLD	10	[229]a
		Sludge (5)			
NPEO(8)	PLE-SPE, metanol/C18	^b Soil (5)	FLD	6–60	[230]a
LAS(4)	MAE, methanol (25)	Sludge	FLD	3.3–5.4	[231]
Retardants					
Brominated (7)	US-SBSE	Soil,dust	UV	2.9–4.2	[232]
Perfluorinated carboxylic (11)	SPE, Derivatization	Water (100)	FLD	4.3–7.5	[233]
Brominated (3)+ phosphates (3)	SPE, bond elut ENV+(μHPLC)	^b River (1000)	UV	0.008–0.518	[234]

^aArticle available online.

^bRoutinely analysis of real samples during an environmental study.

1177 this strategy to determine testosterone, progesterone, estradiol
1178 and hydrocortisone by HPLC/UV in water samples.

1179 The families of compounds susceptible to their analysis
1180 by UV/FLD considered in this review are indicated below.
1181 They have been added in decreasing order according to the
1182 number of works collected (Table 8).
1183

1184 **Pharmaceuticals and personal care products**

1185 **Antibiotics**

1186 The main families of antibiotics are chemically classified as
1187 Quinolones and fluoroquinolones (FQs), Tetracyclines
1188 (TCs), Sulfonamides (SAs), Trimethoprim (TMP). The chro-
1189 matographic analysis can be performed with UV. FLD
1190 detector allows direct determination in FQs, while TCs and
1191 SAs require previous derivatization.
1192

1193 A review of analytical methods for the determination of
1194 fluoroquinolones and sulfonamides in water was carried out
1195 by Peixoto et al.^[235] The authors include detailed informa-
1196 tion about analytical methods for determination 30 individ-
1197 ual antibiotics. One third of reported literature
1198 corresponded to bibliography using UV or FLD detectors
1199 and limits of detection in ng L^{-1} range by FLD are included.
1200 Other review of analytical techniques for determination of
1201 selected quinones includes both detectors as frequently used
1202 tools of analysis.^[82] To a lesser extent they are also included
1203 in the review of Seifrtová et al.^[236]
1204

1205 Sulfacetamide, sulfadiazine, sulfathiazole, sulfamerazine,
1206 sulfadimidine and sulfaquinoxaline are included among the
1207 most monitored sulfonamides. Analogously, the group of
1208 fluoroquinolones includes norfloxacin, enrofloxacin, cipro-
1209 floxacin, danofloxacin.
1210

1211 **Endocrin disruptors**

1212 Estrogens belong to the family of the so-called steroid hor-
1213 mones, capable of replacing natural hormones and causing
1214 disorders in the process of reproduction and development.
1215 In 2010, Kozłowska-Tylingo et al.^[237] carried out a review
1216 of the chromatographic methods applied to the determi-
1217 nation of estrogen disruptors in environmental samples. The
1218 authors point to separations in reversed phase with conven-
1219 tional columns, using both UV and FLD detection.
1220

1221 Compounds frequently determined include estradiol,
1222 estrone, daidzein, genistein, biochanin A, 17- α -ethiny-
1223 lestradiol, bisphenol A, 4-octyl phenol and 4-nonylphenol.
1224 Some of them have been included in the previous section
1225 of phenols.
1226

1227 **Pharmaceuticals active products**

1228 Other pharmaceutical contaminants, also referred to as
1229 pharmaceutical active products (PPs), comprise organics
1230 belonging to different therapeutic classes. Among the most
1231 frequently used have been determined
1232

- 1233 • carbamazepine (anti-epileptic),
- 1234 • clofibric acid and fenofibrate (lipid regulators),

- ibuprofen, naproxen, ketoprofen, fenoprofen and diclofe- 1236
nac (analgesic), 1237
- ethinylestradiol, estradiol and estrone (ster- 1238
oid hormones), 1239
- etoricoxib, salicylic acid, valdecoxib, nimesulide (anti- 1240
inflammatory). 1241

1242 Patrolecco et al.^[211] proposed determination of nine PPs 1243
in polluted waters using HPLC/UV/FLD. The method shows 1244
the feasibility of applying to real samples (LODs, 1245
0.01–1.1 ng mL^{-1}) 1246

1247 **UV filters**

1248 Reversed phase HPLC is widely used for determination of 1249
organic UV filters.^[238] The most used UV filters are benzo- 1250
phenone-3, octyldimethyl-p-aminobenzoic acid, 4-methyl- 1251
benzylidene camphor, ethylhexyl methosycinnamate, 1252
octylmethoxycinnamate, octocrylene, butylmethoxydiben- 1253
zoylmethane, terephthalylidene dicamphorsulfonic acid, 1254
ethylhexyltriazone. 1255

1256 **Parabens**

1257 Some alkyl parabens, i.e. methyl, ethyl, isopropyl, propyl, 1258
isobutyl, butyl parabens, can be determined by HPLC/UV 1259
with detection limits below 0.1 ng mL^{-1} in environmental 1260
waters.^[222] The most recent literature is focused to develop 1261
new microextraction protocols for sample treatment. 1262

1263 **Surfactants**

1264 Environmental applications include determination of anionic 1265
and nonionic surfactants, such as linear alkylbenzene sulph- 1266
onates (LAS) and nonylphenol polyethoxylates (NPEOS), 1267
respectively. The latter are usually analyzed together nonyl 1268
phenol (NP), its raw material. HPLC/UV/FLD have been 1269
widely used in the last decade, although it presents some- 1270
time a lack of sensitivity and specificity at low 1271
concentrations.^[230] 1272

1273 **Amine derivatives**

1274 **Aliphatic and aromatic amines**

1275 A previous derivatization step is usually required to deter- 1276
mine aromatic and mainly aliphatic amines by HPLC with 1277
both, UV and FLD detectors. A detailed review of HPLC 1278
methods applied in the environment field was published by 1279
Fekete et al.^[239] The article compiles more than twenty 1280
references of HPLC/UV/FLD analytical methods including 1281
different derivatization reagents. Primary and secondary 1282
amines generally require independent derivatization reagents 1283
For example, those such as *o*-phthalaldehyde and 9-fluorenyl- 1284
methyl chloroformate are used for primary and secondary 1285
aliphatic amines, respectively. Simultaneous analysis of ali- 1286
phatic and diamines has been also proposed.^[240] 1287

1288 Short chain aliphatic amines such as methylamine, dime- 1289
thylamine, trimethylamine, ethylamine, diethylamine, pro- 1290
pylamine and butylamine are present in the atmosphere. 1291

Among other, aromatic amines such as aniline, aniline derivatives, toluidine can be determined in waters.^[239,241]

Nitramines

Nitramines used in explosives or degradation products also are present in environment. EPA Method 8330 is intended for the trace analyses of hexahydro-1,3,5-tetranitro-1,3,5,7-tetrazocine, hexahydro-1,3,5-trinitro-1,3,5-triazine, 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, methyl-2,4,6-trinitrophenylnitramine, nitrobenzene, 2,4,6-trinitrotoluene, dinitrotoluenes and nitrotoluenes by HPLC/UV.^[242] Gaurav et al. carried out an exhaustive review in 2006 in the field of HPLC methods for the analysis of explosives.^[243]

Other aliphatic (linear and cyclic) nitramines comes from postcombustion CO₂ capture technology. They can be also classified as emerging pollutants. Among the scarce literature on nitramines determination in environment, a review was performed by Lindahl et al.^[244] The work highlighted as analytical shortcomings the need of more research on extraction step and suitable chromatographic liquid columns. Common names of nitramines are included, such as nitrodiethylamine, nitrodimethylamine, nitroethanolamine, nitromethylamine, nitropiperazine.

An evaluation of remedial technologies to removal nitrosamines, nitramines, amines and aldehydes within wash waters during amine-based carbon capture was developed by Shah et al.^[245] In this work, the determination of 2 nitrosamines, 5 nitramines and 3 amines were monitored by HPLC with UV detection. Miguel Mercader et al.^[246] also monitored some nitrosamines during the study of its degradation in drinking water purification.

Nitrosodimethylamine is frequently determined a disinfection by-products in chlorinated waters.^[247]

Flame retardants

Scarce literature can be found on measurement of flame retardants by using UV or FLD detectors. Among the few works found, Wang et al.^[104] conducted an optimization and evaluation to determine tetrabromobisphenol A and its five derivatives by using ultrasound-dispersive liquid-liquid microextraction. Only three references have been found (Table 8).

Conclusions

The development and optimization of analytical procedures requiring no sophisticated and expensive instruments remains of great interest for many analytical laboratories. HPLC/UV/FLD is a robust and affordable analytical tool to use in routine monitoring. However, there is currently a shortage of literature when compared to a more sophisticated liquid chromatography. This work tries to make a claim about its application in environmental analytical measurements.

Current advances related to analyte extraction step must continue promoting the application of HPLC with UV and

FLD detectors in environmental analysis. For instance, new liquid phase microextraction method with freezing deep eutectic solvent need increases of studies on the analysis of organic field. This emerging solvent involves very interesting advantages to contribute in the analysis of organic for its simplicity, low cost, low toxicity, and in general high potential to bring sensitivity. Likewise, methods based on effervescence tablet assisted to pretreatment of liquid samples on site seem especially interesting. Advantages such as in situ preparation, low cost, simplicity of operation and high enrichment factors make it necessary to study more applications in these promising new extracting agents.

There is still a lack to assure the trueness and accuracy of the concentrations obtained with the most methods. The increasing research papers using microextraction techniques to improve sensitivity of HPLC/UV/FLD analysis need to expand well validated methods applied to real samples of unknown composition. Both the results of recoveries and precision obtained for spiked samples usually are better than those obtained from real samples, naturally contaminated samples. There is a lack of research papers on analytical method validation from analyses of real environmental samples. Comparability of data is essential and it's not always guaranteed. In other fields such as the pharmaceutical or food, the requirement of well validated analytical methods is essential.

Abbreviations

μSPE	Micro Solid Phase Extraction	1354
Ald	Aldehydes	1355
BPA	Bisphenol A (4,4'-(propane-2,2-diyl) diphenol)	1356
BTEX	Benzene, Toluene, Ethylbenzene and Xylene	1357
CPE	Cloud Point Extraction	1358
D-μSPE	Solvent-Dispersive Micro Solid Phase Extraction	1359
DAD	Diode Array Detector	1360
DESS	Deep Eutectic Solvents	1361
DLLME	Dispersive Liquid-Liquid Micro Extraction	1362
DNPH	2,4-Dinitrophenylhydrazine	1363
FLD	Fluorescence Detector	1364
FQs	Quinolones and fluoroquinolones	1365
HF	Hollow Fiber	1366
HPLC	High Performance Liquid Chromatography	1367
IL	Ionic Liquids	1368
LAS	Linear Alkylbenzene Sulphonates	1369
LLME	Liquid Liquid Micro Extraction	1370
LPME	Liquid Phase Micro Extraction	1371
MAE	Microwave Assisted Extraction	1372
MEPs	Microextraction by Packed Sorbent	1373
MISPE	Molecularly Imprinted Solid Phase Extraction	1374
MM-ILMSPE	Magnetic Microsphere Ionic Liquid Micro Solid Phase Extraction	1375
MSA	Magnetic Stirring Assisted	1376
MSPD	Matrix Solid Phase Dispersion	1377
MSPE	Magnetic Solid Phase Extraction	1378
NPAHs	Nitro Polycyclic Aromatic Hydrocarbons	1379
NPEOS	Nonylphenol polyethoxylates	1380
OHPAHs	Hydroxy Polycyclic Aromatic Hydrocarbons	1381
PACs	Polycyclic Aromatic Compounds	1382
PAEs	Phthalic acid esters	1383
PAHQs	Polycyclic Aromatic Hydrocarbons Quinones	1384
PAHs	Polycyclic Aromatic Hydrocarbons	1385
PLE	Pressurized Liquid Extraction	1386
PM	Particulate Matter	1387
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1413	PPs	Pharmaceutical active Products
1414	PPCPs	Pharmaceuticals and Personal Care Products
1415	PTFE	Poly tetrafluorethylen
1416	QuEChERS	Quick, Easy, Cheap, Effective, Rugged and Safe
1417	SAs	Sulfonamides
1418	SBSE	Stir Bar Sorptive Extraction
1419	SDME	Single Drop Micro Extraction
1420	SFD	Solidification of Floating Drop
1421	SMS	SupraMolecular Solvent
1422	SPE	Solid Phase Extraction
1423	SPME	Solid Phase Microextraction
1424	TCs	Tetracyclines
1425	TMP	Trimezoprim
1426	US	Ultrasonic extraction
1427	USEPA	United States Environmental Protection Agency
1428	UV	Ultraviolet
1429	ZIF-US	Zeolitic Imidazolate Frameworks for Ultrasonic Extraction

References

- [1] Samanidou, V. F. High Performance Liquid Chromatography (HPLC): The Workhorse in the Analytical Laboratory. *SOJ Chromatograph Sci.* **2016**, *1*, 2. www.symbiosisonlinepublishing.com DOI: [10.15226/2471-3627/1/1/00105](https://doi.org/10.15226/2471-3627/1/1/00105).
- [2] Vega-Morales, T.; Montesdeoca-Esponda, S.; Santana Rodriguez, J. J.; Efremova, S.; Jean-Jacques, A. Luminescence Methods for Study and Determination of Pollutants in the Environment. *Maced. J. Chem. Chem. Eng.* **2010**, *29*, 1–42.
- [3] Prosen, H. Applications of Liquid-Phase Microextraction in the Sample Preparation of Environmental Solid Samples. *Molecules* **2014**, *19*, 6776–6808. DOI: [10.3390/molecules19056776](https://doi.org/10.3390/molecules19056776).
- [4] Yamini, Y.; Rezazadeh, M.; Seidi, S. Liquid-Phase Microextraction—The Different Principles and Configurations. *TrAC Trends Analyt. Chem.* In press.
- [5] Trujillo-Rodríguez, M. J.; Rocio-Bautista, P.; Pino, V.; Afonso, A. M. Ionic Liquids in Dispersive Liquid-Liquid Microextraction. *TrAC Trends Analyt. Chem.* **2013**, *51*, 87–106. DOI: [10.1016/j.trac.2013.06.008](https://doi.org/10.1016/j.trac.2013.06.008).
- [6] Shishov, A.; Bulatov, A.; Locatelli, M.; Carradori, S.; Andruch, V. Application of Deep Eutectic Solvents in Analytical Chemistry. A Review. *Microchem. J.* **2017**, *135*, 33–38. DOI: [10.1016/j.microc.2017.07.015](https://doi.org/10.1016/j.microc.2017.07.015).
- [7] Płotka-Wasyłka, J.; Szczepańska, N.; de la Guardia, M.; Namieśnik, J. Miniaturized Solid-Phase Extraction Techniques. *TrAC Trends Analyt. Chem.* **2015**, *73*, 19–38. DOI: [10.1016/j.trac.2015.04.026](https://doi.org/10.1016/j.trac.2015.04.026).
- [8] Afshar Mogaddam, M. R.; Mohebbi, A.; Pazhohan, A.; Khodadadeian, F.; Farajzadeh, M. A. Headspace Mode of Liquid Phase Microextraction: A Review. *TrAC Trends Analyt. Chem.* **2019**, *110*, 8–14. DOI: [10.1016/j.trac.2018.10.021](https://doi.org/10.1016/j.trac.2018.10.021).
- [9] Saraji, M.; Khalili Boroujeni, M. Recent Developments in Dispersive Liquid-Liquid Microextraction Microextraction Techniques. *Anal. Bioanal. Chem.* **2013**, *406*, 1–40.
- [10] Sajid, M.; Alhooshani, K. Dispersive Liquid-Liquid Microextraction Based Binary Extraction Techniques Prior to Chromatographic Analysis: A Review. *TrAC Trends Analyt. Chem.* **2018**, *108*, 167–182. DOI: [10.1016/j.trac.2018.08.016](https://doi.org/10.1016/j.trac.2018.08.016).
- [11] Smith, E. L.; Abbott, A. P.; Ryder, K. S. Deep Eutectic Solvents (DESs) and Their Applications. *Chem. Rev.* **2014**, *114*, 11060–11082. DOI: [10.1021/cr300162p](https://doi.org/10.1021/cr300162p).
- [12] Seebunrueng, K.; Dejchaiwatana, C.; Santaladchaiyakit, Y.; Srijaranai, S. Development of Supramolecular Solvent Based Microextraction Prior to High Performance Liquid Chromatography for Simultaneous Determination of Phenols in Environmental Water. *RSC Adv.* **2017**, *7*, 50143–50149. DOI: [10.1039/C7RA07780G](https://doi.org/10.1039/C7RA07780G).
- [13] Santaladchaiyakit, Y.; Bunchamnan, J.; Tongsa, D.; Srijaranai, S. Methyl Salicylate-Based Vortex-Assisted Surfactant-Enhanced Emulsification Microextraction and HPLC for Determination of Fungicides in Honey Samples. *Acta Chim. Slov.* **2017**, *64*, 849–857. DOI: [10.17344/acsi.2017.3413](https://doi.org/10.17344/acsi.2017.3413).
- [14] da Silva, D. C.; Oliveira, C. C. Development of Micellar HPLC-UV Method for Determination of Pharmaceuticals in Water Samples. *J. Anal. Methods Chem.* **2018**, *2018*, 1. DOI: [10.1155/2018/9143730](https://doi.org/10.1155/2018/9143730).
- [15] Díaz-Bao, M.; Barreiro, R.; Miranda, J.; Cepeda, A.; Regal, P. Recent Advances and Uses of Monolithic Columns for the Analysis of Residues and Contaminants in Food. *Chromatography* **2015**, *2*, 79. DOI: [10.3390/chromatography2010079](https://doi.org/10.3390/chromatography2010079).
- [16] Chen, R.; Zhou, H.; Liu, M.; Yan, H.; Qiao, X. Ionic Liquids-Based Monolithic Columns: Recent Advancements and Their Applications for High-Efficiency Separation and Enrichment. *TrAC Trends Analyt. Chem.* **2019**, *111*, 1–12. DOI: [10.1016/j.trac.2018.11.026](https://doi.org/10.1016/j.trac.2018.11.026).
- [17] EPA, U. Method 8315A (SW-846): Determination of Carbonyl Compounds by High Performance Liquid Chromatography (HPLC), Revision 1.
- [18] Albaigés, J.; Patnaik, P. Handbook of Environmental Analysis. *Int. J. Environ. Anal. Chem.* **2013**, *93*, 1557–1557. DOI: [10.1080/03067319.2013.869587](https://doi.org/10.1080/03067319.2013.869587).
- [19] Possanzini, M.; Palo, V. D.; Brancaloni, E.; Frattoni, M.; Ciccioli, P. A Train of Carbon and DNPH-Coated Cartridges for the Determination of Carbonyls from C1 to C12 in Air and Emission Samples. *Atmos. Environ.* **2000**, *34*, 5311–5318. DOI: [10.1016/S1352-2310\(00\)00300-9](https://doi.org/10.1016/S1352-2310(00)00300-9).
- [20] Wang, H.; Zhang, X.; Chen, Z. Development of DNPH/HPLC Method for the Measurement of Carbonyl Compounds in the Aqueous Phase: Applications to Laboratory Simulation and Field Measurement. *Environ. Chem.* **2009**, *6*, 389–397. DOI: [10.1071/EN09057](https://doi.org/10.1071/EN09057).
- [21] Kim, K.-H.; Szulejko, J. E.; Kim, Y.-H.; Lee, M.-H. An Exploration on the Suitability of Airborne Carbonyl Compounds Analysis in Relation to Differences in Instrumentation (GC-MS Versus HPLC-UV) and Standard Phases (Gas Versus Liquid). *Sci. World J.* **2014**, *2014*, 1–11. DOI: [10.1155/2014/308405](https://doi.org/10.1155/2014/308405).
- [22] Serrano-Trespalcacios, P. I.; Ryan, L.; Spengler, J. D. Ambient, indoor and Personal Exposure Relationships of Volatile Organic Compounds in Mexico City Metropolitan Area. *J. Expo. Sci. Environ. Epidemiol.* **2004**, *14*, S118–S132. DOI: [10.1038/sj.jea.7500366](https://doi.org/10.1038/sj.jea.7500366).
- [23] García-Alonso, S.; Pérez-Pastor, R.; Sevillano-Castaño, M. L. Determination of Glyoxal and Methylglyoxal in Atmospheric Particulate Matter by 2,4-Dinitrophenylhydrazine Derivatization. *Toxicol. Environ. Chem.* **2006**, *88*, 445–452. DOI: [10.1080/02772240600796837](https://doi.org/10.1080/02772240600796837).
- [24] Custodio, D.; Guimaraes, C. S.; Varandas, L.; Arbillá, G. Pattern of Volatile Aldehydes and Aromatic Hydrocarbons in the Largest Urban Rainforest in the Americas. *Chemosphere* **2010**, *79*, 1064–1069. DOI: [10.1016/j.chemosphere.2010.03.028](https://doi.org/10.1016/j.chemosphere.2010.03.028).
- [25] Liu, Q. Y.; Liu, Y. J.; Chen, S. Z.; Liu, Q. J. Ionic Liquid for Single-Drop Microextraction Followed by High-Performance Liquid Chromatography-Ultraviolet Detection to Determine Carbonyl Compounds in Environmental Waters. *J. Sep. Sci.* **2010**, *33*, 2376–2382. DOI: [10.1002/jssc.201000051](https://doi.org/10.1002/jssc.201000051).
- [26] Prieto-Blanco, M. C.; Iglesias, M. P.; López-Mahía, P.; Lorenzo, S. M.; Rodríguez, D. P. Simultaneous Determination of Carbonyl Compounds and Polycyclic Aromatic Hydrocarbons in Atmospheric Particulate Matter by Liquid Chromatography-Diode Array Detection-Fluorescence Detection. *Talanta* **2010**, *80*, 2083–2092. DOI: [10.1016/j.talanta.2009.11.009](https://doi.org/10.1016/j.talanta.2009.11.009).
- [27] Sofuoglu, S. C.; Aslan, G.; Inal, F.; Sofuoglu, A. An Assessment of Indoor Air Concentrations and Health Risks of

- 1531 Volatile Organic Compounds in Three Primary Schools. *Int. J.*
 1532 *Hyg. Environ. Health* **2011**, *214*, 38–46.
- 1533 [28] Araki, A.; Tsuboi, T.; Kawai, T.; Bamai, Y. A.; Takeda, T.;
 1534 Yoshioka, E.; Kishi, R. Validation of Diffusive Mini-Samplers
 1535 for Aldehyde and VOC and Its Feasibility for Measuring the
 1536 Exposure Levels of Elementary School Children. *J. Environ.*
 1537 *Monit.* **2012**, *14*, 368–374. DOI: [10.1039/C1EM10624D](https://doi.org/10.1039/C1EM10624D).
- 1538 [29] Czaplicka, M.; Jaworek, K.; Wochnik, A. Determination of
 1539 Aldehydes in Wet Deposition. *Arch. Environ. Prot.* **2014**, *40*,
 1540 21–31. DOI: [10.2478/aep-2014-0011](https://doi.org/10.2478/aep-2014-0011).
- 1541 [30] Villanueva, F.; Tapia, A.; Lara, S.; Amo-Salas, M. Indoor and
 1542 Outdoor Air Concentrations of Volatile Organic Compounds
 1543 and NO₂ in Schools of Urban, Industrial and Rural Areas in
 1544 Central-Southern Spain. *Sci. Total Environ.* **2018**, 622–623,
 1545 222–235. DOI: [10.1016/j.scitotenv.2017.11.274](https://doi.org/10.1016/j.scitotenv.2017.11.274).
- 1546 [31] Herrington, J. S.; Hays, M. D. Concerns Regarding 24-h
 1547 Sampling for Formaldehyde, Acetaldehyde, and Acrolein
 1548 Using 2,4-Dinitrophenylhydrazine (DNPH)-Coated Solid
 1549 Sorbents. *Atmos. Environ.* **2012**, *55*, 179–184. DOI: [10.1016/j.atmosenv.2012.02.088](https://doi.org/10.1016/j.atmosenv.2012.02.088).
- 1550 [32] Vairavamurthy, A.; Roberts, J. M.; Newman, L. Methods for
 1551 Determination of Low Molecular Weight Carbonyl
 1552 Compounds in the Atmosphere: A Review. *Atmos. Environ.*
 1553 **1992**, *26*, 1965–1993. DOI: [10.1016/0960-1686\(92\)90083-W](https://doi.org/10.1016/0960-1686(92)90083-W).
- 1554 [33] Vogel, M.; Büldt, A.; Karst, U. Hydrazine Reagents as
 1555 Derivatizing Agents in Environmental Analysis—A Critical
 1556 Review. *Fresenius J. Anal. Chem.* **2000**, 366, 781–791. DOI:
 1557 [10.1007/s002160051572](https://doi.org/10.1007/s002160051572).
- 1558 [34] Szulejko, J. E.; Kim, K.-H. Derivatization Techniques for
 1559 Determination of Carbonyls in Air. *TrAC Trends Analyt.*
 1560 *Chem.* **2015**, *64*, 29–41. DOI: [10.1016/j.trac.2014.08.010](https://doi.org/10.1016/j.trac.2014.08.010).
- 1561 [35] Chen, L.; Fu, Y.-J.; Fang, W.-L.; Guo, X.-F.; Wang, H.
 1562 Screening of a Highly Effective Fluorescent Derivatization
 1563 Reagent for Carbonyl Compounds and Its Application in
 1564 HPLC with Fluorescence Detection. *Talanta* **2018**, *186*,
 1565 221–228. DOI: [10.1016/j.talanta.2018.04.017](https://doi.org/10.1016/j.talanta.2018.04.017).
- 1566 [36] De Lima, L. F.; Brandão, P. F.; Donegatti, T. A.; Ramos, R. M.;
 1567 Gonçalves, L. M.; Cardoso, A. A.; Pereira, E. A.; Rodrigues,
 1568 J. A. 4-Hydrazinobenzoic Acid as a Derivatizing Agent for
 1569 Aldehyde Analysis by HPLC-UV and CE-DAD. *Talanta* **2018**,
 1570 *187*, 113–119. DOI: [10.1016/j.talanta.2018.04.091](https://doi.org/10.1016/j.talanta.2018.04.091).
- 1571 [37] Czauderna, M.; Kowalczyk, J. Lactic Acid Can Be Easily and
 1572 Precisely Determined by Reversed-Phase High Performance
 1573 Liquid Chromatography with Pre-Column Derivatization. *J.*
 1574 *Anim. Feed Sci.* **2008**, *17*, 268–279. DOI: [10.22358/jafs/66606/2008](https://doi.org/10.22358/jafs/66606/2008).
- 1575 [38] Xie, Z. M.; Yu, L.; Yu, H. J.; Deng, Q. Y. Application of a
 1576 Fluorescent Derivatization Reagent 9-Chloromethyl
 1577 Anthracene on Determination of Carboxylic Acids by HPLC.
 1578 *J. Chromatogr. Sci.* **2012**, *50*, 464–468. DOI: [10.1093/chromsci/bms023](https://doi.org/10.1093/chromsci/bms023).
- 1579 [39] Zhang, Q.; Hu, N.; Li, W.; Bai, B.; Wang, H.; Suo, Y.; Ding,
 1580 C.; Wang, X. Quantitative Analysis of Fatty Acids from
 1581 Safflower by Selective and Sensitive Pre-Column Derivatization
 1582 Method Using HPLC-FLD and Online APCI/MS. *Asian J.*
 1583 *Chem.* **2015**, *27*, 2492–2496. DOI: [10.14233/ajchem.2015.17953](https://doi.org/10.14233/ajchem.2015.17953).
- 1584 [40] Salgado, P.; Visnevschi-Necrasov, T.; Kiene, R. P.; Azevedo, I.;
 1585 Rocha, A. C. S.; Almeida, C. M. R.; Magalhaes, C.
 1586 Determination of 3-Mercaptopropionic Acid by HPLC: A
 1587 Sensitive Method for Environmental Applications. *J.*
 1588 *Chromatogr. B Analyt. Technol. Biomed. Life Sci.* **2015**, *992*,
 1589 103–108. DOI: [10.1016/j.jchromb.2015.04.008](https://doi.org/10.1016/j.jchromb.2015.04.008).
- [41] Rezaei, F.; Jamei, R.; Heidari, R. Evaluation of Volatile Profile,
 Fatty Acids Composition and In Vitro Bioactivity of Tagetes
 Minuta Growing Wild in Northern Iran. *Adv. Pharm. Bull.*
2018, *8*, 115–121. DOI: [10.15171/apb.2018.014](https://doi.org/10.15171/apb.2018.014).
- [42] Štěrbová, D.; Matějíček, D.; Vlček, J.; Kubáň, V. Combined
 Microwave-Assisted Isolation and Solid-Phase Purification
 Procedures Prior to the Chromatographic Determination of
 Phenolic Compounds in Plant Materials. *Anal. Chim. Acta*
2004, *513*, 435–444. DOI: [10.1016/j.aca.2004.03.031](https://doi.org/10.1016/j.aca.2004.03.031).
- [43] Czauderna, M.; Kowalczyk, J. HPLC Separation of Some
 Unsaturated and Saturated Fatty Acids. *Chem. Anal.* **2002**, *47*,
 867–882.
- [44] Dremetsika, A. V.; Siskos, P. A.; Bakeas, E. B. Determination
 of Formic and Acetic Acid in the Interior Atmosphere of
 Display Cases and Cabinets in Athens Museums by Reverse
 Phase High Performance Liquid Chromatography. *Indoor Built*
Environ. **2005**, *14*, 51–58. DOI: [10.1177/1420326X05050345](https://doi.org/10.1177/1420326X05050345).
- [45] Possanzini, M.; Tagliacozzo, G.; Cecinato, A. Simultaneous
 Determination of Formic Acid and Lower Carbonyls in Air
 Samples by DNPH Derivatization. *J. Sep. Sci.* **2007**, *30*,
 2460–2465. DOI: [10.1002/jssc.200700109](https://doi.org/10.1002/jssc.200700109).
- [46] USEPA Measurements of n-Methylcarbamoyloxams and n-
 Methylcarbamates in Water by Direct Aqueous Injection
 HPLC with Postcolumn Derivatization.
- [47] Zhang, Q.; Yang, F.; Tang, F.; Zeng, K.; Wu, K.; Cai, Q.; Yao,
 S. Ionic Liquid-Coated Fe₃O₄ Magnetic Nanoparticles as an
 Adsorbent of Mixed Hemimicelles Solid-Phase Extraction for
 Preconcentration of Polycyclic Aromatic Hydrocarbons in
 Environmental Samples. *Analyst* **2010**, *135*, 2426–2433. DOI:
[10.1039/c0an00245c](https://doi.org/10.1039/c0an00245c).
- [48] Zhang, S. X.; Niu, H. Y.; Cai, Y. Q.; Shi, Y. L. Barium Alginate
 Caged Fe₃O₄@C18 Magnetic Nanoparticles for the Pre-
 Concentration of Polycyclic Aromatic Hydrocarbons and
 Phthalate Esters from Environmental Water Samples. *Anal.*
Chim. Acta **2010**, *665*, 167–175. DOI: [10.1016/j.aca.2010.03.026](https://doi.org/10.1016/j.aca.2010.03.026).
- [49] Huang, Y. R.; Zhou, Q. X.; Xie, G. H. Development of Micro-
 Solid Phase Extraction with Titanate Nanotube Array
 Modified by Cetyltrimethylammonium Bromide for Sensitive
 Determination of Polycyclic Aromatic Hydrocarbons from
 Environmental Water Samples. *J. Hazard. Mater.* **2011**, *193*,
 82–89. DOI: [10.1016/j.jhazmat.2011.07.025](https://doi.org/10.1016/j.jhazmat.2011.07.025).
- [50] Long, Y.; Chen, Y.; Yang, F.; Chen, C.; Pan, D.; Cai, Q.; Yao,
 S. Triphenylamine-Functionalized Magnetic Microparticles as
 a New Adsorbent Coupled with High Performance Liquid
 Chromatography for the Analysis of Trace Polycyclic
 Aromatic Hydrocarbons in Aqueous Samples. *Analyst* **2012**,
137, 2716–2722. DOI: [10.1039/c2an16248b](https://doi.org/10.1039/c2an16248b).
- [51] Khalili-Fard, V.; Ghanemi, K.; Nikpour, Y.; Fallah-Mehrjardi,
 M. Application of Sulfur Microparticles for Solid-Phase
 Extraction of Polycyclic Aromatic Hydrocarbons from Sea
 Water and Wastewater Samples. *Anal. Chim. Acta* **2012**, *714*,
 89–97. DOI: [10.1016/j.aca.2011.11.065](https://doi.org/10.1016/j.aca.2011.11.065).
- [52] Mao, X. J.; Hu, B.; He, M.; Fan, W. Y. Stir Bar Sorptive
 Extraction Approaches with a Home-Made Portable Electric
 Stirrer for the Analysis of Polycyclic Aromatic Hydrocarbon
 Compounds in Environmental Water. *J. Chromatogr. A* **2012**,
1260, 16–24. DOI: [10.1016/j.chroma.2012.08.062](https://doi.org/10.1016/j.chroma.2012.08.062).
- [53] Huo, S.-H.; Yan, X.-P. Facile Magnetization of Metal-Organic
 Framework MIL-101 for Magnetic Solid-Phase Extraction of
 Polycyclic Aromatic Hydrocarbons in Environmental Water
 Samples. *Analyst* **2012**, *137*, 3445–3451. DOI: [10.1039/c2an35429b](https://doi.org/10.1039/c2an35429b).
- [54] Vinci, G.; Antonelli, M. L.; Preti, R. Rapid Determination of
 Polycyclic Aromatic Hydrocarbons in Rainwater by Liquid-
 Liquid Microextraction and LC with Core-Shell Particles
 Column and Fluorescence Detection. *J. Sep. Sci.* **2013**, *36*,
 461–468. DOI: [10.1002/jssc.201200854](https://doi.org/10.1002/jssc.201200854).
- [55] Wang, Y. X.; Wang, S. H.; Niu, H. Y.; Ma, Y. R.; Zeng, T.;
 Cai, Y. Q.; Meng, Z. F. Preparation of Polydopamine Coated
 Fe₃O₄ Nanoparticles and Their Application for Enrichment of
 Polycyclic Aromatic Hydrocarbons from Environmental Water
 Samples. *J. Chromatogr. A* **2013**, *1283*, 20–26. DOI: [10.1016/j.chroma.2013.01.110](https://doi.org/10.1016/j.chroma.2013.01.110).
- [56] Pan, D.; Wang, J.; Chen, C.; Huang, C. a.; Cai, Q.; Yao, S.
 Ultrasonic Assisted Extraction Combined with Titanium-Plate
 Based Solid Phase Extraction for the Analysis of PAHs in Soil

- 1649 Samples by HPLC-FLD. *Talanta* **2013**, *108*, 117–122. DOI: 10.1016/j.talanta.2013.02.066.
- 1650 [57] Huang, K. J.; Liu, Y. J.; Li, J.; Gan, T.; Liu, Y. M. Ultra-Trace
- 1651 Determination of Polycyclic Aromatic Hydrocarbons Using
- 1652 Solid-Phase Extraction Coupled with HPLC Based on
- 1653 Graphene-Functionalized Silica Gel Composites. *Anal.*
- 1654 *Methods* **2014**, *6*, 194–201. DOI: 10.1039/C3AY41588K.
- 1655 [58] Zhou, Q.; Gao, Y. Determination of Polycyclic Aromatic
- 1656 Hydrocarbons in Water Samples by Temperature-Controlled
- 1657 Ionic Liquid Dispersive Liquid-Liquid Microextraction
- 1658 Combined with High Performance Liquid Chromatography.
- 1659 *Anal. Methods* **2014**, *6*, 2553–2559. DOI: 10.1039/c3ay42254b.
- 1660 [59] Zhang, W.; Zhang, Z.; Zhang, J.; Meng, J.; Bao, T.; Chen, Z.
- 1661 Covalent Immobilization of Graphene onto Stainless Steel
- 1662 Wire for Jacket-Free Stir Bar Sorptive Extraction. *J*
- 1663 *Chromatogr. A*. **In press**.
- 1664 [60] Liu, X. F.; Lu, X.; Huang, Y.; Liu, C. W.; Zhao, S. L.
- 1665 Fe₃O₄@Ionic Liquid@methyl Orange Nanoparticles as a Novel
- 1666 Nano-Adsorbent for Magnetic Solid-Phase Extraction of
- 1667 Polycyclic Aromatic Hydrocarbons in Environmental Water
- 1668 Samples. *Talanta* **2014**, *119*, 341–347. DOI: 10.1016/
- 1669 *j.talanta.2013.11.039*.
- 1670 [61] Hu, C.; He, M.; Chen, B. B.; Zhong, C.; Hu, B. Sorptive
- 1671 Extraction Using Polydimethylsiloxane/metal-Organic
- 1672 Framework Coated Stir Bars Coupled with High Performance
- 1673 Liquid Chromatography-Fluorescence Detection for the
- 1674 Determination of Polycyclic Aromatic Hydrocarbons in
- 1675 Environmental Water Samples. *J. Chromatogr. A* **2014**, *1356*,
- 1676 45–53. DOI: 10.1016/j.chroma.2014.06.062.
- 1677 [62] Hu, H.; Liu, S.; Chen, C.; Wang, J.; Zou, Y.; Lin, L.; Yao, S.
- 1678 Two Novel Zeolitic Imidazolate Frameworks (ZIFs) as
- 1679 Sorbents for Solid-Phase Extraction (SPE) of Polycyclic
- 1680 Aromatic Hydrocarbons (PAHs) in Environmental Water
- 1681 Samples. *Analyst* **2014**, *139*, 5818–5826. DOI: 10.1039/
- 1682 *C4AN01410C*.
- 1683 [63] Liu, L.; Zhou, X.; Wang, C.; Wu, Q.; Wang, Z. Extraction and
- 1684 Enrichment of Polycyclic Aromatic Hydrocarbons by Ordered
- 1685 Mesoporous Carbon Reinforced Hollow Fiber Liquid-Phase
- 1686 Microextraction. *J. Sep. Sci.* **2015**, *38*, 683–689. DOI: 10.1002/
- 1687 *jssc.201401071*.
- 1688 [64] Su, R.; Ruan, G.; Nie, H.; Xie, T.; Zheng, Y.; Du, F.; Li, J.
- 1689 Development of High Internal Phase Emulsion Polymeric
- 1690 Monoliths for Highly Efficient Enrichment of Trace Polycyclic
- 1691 Aromatic Hydrocarbons from Large-Volume Water Samples.
- 1692 *J. Chromatogr. A* **2015**, *1405*, 23–31. DOI: 10.1016/
- 1693 *j.chroma.2015.05.067*.
- 1694 [65] Yang, X.; Luo, N.; Zong, Y. Y.; Jia, Z. H.; Liao, X. Quantum
- 1695 Dots Extraction Coupled with High-Performance Liquid
- 1696 Chromatography for the Determination of Polycyclic Aromatic
- 1697 Hydrocarbons in Water. *Appl. Ecol. Environ. Res.* **2017**, *15*,
- 1698 171–186. DOI: 10.15666/aer/1503_171186.
- 1699 [66] Zhang, W. F.; Zhang, Y. H.; Jiang, Q.; Zhao, W. J.; Yu, A. J.;
- 1700 Chang, H.; Lu, X. M.; Xie, F. W.; Ye, B. X.; Zhang, S. S.
- 1701 Tetraazacalix 2 Arene 2 Triazine Coated Fe₃O₄/SiO₂
- 1702 Magnetic Nanoparticles for Simultaneous Dispersive Solid
- 1703 Phase Extraction and Determination of Trace Multitarget
- 1704 Analytes. *Anal. Chem.* **2016**, *88*, 10523–10532. DOI: 10.1021/
- 1705 *acs.analchem.6b02583*.
- 1706 [67] Xu, J.; Li, Y.; Li, C.; Zhang, R.; Xiao, Y. Hexafluoroisopropanol-Mediated Cloud Point Extraction of
- 1707 Organic Pollutants in Water with Analysis by High-
- 1708 Performance Liquid Chromatography. *Anal. Bioanal. Chem.*
- 1709 **2017**, *409*, 4559–4569. DOI: 10.1007/s00216-017-0394-7.
- 1710 [68] Yousefi, S. M.; Shemirani, F.; Ghorbanian, S. A. Hydrophobic
- 1711 Deep Eutectic Solvents in Developing Microextraction
- 1712 Methods Based on Solidification of Floating Drop: Application
- 1713 to the Trace HPLC/FLD Determination of PAHs. *Chromatographia*
- 1714 **2018**, *81*, 1201–1211. DOI: 10.1007/s10337-018-3548-7.
- 1715 [69] Roper, J. C.; Pfaender, F. K. Pyrene and Chrysene Fate in
- 1716 Surface Soil and Sand Microcosms. *Environ. Toxicol. Chem.*
- 1717 **2001**, *20*, 223–230. DOI: 10.1002/etc.5620200201.
- 1718 [70] Kishikawa, N.; Morita, S.; Wada, M.; Ohba, Y.; Nakashima, K.;
- 1719 Kuroda, N. Determination of Hydroxylated Polycyclic
- 1720 Aromatic Hydrocarbons in Airborne Particulates by High-
- 1721 Performance Liquid Chromatography with Fluorescence
- 1722 Detection. *Anal. Sci.* **2004**, *20*, 129–132. DOI: 10.2116/
- 1723 *analsci.20.129*.
- 1724 [71] Barrado, A. I.; García, S.; Barrado, E.; Pérez, R. M. PM_{2.5}-
- 1725 Bound PAHs and Hydroxy-PAHs in Atmospheric Aerosol
- 1726 Samples: Correlations with Season and with Physical and
- 1727 Chemical Factors. *Atmos. Environ.* **2012**, *49*, 224–232. DOI: 10.1016/j.atmosenv.2011.11.056.
- 1728 [72] Kamiura, T.; Kawaraya, T.; Tanaka, M.; Nakadoi, T.
- 1729 Determination of 3-Nitrofluoranthene and 1-Nitropyrene in
- 1730 Suspended Particulate Matter by Liquid Chromatography with
- 1731 Fluorescence Detection. *Anal. Chim. Acta* **1991**, *254*, 27–31.
- 1732 DOI: 10.1016/0003-2670(91)90005-P.
- 1733 [73] Brichac, J.; Zima, J.; Barek, J. HPLC Determination of Nitrated
- 1734 Polycyclic Aromatic Hydrocarbons after Their Reduction to
- 1735 Amino Derivatives. *Anal. Lett.* **2004**, *37*, 2379–2392. DOI: 10.1081/AL-200028178.
- 1736 [74] García-Alonso, S.; Barrado-Olmedo, A. I.; Pérez-Pastor, R. M.
- 1737 An Analytical Method to Determine Selected Nitro-PAHs in
- 1738 Soil Samples by HPLC with Fluorescence Detection. *Polycycl.*
- 1739 *Aromat. Comp.* **2012**, *32*, 669–682. DOI: 10.1080/
- 1740 *10406638.2012.725196*.
- 1741 [75] Barrado, A. I.; García, S.; Castrillejo, Y.; Barrado, E.
- 1742 Exploratory Data Analysis of PAH, Nitro-PAH and Hydroxy-
- 1743 PAH Concentrations in Atmospheric PM₁₀-Bound Aerosol
- 1744 Particles. Correlations with Physical and Chemical Factors.
- 1745 *Atmos. Environ.* **2013**, *67*, 385–393. DOI: 10.1016/
- 1746 *j.atmosenv.2012.10.030*.
- 1747 [76] AlSalka, Y.; Karabet, F.; Hashem, S. Development and
- 1748 Optimisation of Quantitative Analytical Method to Determine
- 1749 BTEX in Environmental Water Samples Using HPLC-DAD.
- 1750 *Anal. Methods* **2010**, *2*, 1026–1035. DOI: 10.1039/c0ay00285b.
- 1751 [77] Filho, C. M. C.; Neto, M. N. L.; Teixeira, R. S.; Pais, A. A. C. C.;
- 1752 Valente, A. J. M. Development and Optimization of an
- 1753 HPLC-DAD Method for Quantification of Six Petroleum
- 1754 Hydrocarbon Compounds in Aqueous Samples. *J. Liq.*
- 1755 *Chromatogr. Relat. Technol.* **2016**, *39*, 837–846. DOI: 10.1080/
- 1756 *10826076.2016.1274998*.
- 1757 [78] Abdel-Shafy, H. I.; Mansour, M. A Review on Polycyclic
- 1758 Aromatic Hydrocarbons: Source, Environmental Impact, Effect
- 1759 on Human Health and Remediation. *Egypt. J. Petrol.* **2016**, *25*,
- 1760 107–123. DOI: 10.1016/j.ejpe.2015.03.011.
- 1761 [79] Kim, K. H.; Jahan, S. A.; Kabir, E.; Brown, R. J. C. A Review
- 1762 of Airborne Polycyclic Aromatic Hydrocarbons (PAHs) and
- 1763 Their Human Health Effects. *Environ. Int.* **2013**, *60*, 71–81.
- 1764 DOI: 10.1016/j.envint.2013.07.019.
- 1765 [80] Li, K.; Woodward, L. A.; Karu, A. E.; Li, Q. X. Immunochemical
- 1766 Detection of Polycyclic Aromatic
- 1767 Hydrocarbons and 1-Hydroxypyrene in Water and Sediment
- 1768 Samples. *Anal. Chim. Acta* **2000**, *419*, 1–8. DOI: 10.1016/
- 1769 *S0003-2670(00)00989-2*.
- 1770 [81] Barrado, A. I.; Garcia, S.; Castrillejo, Y.; Perez, R. M. Hydroxy-PAH Levels in Atmospheric PM₁₀ Aerosol Samples
- 1771 Correlated with Season, physical Factors and Chemical
- 1772 Indicators of Pollution. *Atmos. Pollut. Res.* **2012**, *3*, 81–87.
- 1773 DOI: 10.5094/APR.2012.007.
- 1774 [82] Kishikawa, N.; Kuroda, N. Analytical Techniques for the
- 1775 Determination of Biologically Active Quinones in Biological
- 1776 and Environmental Samples. *J. Pharmaceut. Biomed.* **2014**, *87*,
- 1777 261–270. DOI: 10.1016/j.jpba.2013.05.035.
- 1778 [83] Cvacka, J.; Barek, J.; Zima, J.; G.; Fogg, A.; C.; Moreira, J. Critical Review. High-Performance Liquid Chromatography of
- 1779 Nitrated Polycyclic Aromatic Hydrocarbons. *Analyst* **1998**,
- 1780 *123*, 9R–18R. DOI: 10.1039/a705097f.

- 1767 [84] Zielinska, B.; Samy, S. Analysis of Nitrated Polycyclic
1768 Aromatic Hydrocarbons. *Anal. Bioanal. Chem.* **2006**, *386*,
1769 883–890. DOI: [10.1007/s00216-006-0521-3](https://doi.org/10.1007/s00216-006-0521-3).
- 1770 [85] Hernández, J. J.; Ballesteros, R.; Aranda, G. Characterisation of
1771 Tars from Biomass Gasification: Effect of the Operating
1772 Conditions. *Energy* **2013**, *50*, 333–342. DOI: [10.1016/
1773 j.energy.2012.12.005](https://doi.org/10.1016/j.energy.2012.12.005).
- 1774 [86] González, J. L.; Pell, A.; López-Mesas, M.; Valiente, M.
1775 Simultaneous Determination of BTEX and Their Metabolites
1776 Using Solid-Phase Microextraction Followed by HPLC or GC/
1777 MS: An Application in Teeth as Environmental Biomarkers.
1778 *Sci. Total Environ.* **2017**, 603–604, 109–117. DOI: [10.1016/
1779 j.scitotenv.2017.05.267](https://doi.org/10.1016/j.scitotenv.2017.05.267).
- 1780 [87] Meulenberg, E. Phenolics: Occurrence and Immunochemical
1781 Detection in Environment and Food. *Molecules* **2009**, *14*, 439
1782 DOI: [10.3390/molecules14010439](https://doi.org/10.3390/molecules14010439).
- 1783 [88] Opeolu, B. O.; Fatoki, O. S.; Odendaal, J. Development of a
1784 Solid-Phase Extraction Method Followed by HPLC-UV
1785 Detection for the Determination of Phenols in Water. *Int. J.*
1786 *Phys. Sci.* **2010**, *5*, 576–581.
- 1787 [89] Yang, F.; Shen, R.; Long, Y. M.; Sun, X. Y.; Tang, F.; Cai,
1788 Q. Y.; Yao, S. Z. Magnetic Microsphere Confined Ionic Liquid
1789 as a Novel Sorbent for the Determination of Chlorophenols in
1790 Environmental Water Samples by Liquid Chromatography. *J.*
1791 *Environ. Monit.* **2011**, *13*, 440–445. DOI: [10.1039/
1792 C0EM00389A](https://doi.org/10.1039/C0EM00389A).
- 1793 [90] Cruceru, I.; Florescu, A.; Badea, I. A.; Vladescu, L.
1794 Determination of Three Alkylphenol Isomers in Various
1795 Water Samples Using a New HPLC Method Based on a Duet
1796 Stationary Phase. *Environ. Monit. Assess.* **2012**, *184*,
1797 6061–6070. DOI: [10.1007/s10661-011-2403-1](https://doi.org/10.1007/s10661-011-2403-1).
- 1798 [91] Cruceru, I.; Iancu, V.; Petre, J.; Badea, I. A.; Vladescu, L.
1799 HPLC-FLD Determination of 4-Nonylphenol and 4-Tert-
1800 Octylphenol in Surface Water Samples. *Environ. Monit. Assess.*
1801 **2012**, *184*, 2783–2795. DOI: [10.1007/s10661-011-2151-2](https://doi.org/10.1007/s10661-011-2151-2).
- 1802 [92] Lou, L.; Cheng, G.; Yang, Q.; Xu, X.; Hu, B.; Chen, Y.
1803 Development of a Novel Solid-Phase Extraction Element for the
1804 Detection of Nonylphenol in the Surface Water of
1805 Hangzhou. *J. Environ. Monit.* **2012**, *14*, 517–523. DOI:
1806 [10.1039/C1EM10731C](https://doi.org/10.1039/C1EM10731C).
- 1807 [93] Li, X. Y.; Xue, A. F.; Chen, H.; Li, S. Q. Low-Density Solvent-
1808 Based Dispersive Liquid-Liquid Microextraction Combined
1809 with Single-Drop Microextraction for the Fast Determination
1810 of Chlorophenols in Environmental Water Samples by High
1811 Performance Liquid Chromatography-Ultraviolet Detection. *J.*
1812 *Chromatogr. A* **2013**, *1280*, 9–15. DOI: [10.1016/
1813 j.chroma.2013.01.023](https://doi.org/10.1016/j.chroma.2013.01.023).
- 1814 [94] Kadmi, Y.; Favier, L.; Yehya, T.; Soutrel, I.; Simion, A. I.; Vial,
1815 C.; Wolbert, D. Controlling Contamination for Determination
1816 of Ultra-Trace Levels of Priority Pollutants Chlorophenols in
1817 Environmental Water Matrices. *Arab. J. Chem.* **in press**.
- 1818 [95] Villar-Navarro, M.; Ramos-Payán, M.; Fernández-Torres, R.;
1819 Callejón-Mochón, M.; Bello-López, M. Á. A Novel Application
1820 of Three Phase Hollow Fiber Based Liquid Phase
1821 Microextraction (HF-LPME) for the HPLC Determination of
1822 Two Endocrine Disrupting Compounds (EDCs), n-
1823 Octylphenol and n-Nonylphenol, in Environmental Waters.
1824 *Sci. Total Environ.* **2013**, *443*, 1–6. DOI: [10.1016/
1825 j.scitotenv.2012.10.071](https://doi.org/10.1016/j.scitotenv.2012.10.071).
- 1826 [96] Suliman, F. O.; Al-Busaidi, J. N.; Al-Lawati, H. A.; Al-Kindy,
1827 S. M. Microfluidic Precolumn Derivatization of Environmental
1828 Phenols with Coumarin-6-Sulfonyl Chloride and HPLC
1829 Separation. *J. Chromatogr. Sci.* **2015**, *53*, 1379–1385. DOI:
1830 [10.1093/chromsci/bmv028](https://doi.org/10.1093/chromsci/bmv028).
- 1831 [97] Graca, B.; Staniszevska, M.; Zakrzewska, D.; Zalewska, T.
1832 Reconstruction of the Pollution History of Alkylphenols (4-
1833 Tert-Octylphenol, 4-Nonylphenol) in the Baltic Sea. *Environ.*
1834 *Sci. Pollut. Res. Int.* **2016**, *23*, 11598–11610. DOI: [10.1007/
1835 s11356-016-6262-8](https://doi.org/10.1007/s11356-016-6262-8).
- 1836 [98] Zhong, C.; He, M.; Liao, H. P.; Chen, B. B.; Wang, C.; Hu, B.
1837 Polydimethylsiloxane/Covalent Triazine Frameworks Coated
1838 Stir Bar Sorptive Extraction Coupled with High Performance
1839 Liquid Chromatography-Ultraviolet Detection for the
1840 Determination of Phenols in Environmental Water Samples. *J.*
1841 *Chromatogr. A* **2016**, *1441*, 8–15. DOI: [10.1016/
1842 j.chroma.2016.02.073](https://doi.org/10.1016/j.chroma.2016.02.073).
- 1843 [99] Zhou, Q. X.; Gao, Y. Y.; Xie, G. H. Determination of
1844 Bisphenol A, 4-n-Nonylphenol, and 4-Tert-Octylphenol by
1845 Temperature-Controlled Ionic Liquid Dispersive Liquid-Phase
1846 Microextraction Combined with High Performance Liquid
1847 Chromatography-Fluorescence Detector. *Talanta* **2011**, *85*,
1848 1598–1602. DOI: [10.1016/j.talanta.2011.06.050](https://doi.org/10.1016/j.talanta.2011.06.050).
- 1849 [100] Banihashemi, B.; Droste, R. L. Trace Level Determination of
1850 Bisphenol-A in Wastewater and Sewage Sludge by High-
1851 Performance Liquid Chromatography and UV Detection.
1852 *Water Qual. Res. J. Can.* **2013**, *48*, 133–144. DOI: [10.2166/
1853 wqrj.2013.037](https://doi.org/10.2166/wqrj.2013.037).
- 1854 [101] Chen, B.; Huang, Y.; He, M.; Hu, B. Hollow Fiber Liquid-
1855 Liquid-Liquid Microextraction Combined with High
1856 Performance Liquid Chromatography-Ultraviolet Detection for
1857 the Determination of Various Environmental Estrogens in
1858 Environmental and Biological Samples. *J. Chromatogr. A* **2013**,
1859 *1305*, 17–26. DOI: [10.1016/j.chroma.2013.06.029](https://doi.org/10.1016/j.chroma.2013.06.029).
- 1860 [102] Hu, C.; He, M.; Chen, B.; Zhong, C.; Hu, B.
1861 Polydimethylsiloxane/Metal-Organic Frameworks Coated Stir
1862 Bar Sorptive Extraction Coupled to High Performance Liquid
1863 Chromatography-Ultraviolet Detector for the Determination of
1864 Estrogens in Environmental Water Samples. *J. Chromatogr. A*
1865 **2013**, *1310*, 21–30. DOI: [10.1016/j.chroma.2013.08.047](https://doi.org/10.1016/j.chroma.2013.08.047).
- 1866 [103] Lima, D. L. D.; Silva, C. P.; Otero, M.; Esteves, V. I. Low Cost
1867 Methodology for Estrogens Monitoring in Water Samples
1868 Using Dispersive Liquid-Liquid Microextraction and HPLC
1869 with Fluorescence Detection. *Talanta* **2013**, *115*, 980–985.
1870 DOI: [10.1016/j.talanta.2013.07.007](https://doi.org/10.1016/j.talanta.2013.07.007).
- 1871 [104] Wang, X.; Liu, J.; Liu, Q.; Du, X.; Jiang, G. Rapid
1872 Determination of Tetrabromobisphenol A and Its Main
1873 Derivatives in Aqueous Samples by Ultrasound-Dispersive
1874 Liquid-Liquid Microextraction Combined with High-
1875 Performance Liquid Chromatography. *Talanta* **2013**, *116*,
1876 906–911. DOI: [10.1016/j.talanta.2013.08.011](https://doi.org/10.1016/j.talanta.2013.08.011).
- 1877 [105] Zhou, Q.; Wang, G.; Xie, G. Preconcentration and
1878 Determination of Bisphenol A, Naphthol and Dinitrophenol
1879 from Environmental Water Samples by Dispersive Liquid-
1880 Phase Microextraction and HPLC. *Anal. Methods* **2014**, *6*,
1881 187–193. DOI: [10.1039/C3AY40281A](https://doi.org/10.1039/C3AY40281A).
- 1882 [106] Zhou, Q. X.; Wu, W.; Huang, Y. R. TiO₂ Nanotube Array
1883 Micro-Solid Phase Equilibrium Extraction for the
1884 Determination of Bisphenol A, 4-n-Nonylphenol, and 4-Tert-
1885 Octylphenol at Trace Levels with High-Performance Liquid
1886 Chromatography. *Anal. Methods* **2014**, *6*, 8396–8402. DOI:
1887 [10.1039/C4AY01412J](https://doi.org/10.1039/C4AY01412J).
- 1888 [107] Zou, Y. M.; Zhang, Z.; Shao, X. L.; Chen, Y.; Wu, X. Y.; Yang,
1889 L. Q.; Zhu, J. J.; Zhang, D. M. Hollow-Fiber-Supported
1890 Liquid-Phase Microextraction Using an Ionic Liquid as the
1891 Extractant for the Pre-Concentration of Bisphenol A, 17-Beta-
1892 Estradiol, Estrone and Diethylstilbestrol from Water Samples
1893 with HPLC Detection. *Water Sci. Technol.* **2014**, *69*,
1894 1028–1035. DOI: [10.2166/wst.2013.824](https://doi.org/10.2166/wst.2013.824).
- 1895 [108] Diao, C. P.; Yang, X.; Sun, A. L.; Liu, R. M. A Combined
1896 Technique for the Pretreatment of Ultra Trace Bisphenol A in
1897 Environmental Water Based on Magnetic Matrix Solid Phase
1898 Extraction Assisted Dispersive Liquid-Liquid Microextraction.
1899 *Anal. Methods* **2015**, *7*, 10170–10176. DOI: [10.1039/
1900 C5AY02711J](https://doi.org/10.1039/C5AY02711J).
- 1901 [109] Trujillo-Rodríguez, M. J.; Pino, V.; Anderson, J. L.; Ayala,
1902 J. H.; Afonso, A. M. Double Salts of Ionic-Liquid-Based
1903 Surfactants in Microextraction: Application of Their Mixed
1904 Hemimicelles as Novel Sorbents in Magnetic-Assisted Micro-
1905 Dispersive Solid-Phase Extraction for the Determination of

- Phenols. *Anal. Bioanal. Chem.* **2015**, *407*, 8753–8764. DOI: 10.1007/s00216-015-9034-2.
- [110] Sadeghi, M.; Nematifar, Z.; Fattahi, N.; Pirsahab, M.; Shamsipur, M. Determination of Bisphenol A in Food and Environmental Samples Using Combined Solid-Phase Extraction-Dispersive Liquid-Liquid Microextraction with Solidification of Floating Organic Drop Followed by HPLC. *Food Anal. Methods* **2016**, *9*, 1814–1824. DOI: 10.1007/s12161-015-0357-6.
- [111] Wu, X.; Li, Y. R.; Zhu, X. L.; He, C. Y.; Wang, Q.; Liu, S. R. Dummy Molecularly Imprinted Magnetic Nanoparticles for Dispersive Solid-Phase Extraction and Determination of Bisphenol A in Water Samples and Orange Juice. *Talanta* **2017**, *162*, 57–64. DOI: 10.1016/j.talanta.2016.10.007.
- [112] Nur, M.; Yahaya, N.; Saad, B.; Kamaruzaman, S.; Hanapi, N. S. M. Rapid Ultrasound Assisted Emulsification Micro-Solid Phase Extraction Based on Molecularly Imprinted Polymer for HPLC-DAD Determination of Bisphenol A in Aqueous Matrices. *Talanta* **2017**, *171*, 242–249.
- [113] Oenning, A. L.; Lopes, D.; Dias, A. N.; Merib, J.; Carasek, E. Evaluation of Two Membrane-Based Microextraction Techniques for the Determination of Endocrine Disruptors in Aqueous Samples by HPLC with Diode Array Detection. *J. Sep. Sci.* **2017**, *40*, 4431–4438. DOI: 10.1002/jssc.201700583.
- [114] Sobhi, H. R.; Ghambarian, M.; Behbahani, M.; Esrafil, A. Application Application of Dispersive Solid Phase Extraction Based on a Surfactant-Coated Titanium-Based Nanomagnetic Sorbent for Preconcentration of Bisphenol A in Water Samples. *J. Chromatogr. A* **2017**, *1518*, 25–33. DOI: 10.1016/j.chroma.2017.08.064.
- [115] Ayazi, Z.; Matin, A. A. Development of Carbon Nanotube-Polyamide Nanocomposite-Based Stir Bar Sorptive Extraction Coupled to HPLC-UV Applying Response Surface Methodology for the Analysis of Bisphenol A in Aqueous Samples. *J. Chromatogr. Sci.* **2016**, *54*, 1841–1850.
- [116] de Moraes, P.; Stoichev, T.; Basto, M. C. P.; Vasconcelos, M. T. S. D. Extraction and Preconcentration Techniques for Chromatographic Determination of Chlorophenols in Environmental and Food Samples. *Talanta* **2012**, *89*, 1–11. DOI: 10.1016/j.talanta.2011.12.044.
- [117] Bisphenol A and Diglycidyl Ether of Bisphenol A. Method 1018. Occupational Safety and Health Administration (OSHA), United States **2013**. <https://www.osha.gov/dts/sltc/methods/validated/1018/1018.html>
- [118] Bruhn, C. Method for the Determination of Bisphenol A [Air Monitoring Methods, 2012]. In *The MAK-Collection for Occupational Health and Safety*; Wiley-VCH Verlag GmbH & Co. KGaA, **2002**.
- [119] Yi, B.; Kim, C.; Yang, M. Biological Monitoring of Bisphenol A with HPLC/FLD and LC/MS/MS Assays. *J. Chromatogr. B Analyt. Technol. Biomed. Life Sci.* **2010**, *878*, 2606–2610. DOI: 10.1016/j.jchromb.2010.02.008.
- [120] Gao, D. W.; Wen, Z. D. Phthalate Esters in the Environment: A Critical Review of Their Occurrence, Biodegradation, and Removal During Wastewater Treatment Processes. *Sci. Total Environ.* **2016**, *541*, 986–1001. DOI: 10.1016/j.scitotenv.2015.09.148.
- [121] David, F.; Sandra, P.; Tienpont, B.; Vanwalleghem, F.; Ikonomou, M. Analytical Methods Review. In *Series Anthropogenic Compounds: Phthalate Esters*; Staples, C. A., Ed.; Springer Berlin Heidelberg: Berlin, Heidelberg, **2003**; pp 9–56.
- [122] Net, S.; Delmont, A.; Sempéré, R.; Paluselli, A.; Ouddane, B. Reliable Quantification of Phthalates in Environmental Matrices (Air, Water, Sludge, Sediment and Soil): A Review. *Sci. Total Environ.* **2015**, *515–516*, 162–180. DOI: 10.1016/j.scitotenv.2015.02.013.
- [123] Cobellis, L.; Latini, G.; De Felice, C.; Razzi, S.; Paris, I.; Ruggieri, F.; Mazzeo, P.; Petraglia, F. High Plasma Concentrations of Di-(2-Ethylhexyl)-Phthalate in Women with Endometriosis. *Hum. Reprod.* **2003**, *18*, 1512–1515. DOI: 10.1093/humrep/deg254.
- [124] Sircar, D.; Albazi, J.; Atallah, Y.; Pizzi, W. Validation and Application of an HPLC Method for Determination of Di (2-Ethylhexyl) Phthalate and Mono (2-Ethylhexyl) Phthalate in Liver Samples. *J. Chromatogr. Sci.* **2008**, *46*, 627–631. DOI: 10.1093/chromsci/46.7.627.
- [125] Chung, E. N.; Albazi, S. J. Method Development for Determination of Di(2-Ethylhexyl)Phthalate and Its Metabolite Mono(2-Ethylhexyl)Phthalate by Reverse-Phase Liquid Chromatography. *Trans. Ill. State Acad. Sci.* **2005**, *98*, 131–138.
- [126] Fernández-Amado, M.; Prieto-Blanco, M. C.; López-Mahía, P.; Muniategui-Lorenzo, S.; Prada-Rodríguez, D. A Comparative Study of Extractant and Chromatographic Phases for the Rapid and Sensitive Determination of Six Phthalates in Rainwater Samples. *Chemosphere* **2017**, *175*, 52–65. DOI: 10.1016/j.chemosphere.2017.02.001.
- [127] Cortazar, E.; Bartolomé, L.; Delgado, A.; Etxebarria, N.; Fernández, L. A.; Usobiaga, A.; Zuloaga, O. Optimisation of Microwave-Assisted Extraction for the Determination of Nonylphenols and Phthalate Esters in Sediment Samples and Comparison with Pressurised Solvent Extraction. *Anal. Chim. Acta* **2005**, *534*, 247–254. DOI: 10.1016/j.aca.2004.11.037.
- [128] Wang, L.; Jiang, GB.; Cai, YQ.; He, B.; Wang, YW.; Shen, DZ. Cloud Point Extraction Coupled with HPLC-UV for the Determination of Phthalate Esters in Environmental Water Samples. *J. Environ. Sci.* **2007**, *19*, 874–878. DOI: 10.1016/S1001-0742(07)60145-4.
- [129] Niu, H.; Cai, Y.; Shi, Y.; Wei, F.; Mou, S.; Jiang, G. Cetyltrimethylammonium Bromide-Coated Titanate Nanotubes for Solid-Phase Extraction of Phthalate Esters from Natural Waters Prior to High-Performance Liquid Chromatography Analysis. *J. Chromatogr. A* **2007**, *1172*, 113–120. DOI: 10.1016/j.chroma.2007.10.014.
- [130] Li, J.; Cai, Y.; Shi, Y.; Mou, S.; Jiang, G. Analysis of Phthalates Via HPLC-UV in Environmental Water Samples after Concentration by Solid-Phase Extraction Using Ionic Liquid Mixed Hemimicelles. *Talanta* **2008**, *74*, 498–504. DOI: 10.1016/j.talanta.2007.06.008.
- [131] Zhao, R.-S.; Wang, X.; Yuan, J.-P.; Lin, J.-M. Investigation of Feasibility of Bamboo Charcoal as Solid-Phase Extraction Adsorbent for the Enrichment and Determination of Four Phthalate Esters in Environmental Water Samples. *J. Chromatogr. A* **2008**, *1183*, 15–20. DOI: 10.1016/j.chroma.2008.01.021.
- [132] Xu, Q.; Yin, X.; Wu, S.; Wang, M.; Wen, Z.; Gu, Z. Determination of Phthalate Esters in Water Samples Using Nylon6 Nanofibers Mat-Based Solid-Phase Extraction Coupled to Liquid Chromatography. *Microchim. Acta* **2010**, *168*, 267–275. DOI: 10.1007/s00604-010-0290-8.
- [133] Chang, M. S.; Shen, J. Y.; Yang, S. H.; Wu, G. J. Subcritical Water Extraction for the Remediation of Phthalate Ester-Contaminated Soil. *J. Hazard. Mater.* **2011**, *192*, 1203–1209. DOI: 10.1016/j.jhazmat.2011.06.031.
- [134] Hadjmohammadi, M. R.; Ranjbari, E. Utilization of Homogeneous Liquid-Liquid Extraction Followed by HPLC-UV as a Sensitive Method for the Extraction and Determination of Phthalate Esters in Environmental Water Samples. *Int. J. Environ. Anal. Chem.* **2012**, *92*, 1312–1324. DOI: 10.1080/03067319.2011.603049.
- [135] Ranjbari, E.; Hadjmohammadi, M. R. Magnetic Stirring-Assisted Dispersive Liquid-Liquid Microextraction Followed by High Performance Liquid Chromatography for Determination of Phthalate Esters in Drinking and Environmental Water Samples. *Talanta* **2012**, *100*, 447–453. DOI: 10.1016/j.talanta.2012.08.019.
- [136] Wu, Q.; Liu, M.; Ma, X.; Wang, W.; Wang, C.; Zang, X.; Wang, Z. Extraction of Phthalate Esters from Water and Beverages Using a Graphene-Based Magnetic Nanocomposite

- Prior to Their Determination by HPLC. *Microchim. Acta* **2012**, *177*, 23–30. DOI: [10.1007/s00604-011-0752-7](https://doi.org/10.1007/s00604-011-0752-7).
- [137] Xue, L.; Zhang, D.; Wang, T.; Wang, X.-M.; Du, X. Dispersive Liquid-Liquid Microextraction Followed by High Performance Liquid Chromatography for Determination of Phthalic Esters in Environmental Water Samples. *Anal. Methods* **2014**, *6*, 1121–1127. DOI: [10.1039/C3AY41996G](https://doi.org/10.1039/C3AY41996G).
- [138] Zaater, M. F.; Tahboub, Y. R.; Al Sayyed, A. N. Determination of Phthalates in Jordanian Bottled Water Using GC-MS and HPLC-UV: Environmental Study. *J. Chromatogr. Sci.* **2014**, *52*, 447–452. DOI: [10.1093/chromsci/bmt059](https://doi.org/10.1093/chromsci/bmt059).
- [139] Brzeźnicki, S.; Bonczarowska, M. Occupational Exposure to Selected Isocyanates in Polish Industry. *Med. Pr.* **2015**, *66*, 291–301. DOI: [10.13075/mp.5893.00020](https://doi.org/10.13075/mp.5893.00020).
- [140] Streicher, R. P.; Reh, C. M.; Key-Schwartz, R.; Schlecht, P. C.; Cassinelli, M. E. Determination of Airborne Isocyanate Exposure. *Niosh Methods* **1998**. <https://www.cdc.gov/niosh/docs/2003-154/pdfs/chapter-k.pdf>
- [141] Dahlin, J. *Aerosols of Isocyanates, Amines and Anhydrides. Sampling and Analysis*; Stockholm University, **2007**. Mismatch]
- [142] Streicher, R. P.; Arnold, J. E.; Ernst, M. K.; Cooper, C. V. Development of a Novel Derivatization Reagent for the Sampling and Analysis of Total Isocyanate Group in Air and Comparison of Its Performance with That of Several Established Reagent. *Am. Ind. Hyg. Assoc. J.* **1996**, *57*, 905–913. DOI: [10.1202/0002-8894\(1996\)057<0905:DOANDR>2.0.CO;2](https://doi.org/10.1202/0002-8894(1996)057<0905:DOANDR>2.0.CO;2).
- [143] Key-Schwartz, R. J.; Tucker, S. P. An Approach to Area Sampling and Analysis for Total Isocyanates in Workplace Air. *Am. Ind. Hyg. Assoc. J.* **1999**, *60*, 200–207. DOI: [10.1080/00028899908984436](https://doi.org/10.1080/00028899908984436).
- [144] Henneken, H.; Lindahl, R.; Ostin, A.; Vogel, M.; Levin, J. O.; Karst, U. Diffusive Sampling of Methyl Isocyanate Using 4-Nitro-7-Piperazinobenzo-2-Oxa-1,3-Diazole (NBDPZ) as Derivatizing Agent. *J. Environ. Monit.* **2003**, *5*, 100–105. DOI: [10.1039/b209816b](https://doi.org/10.1039/b209816b).
- [145] Werlich, S.; Stockhorst, H.; Witting, U.; Binding, N. MMNTP-A New Tailor-Made Modular Derivatization Agent for the Selective Determination of Isocyanates and Diisocyanates. *Analyst* **2004**, *129*, 364–370. DOI: [10.1039/B309221F](https://doi.org/10.1039/B309221F).
- [146] Streicher, R. P.; Reh, C. M.; Key-Schwartz, R. J.; Schlecht, P. C.; Cassinelli, M. E.; O'connor, P. F. Determination of Airborne Isocyanate Exposure: Considerations in Method Selection. *AIHAJ* **2000**, *61*, 544–556. DOI: [10.1080/15298660008984567](https://doi.org/10.1080/15298660008984567).
- [147] Song, L. Q.; Yu, Y.; Wang, X. Y. Determination of Methyl Isocyanate (MIC) in Air of Workplaces by HPLC. *Chinese J. Ind. Hyg. Occup. Dis.* **2012**, *30*, 618–620.
- [148] Hegedus, O.; Smotlakova, Z.; Hegedusova, A.; Dubajova, J.; Andrejiova, A.; Jakabova, S.; Tonk, S.; Szep, R.; Pernyeszi, T. Determination of Isocyanates in Workplace Atmosphere by HPLC. *Rev. Chim.* **2018**, *69*, 533–538.
- [149] Tuzimski, T.; Sherma, J. *High Performance Liquid Chromatography in Pesticide Residue Analysis*; CRC Press, **2015**.
- [150] Samsidar, A.; Siddiquee, S.; Shaarani, S. M. A Review of Extraction, analytical and Advanced Methods for Determination of Pesticides in Environment and Foodstuffs. *Trends Food Sci. Technol.* **2018**, *71*, 188–201. DOI: [10.1016/j.tifs.2017.11.011](https://doi.org/10.1016/j.tifs.2017.11.011).
- [151] Bedassa, T.; Gure, A.; Megersa, N. The QuEChERS Analytical Method Combined with Low Density Solvent Based Dispersive Liquid-Liquid Microextraction for Quantitative Extraction of Multiclass Pesticide Residues in Cereals. *Bull. Chem. Soc. Eth.* **2017**, *31*, 1–15. DOI: [10.4314/bcse.v31i1.1](https://doi.org/10.4314/bcse.v31i1.1).
- [152] Pirsaeheb, M.; Fattahi, N. Development of a Liquid-Phase Microextraction Based on the Freezing of a Deep Eutectic Solvent Followed by HPLC-UV for Sensitive Determination of Common Pesticides in Environmental Water Samples. *RSC Adv.* **2018**, *8*, 11412–11418. DOI: [10.1039/C8RA00912K](https://doi.org/10.1039/C8RA00912K).
- [153] Liu, Z. M.; Zang, X. H.; Liu, W. H.; Wang, C.; Wang, Z. Novel Method for the Determination of Five Carbamate Pesticides in Water Samples by Dispersive Liquid-Liquid Microextraction Combined with High Performance Liquid Chromatography. *Chin. Chem. Lett.* **2009**, *20*, 213–216. DOI: [10.1016/j.ccl.2008.10.047](https://doi.org/10.1016/j.ccl.2008.10.047).
- [154] Fu, L.; Liu, X.; Hu, J.; Zhao, X.; Wang, H.; Wang, X. Application of Dispersive Liquid-Liquid Microextraction for the Analysis of Triazophos and Carbaryl Pesticides in Water and Fruit Juice Samples. *Anal. Chim. Acta* **2009**, *632*, 289–295. DOI: [10.1016/j.aca.2008.11.020](https://doi.org/10.1016/j.aca.2008.11.020).
- [155] Wu, Q.; Li, Y.; Wang, C.; Liu, Z.; Zang, X.; Zhou, X.; Wang, Z. Dispersive Liquid-Liquid Microextraction Combined with High Performance Liquid Chromatography-Fluorescence Detection for the Determination of Carbendazim and Thiabendazole in Environmental Samples. *Anal. Chim. Acta* **2009**, *638*, 139–145. DOI: [10.1016/j.aca.2009.02.017](https://doi.org/10.1016/j.aca.2009.02.017).
- [156] Wu, Q.; Chang, Q.; Wu, C.; Rao, H.; Zeng, X.; Wang, C.; Wang, Z. Ultrasound-Assisted Surfactant-Enhanced Emulsification Microextraction for the Determination of Carbamate Pesticides in Water Samples by High Performance Liquid Chromatography. *J. Chromatogr. A* **2010**, *1217*, 1773–1778. DOI: [10.1016/j.chroma.2010.01.060](https://doi.org/10.1016/j.chroma.2010.01.060).
- [157] Goulart, S. M.; Alves, R. D.; Neves, A. A.; de Queiroz, J. H.; de Assis, T. C.; de Queiroz, M. E. L. R. Optimization and Validation of Liquid-Liquid Extraction with Low Temperature Partitioning for Determination of Carbamates in Water. *Anal. Chim. Acta* **2010**, *671*, 41–47. DOI: [10.1016/j.aca.2010.05.003](https://doi.org/10.1016/j.aca.2010.05.003).
- [158] Cao, X.; Li, Y. Determination of N,N-Dimethyldithiocarbamate in Wastewater Using Pre-Column Derivatization and High-Performance Liquid Chromatography. *Anal. Methods* **2012**, *4*, 2996–3001. DOI: [10.1039/c2ay25235j](https://doi.org/10.1039/c2ay25235j).
- [159] Salisaeng, P.; Arnnok, P.; Patdhanagul, N.; Burakham, R. Vortex-Assisted Dispersive Micro-Solid Phase Extraction Using CTAB-Modified Zeolite NaY Sorbent Coupled with HPLC for the Determination of Carbamate Insecticides. *J. Agric. Food Chem.* **2016**, *64*, 2145–2152. DOI: [10.1021/acs.jafc.5b05437](https://doi.org/10.1021/acs.jafc.5b05437).
- [160] Talebianpoor, M. S.; Khodadoust, S.; Mousavi, A.; Mahmoudi, R.; Nikbakht, J.; Mohammadi, J. Preconcentration of Carbamate Insecticides in Water Samples by Using Modified Stir Bar with ZnS Nanoparticles Loaded on Activated Carbon and Their HPLC Determination: Response Surface Methodology. *Microchem. J.* **2017**, *130*, 64–70. DOI: [10.1016/j.microc.2016.08.002](https://doi.org/10.1016/j.microc.2016.08.002).
- [161] He, L.; Luo, X.; Xie, H.; Wang, C.; Jiang, X.; Lu, K. Ionic Liquid-Based Dispersive Liquid-Liquid Microextraction Followed High-Performance Liquid Chromatography for the Determination of Organophosphorus Pesticides in Water Sample. *Anal. Chim. Acta* **2009**, *655*, 52–59. DOI: [10.1016/j.aca.2009.09.044](https://doi.org/10.1016/j.aca.2009.09.044).
- [162] Wu, C.; Liu, N.; Wu, Q.; Wang, C.; Wang, Z. Application of Ultrasound-Assisted Surfactant-Enhanced Emulsification Microextraction for the Determination of Some Organophosphorus Pesticides in Water Samples. *Anal. Chim. Acta* **2010**, *679*, 56–62. DOI: [10.1016/j.aca.2010.09.009](https://doi.org/10.1016/j.aca.2010.09.009).
- [163] Farajzadeh, M. A.; Bahram, M.; Vardast, M. R.; Bamorowat, M. Dispersive Liquid-Liquid Microextraction for the Analysis of Three Organophosphorus Pesticides in Real Samples by High Performance Liquid Chromatography-Ultraviolet Detection and Its Optimization by Experimental Design. *Microchim. Acta* **2011**, *172*, 465–470. DOI: [10.1007/s00604-010-0451-9](https://doi.org/10.1007/s00604-010-0451-9).
- [164] Wang, S.; Xiang, B.; Tang, Q. Trace Determination of Dichlorvos in Environmental Samples by Room Temperature Ionic Liquid-Based Dispersive Liquid-Phase Microextraction Combined with HPLC. *J. Chromatogr. Sci.* **2012**, *50*, 702–708. DOI: [10.1093/chromsci/bms058](https://doi.org/10.1093/chromsci/bms058).

- [165] Delmonico, E. L.; Bertozzi, J.; de Souza, N. E.; Oliveira, C. C. Determination of Glyphosate and Aminomethylphosphonic Acid for Assessing the Quality Tap Water Using SPE and HPLC. *Acta Sci. Technol.* **2014**, *36*, 513–519. DOI: [10.4025/actascitechnol.v36i3.22406](https://doi.org/10.4025/actascitechnol.v36i3.22406).
- [166] Seebunrueng, K.; Santaladchaiyakit, Y.; Srijaranai, S. Vortex-Assisted Low Density Solvent Based Demulsified Dispersive Liquid-Liquid Microextraction and High-Performance Liquid Chromatography for the Determination of Organophosphorus Pesticides in Water Samples. *Chemosphere* **2014**, *103*, 51–58. DOI: [10.1016/j.chemosphere.2013.11.024](https://doi.org/10.1016/j.chemosphere.2013.11.024).
- [167] Jiang, Q.; Liu, Q.; Chen, Q.; Zhao, W.; Xiang, G.; He, L.; Jiang, X.; Zhang, S. Dicationic Polymeric Ionic-Liquid-Based Magnetic Material as an Adsorbent for the Magnetic Solid-Phase Extraction of Organophosphate Pesticides and Polycyclic Aromatic Hydrocarbons. *J. Sep. Sci.* **2016**, *39*, 3221–3229. DOI: [10.1002/jssc.201600267](https://doi.org/10.1002/jssc.201600267).
- [168] Wee, S. Y.; Omar, T. F. T.; Aris, A. Z.; Lee, Y. Surface Water Organophosphorus Pesticides Concentration and Distribution in the Langat River, Selangor, Malaysia. *Expo. Health* **2016**, *8*, 497–511. DOI: [10.1007/s12403-016-0214-x](https://doi.org/10.1007/s12403-016-0214-x).
- [169] Maddah, B.; Soltaninezhad, M.; Adib, K.; Hasanzadeh, M. Activated Carbon Nanofiber Produced from Electrospun PAN Nanofiber as a Solid Phase Extraction Sorbent for the Preconcentration of Organophosphorus Pesticides. *Sep. Sci. Technol.* **2017**, *52*, 700–711. DOI: [10.1080/01496395.2016.1221432](https://doi.org/10.1080/01496395.2016.1221432).
- [170] Meseguer-Lloret, S.; Torres-Cartas, S.; Catalá-Icardo, M.; Simó-Alfonso, E. F.; Herrero-Martínez, J. M. Extraction and Preconcentration of Organophosphorus Pesticides in Water by Using a Polymethacrylate-Based Sorbent Modified with Magnetic Nanoparticles. *Anal. Bioanal. Chem.* **2017**, *409*, 3561–3571. DOI: [10.1007/s00216-017-0294-x](https://doi.org/10.1007/s00216-017-0294-x).
- [171] Bazmandegan-Shamili, A.; Haji Shabani, A. M.; Dadfarnia, S.; Rohani Moghadam, M.; Saeidi, M. Preparation of Magnetic Mesoporous Silica Composite for the Solid-Phase Microextraction of Diazinon and Malathion before Their Determination by High-Performance Liquid Chromatography. *J. Sep. Sci.* **2017**, *40*, 1731–1738. DOI: [10.1002/jssc.201601339](https://doi.org/10.1002/jssc.201601339).
- [172] Zhou, Q.; Zhang, X.; Xie, G.; Xiao, J. Temperature-Controlled Ionic Liquid-Dispersive Liquid-Phase Microextraction for Preconcentration of Chlorotoluron, Diethofencarb and Chlorbenzuron in Water Samples. *J. Sep. Sci.* **2009**, *32*, 3945–3950. DOI: [10.1002/jssc.200900444](https://doi.org/10.1002/jssc.200900444).
- [173] Saraji, M.; Tansazan, N. Application of Dispersive Liquid-Liquid Microextraction for the Determination of Phenylurea Herbicides in Water Samples by HPLC-Diode Array Detection. *J. Sep. Sci.* **2009**, *32*, 4186–4192. DOI: [10.1002/jssc.200900438](https://doi.org/10.1002/jssc.200900438).
- [174] Kaur, M.; Malik, A.; Singh, B. Determination of Phenylurea Herbicides in Tap Water and Soft Drink Samples by HPLC-UV and Solid-Phase Extraction. *LCGC* **2011**, *29*, 338–347.
- [175] Wang, C.-H.; Ma, X.-X.; Wang, C.; Wu, Q.-H.; Wang, Z. Poly(vinylidene Fluoride) Membrane Based Thin Film Microextraction for Enrichment of Benzoylurea Insecticides from Water Samples Followed by Their Determination with HPLC. *Chin. Chem. Lett.* **2014**, *25*, 1625–1629. DOI: [10.1016/j.ccllet.2014.06.018](https://doi.org/10.1016/j.ccllet.2014.06.018).
- [176] Felicio, A. L.; Monteiro, A. M.; Almeida, M. B.; Madeira, T. B.; Nixdorf, S. L.; Yabe, M. J. Validation of a Liquid Chromatography Ultraviolet Method for Determination of Herbicide Diuron and Its Metabolites in Soil Samples. *An. Acad. Bras. Ciênc.* **2016**, *88*, 1235–1241. DOI: [10.1590/0001-3765201620150234](https://doi.org/10.1590/0001-3765201620150234).
- [177] Zhou, Q.; Bai, H.; Xie, G.; Xiao, J. Temperature-Controlled Ionic Liquid Dispersive Liquid Phase Micro-Extraction. *J. Chromatogr. A* **2008**, *1177*, 43–49. DOI: [10.1016/j.chroma.2007.10.103](https://doi.org/10.1016/j.chroma.2007.10.103).
- [178] Geng, H. R.; Miao, S. S.; Jin, S. F.; Yang, H. A Newly Developed Molecularly Imprinted Polymer on the Surface of TiO₂ for Selective Extraction of Triazine Herbicides Residues in Maize, Water, and Soil. *Anal. Bioanal. Chem.* **2015**, *407*, 8803–8812. DOI: [10.1007/s00216-015-9039-x](https://doi.org/10.1007/s00216-015-9039-x).
- [179] Rodríguez-González, N.; Beceiro-González, E.; González-Castro, M. J.; Muniategui-Lorenzo, S. An Environmentally Friendly Method for the Determination of Triazine Herbicides in Estuarine Seawater Samples by Dispersive Liquid-Liquid Microextraction. *Environ. Sci. Pollut. Res. Int.* **2015**, *22*, 618–626. DOI: [10.1007/s11356-014-3383-9](https://doi.org/10.1007/s11356-014-3383-9).
- [180] Rodríguez-González, N.; González-Castro, M.-J.; Beceiro-González, E.; Muniategui-Lorenzo, S. Development of a Matrix Solid Phase Dispersion Methodology for the Determination of Triazine Herbicides in Marine Sediments. *Microchem. J.* **2017**, *133*, 137–143. DOI: [10.1016/j.microc.2017.03.022](https://doi.org/10.1016/j.microc.2017.03.022).
- [181] Wang, K.; Jiang, J.; Kang, M.; Li, D.; Zang, S.; Tian, S.; Zhang, H.; Yu, A.; Zhang, Z. Magnetical Hollow Fiber Bar Collection of Extract in Homogenous Ionic Liquid Microextraction of Triazine Herbicides in Water Samples. *Anal. Bioanal. Chem.* **2017**, *409*, 2569–2579. DOI: [10.1007/s00216-017-0201-5](https://doi.org/10.1007/s00216-017-0201-5).
- [182] Lei, Y.; Chen, B.; You, L.; He, M.; Hu, B. Polydimethylsiloxane/MIL-100(Fe) Coated Stir Bar Sorptive Extraction-High Performance Liquid Chromatography for the Determination of Triazines in Environmental Water Samples. *Talanta* **2017**, *175*, 158–167. DOI: [10.1016/j.talanta.2017.05.040](https://doi.org/10.1016/j.talanta.2017.05.040).
- [183] Lourencetti, C.; de Marchi, M. R. R.; Ribeiro, M. L., Determination of Sugar Cane Herbicides in Soil and Soil Treated with Sugar Cane Vinasse by Solid-Phase Extraction and HPLC-UV. *Talanta* **2008**, *77*, 701–709. DOI: [10.1016/j.talanta.2008.07.013](https://doi.org/10.1016/j.talanta.2008.07.013).
- [184] Caldas, S. S.; Demoliner, A.; Primel, E. G. Validation of a Method Using Solid Phase Extraction and Liquid Chromatography for the Determination of Pesticide Residues in Groundwaters. *J. Braz. Chem. Soc.* **2009**, *20*, 125–132. DOI: [10.1590/S0103-50532009000100020](https://doi.org/10.1590/S0103-50532009000100020).
- [185] Asensio-Ramos, M.; Hernández-Borges, J.; Borges-Miquel, T. M.; Rodríguez-Delgado, M. Á. Ionic Liquid-Dispersive Liquid-Liquid Microextraction for the Simultaneous Determination of Pesticides and Metabolites in Soils Using High-Performance Liquid Chromatography and Fluorescence Detection. *J. Chromatogr. A* **2011**, *1218*, 4808–4816. DOI: [10.1016/j.chroma.2010.11.030](https://doi.org/10.1016/j.chroma.2010.11.030).
- [186] Kaur, M.; Rani, S.; Malik, A. K.; Aulakh, J. S. Microextraction by Packed Sorbent-High-Pressure Liquid Chromatographic-Ultra Violet Analysis of Endocrine Disruptor Pesticides in Various Matrices. *J. Chromatogr. Sci.* **2014**, *52*, 977–984. DOI: [10.1093/chromsci/bmt136](https://doi.org/10.1093/chromsci/bmt136).
- [187] Tadesse, B.; Teju, E.; Gure, A.; Megersa, N. Ionic-Liquid-Based Dispersive Liquid-Liquid Microextraction Combined with High-Performance Liquid Chromatography for the Determination of Multiclass Pesticide Residues in Water Samples. *J. Sep. Sci.* **2015**, *38*, 829–835. DOI: [10.1002/jssc.201401105](https://doi.org/10.1002/jssc.201401105).
- [188] Amde, M.; Tan, Z.-Q.; Liu, R.; Liu, J.-F. Nanofluid of Zinc Oxide Nanoparticles in Ionic Liquid for Single Drop Liquid Microextraction of Fungicides in Environmental Waters Prior to High Performance Liquid Chromatographic Analysis. *J. Chromatogr. A* **2015**, *1395*, 7–15. DOI: [10.1016/j.chroma.2015.03.049](https://doi.org/10.1016/j.chroma.2015.03.049).
- [189] Yaqub, G.; Iqbal, K.; Sadiq, Z.; Hamid, A. Rapid Determination of Residual Pesticides and Polyaromatic Hydrocarbons Ins Different Environmental Samples by HPLC. *Pak. J. Agric. Sci.* **2017**, *54*, 355–361.
- [190] Bassett, M. V.; Wendelken, S. C.; Pepich, B. V.; Munch, D. J. Improvements to EPA Method 531.1 for the Analysis of Carbamates That Resulted in the Development of U.S. EPA Method 531.2. *J. Chromatogr. Sci.* **2003**, *41*, 100–106. DOI: [10.1093/chromsci/41.2.100](https://doi.org/10.1093/chromsci/41.2.100).
- [191] Kumar, R. Simultaneous Determination of Some Organophosphorus Pesticides by High Performance Liquid

- Chromatography. *Biomed. Chromatogr.* **1989**, *3*, 272–273. DOI: [10.1002/bmc.1130030610](https://doi.org/10.1002/bmc.1130030610).
- [192] EPA, U. Method 532. Determination of Phenylurea Compounds in drinking water by solid phase extraction and high performance liquid chromatography with UV detection.
- [193] De la Pena, A. M.; Mahedero, M. C.; Bautista-Sanchez, A. Monitoring of Phenylurea and Propanil Herbicides in River Water by Solid-Phase-Extraction High Performance Liquid Chromatography with Photoinduced-Fluorimetric Detection. *Talanta* **2003**, *60*, 279–285. DOI: [10.1016/S0039-9140\(03\)00072-9](https://doi.org/10.1016/S0039-9140(03)00072-9).
- [194] Feo, M.; Eljarrat, E.; Barceló, D. Determination of Pyrethroid Insecticides in Environmental Samples by GC–MS and GC–MS–MS. **2010**, *29*, 692–705.
- [195] Abbas, H. H.; Elbashir, A. A.; Aboul-Enein, H. Y. Chromatographic Methods for Analysis of Triazine Herbicides. *Crit. Rev. Anal. Chem.* **2015**, *45*, 226–240. DOI: [10.1080/10408347.2014.927731](https://doi.org/10.1080/10408347.2014.927731).
- [196] Rykowska, I.; Wasiak, W. Research Trends on Emerging Environment Pollutants—A Review. *Open Chem.* **2015**, *13*, 1353–1370.
- [197] Tadeo, J. L.; Sánchez-Brunete, C.; Albero, B.; García-Valcárcel, A. I.; Pérez, R. A. Analysis of Emerging Organic Contaminants in Environmental Solid Samples. *Cen. Eur. J. Chem.* **2012**, *10*, 480–520.
- [198] Richardson, S. D. Water Analysis: Emerging Contaminants and Current Issues. *Anal. Chem.* **2009**, *81*, 4645–4677. DOI: [10.1021/ac9008012](https://doi.org/10.1021/ac9008012).
- [199] Shishov, A.; Sviridov, I.; Timofeeva, I.; Chibisova, N.; Moskvina, L.; Bulatov, A. An Effervescence Tablet-Assisted Switchable Solvent-Based Microextraction: On-Site Preconcentration of Steroid Hormones in Water Samples Followed by HPLC–UV Determination. *J. Mol. Liq.* **2017**, *247*, 246–253. DOI: [10.1016/j.molliq.2017.09.120](https://doi.org/10.1016/j.molliq.2017.09.120).
- [200] Babić, S.; Ašperger, D.; Mutavdžić, D.; Horvat, A. J. M.; Kaštelan-Macan, M. Solid Phase Extraction and HPLC Determination of Veterinary Pharmaceuticals in Wastewater. *Talanta* **2006**, *70*, 732–738. DOI: [10.1016/j.talanta.2006.07.003](https://doi.org/10.1016/j.talanta.2006.07.003).
- [201] Lin, C.-Y.; Huang, S.-D. Application of Liquid–Liquid–Liquid Microextraction and High-Performance Liquid-Chromatography for the Determination of Sulfonamides in Water. *Anal. Chim. Acta* **2008**, *612*, 37–43. DOI: [10.1016/j.aca.2008.02.008](https://doi.org/10.1016/j.aca.2008.02.008).
- [202] Prado, N.; Renault, E.; Ochoa, J.; Amrane, A. Development and Validation of a Rapid Method for the Determination of Tetracycline in Activated Sludge by SPE Clean-Up and HPLC–UV Detection. *Environ. Technol.* **2009**, *30*, 469–476. DOI: [10.1080/09593330902772040](https://doi.org/10.1080/09593330902772040).
- [203] Ašperger, D.; Babić, S.; Pavlović, D. M.; Dolar, D.; Košutić, K.; Horvat, A. J. M.; Kaštelan-Macan, M. SPE-HPLC/DAD Determination of Trimethoprim, Oxytetracycline and Enrofloxacin in Water Samples. *Int. J. Environ. Anal. Chem.* **2009**, *89*, 809–819. DOI: [10.1080/03067310902822896](https://doi.org/10.1080/03067310902822896).
- [204] Sun, L.; Chen, L. G.; Sun, X.; Du, X. B.; Yue, Y. S.; He, D. Q.; Xu, H. Y.; Zeng, Q. L.; Wang, H.; Ding, L. Analysis of Sulfonamides in Environmental Water Samples Based on Magnetic Mixed Hemimicelles Solid-Phase Extraction Coupled with HPLC–UV Detection. *Chemosphere* **2009**, *77*, 1306–1312. DOI: [10.1016/j.chemosphere.2009.09.049](https://doi.org/10.1016/j.chemosphere.2009.09.049).
- [205] Rodríguez-Flores, J.; Contento-Salcedo, A. M.; Muñoz-Fernández, L. Rapid HPLC Method for Monitoring Relevant Residues of Pharmaceuticals Products in Environmental Samples. *Am. J. Anal. Chem.* **2011**, *2*, 18–26. DOI: [10.4236/ajac.2011.21003](https://doi.org/10.4236/ajac.2011.21003).
- [206] Wang, P. H.; Yuan, T.; Hu, J. Y.; Tan, Y. M. Determination of Cephalosporin Antibiotics in Water Samples by Optimised Solid Phase Extraction and High Performance Liquid Chromatography with Ultraviolet Detector. *Int. J. Environ. Anal. Chem.* **2011**, *91*, 1267–1281. DOI: [10.1080/03067311003778649](https://doi.org/10.1080/03067311003778649).
- [207] Leal, R. M. P.; Alleoni, L. R. F.; Tornisielo, V. L.; Regitano, J. B. Sorption of Fluoroquinolones and Sulfonamides in 13 Brazilian Soils. *Chemosphere* **2013**, *92*, 979–985. DOI: [10.1016/j.chemosphere.2013.03.018](https://doi.org/10.1016/j.chemosphere.2013.03.018).
- [208] Ribeiro, C.; Tiritan, M. E.; Rocha, E.; Rocha, M. J. Development and Validation of a HPLC–DAD Method for Determination of Several Endocrine Disrupting Compounds in Estuarine Water. *J. Liq. Chromatogr. Rel. Technol.* **2007**, *30*, 2729–2746. DOI: [10.1080/10826070701560652](https://doi.org/10.1080/10826070701560652).
- [209] Bravo, J. C.; Garcinuno, R. M.; Fernandez, P.; Durand, J. S. A New Molecularly Imprinted Polymer for the On-Column Solid-Phase Extraction of Diethylstilbestrol from Aqueous Samples. *Anal. Bioanal. Chem.* **2007**, *388*, 1039–1045. DOI: [10.1007/s00216-007-1219-x](https://doi.org/10.1007/s00216-007-1219-x).
- [210] Ribeiro, C.; Pardal, M. A.; Martinho, F.; Margalho, R.; Tiritan, M. E.; Rocha, E.; Rocha, M. J. Distribution of Endocrine Disruptors in the Mondego River Estuary, Portugal. *Environ. Monit. Assess.* **2009**, *149*, 183–193. DOI: [10.1007/s10661-008-0192-y](https://doi.org/10.1007/s10661-008-0192-y).
- [211] Patrolocco, L.; Ademollo, N.; Grenni, P.; Tolomei, A.; Barra Caracciolo, A.; Capri, S. Simultaneous Determination of Human Pharmaceuticals in Water Samples by Solid Phase Extraction and HPLC with UV-Fluorescence Detection. *Microchem. J.* **2013**, *107*, 165–171. DOI: [10.1016/j.microc.2012.05.035](https://doi.org/10.1016/j.microc.2012.05.035).
- [212] Amdany, R.; Chimuka, L.; Cukrowska, E. Determination of Naproxen, Ibuprofen and Triclosan in Wastewater Using the Polar Organic Chemical Integrative Sampler (POCIS): A Laboratory Calibration and Field Application. *Wate SA* **2014**, *40*, 407–414. DOI: [10.4314/wsa.v40i3.3](https://doi.org/10.4314/wsa.v40i3.3).
- [213] Peng, G.; He, Q.; Al-Hamadani, S. M. Z. F.; Zhou, G.; Liu, M.; Zhu, H.; Chen, J. Dispersive Liquid–Liquid Microextraction Method Based on Solidification of Floating Organic Droplet for the Determination of Thiamphenicol and Florfenicol in Environmental Water Samples. *Ecotoxicol. Environ. Saf.* **2015**, *115*, 229–233. DOI: [10.1016/j.ecoenv.2015.02.025](https://doi.org/10.1016/j.ecoenv.2015.02.025).
- [214] He, K.; Blaney, L. Systematic Optimization of an SPE with HPLC–FLD Method for Fluoroquinolone Detection in Wastewater. *J. Hazard. Mater.* **2015**, *282*, 96–105. DOI: [10.1016/j.jhazmat.2014.08.027](https://doi.org/10.1016/j.jhazmat.2014.08.027).
- [215] Li, X. Y.; Li, Q. L.; Xue, A. F.; Chen, H.; Li, S. Q. Dispersive Liquid–Liquid Microextraction Coupled with Single-Drop Microextraction for the Fast Determination of Sulfonamides in Environmental Water Samples by High Performance Liquid Chromatography–Ultraviolet Detection. *Anal. Methods* **2016**, *8*, 517–525. DOI: [10.1039/C5AY02619A](https://doi.org/10.1039/C5AY02619A).
- [216] Zhong, C.; Chen, B. B.; He, M.; Hu, B. Covalent Triazine Framework-1 as Adsorbent for Inline Solid Phase Extraction–High Performance Liquid Chromatographic Analysis of Trace Nitroimidazoles in Porcine Liver and Environmental Waters. *J. Chromatogr. A* **2017**, *1483*, 40–47. DOI: [10.1016/j.chroma.2016.12.073](https://doi.org/10.1016/j.chroma.2016.12.073).
- [217] Lima, D. L. D.; Silva, C. P.; Otero, M. Dispersive Liquid–Liquid Microextraction for the Quantification of Venlafaxine in Environmental Waters. *J. Environ. Manage.* **2018**, *217*, 71–77. DOI: [10.1016/j.jenvman.2018.03.060](https://doi.org/10.1016/j.jenvman.2018.03.060).
- [218] Shareef, A.; Li, G.; Kookana, R. S. Quantitative Determination of Fullerene (C60) in Soils by High Performance Liquid Chromatography and Accelerated Solvent Extraction Technique. *Environ. Chem.* **2010**, *7*, 292–297. DOI: [10.1071/EN09150](https://doi.org/10.1071/EN09150).
- [219] Núñez, L.; Turiel, E.; Martín-Esteban, A.; Tadeo, J. L. Molecularly Imprinted Polymer for the Extraction of Parabens from Environmental Solid Samples Prior to Their Determination by High Performance Liquid Chromatography–Ultraviolet Detection. *Talanta* **2010**, *80*, 1782–1788. DOI: [10.1016/j.talanta.2009.10.023](https://doi.org/10.1016/j.talanta.2009.10.023).
- [220] Delgado, B.; Pino, V.; Anderson, J. L.; Ayala, J. H.; Afonso, A. M.; González, V. An In-Situ Extraction–Preconcentration Method Using Ionic Liquid-Based Surfactants for the

- Determination of Organic Contaminants Contained in Marine Sediments. *Talanta* **2012**, *99*, 972–983. DOI: [10.1016/j.talanta.2012.07.073](https://doi.org/10.1016/j.talanta.2012.07.073).
- [221] Díaz-Álvarez, M.; Turiel, E.; Martín-Esteban, A. Hollow Fibre Liquid-Phase Microextraction of Parabens from Environmental Waters. *Int. J. Environ. Anal. Chem.* **2013**, *93*, 727–738. DOI: [10.1080/03067319.2012.708749](https://doi.org/10.1080/03067319.2012.708749).
- [222] Rocio-Bautista, P.; Martínez-Benito, C.; Pino, V.; Pasan, J.; Ayala, J. H.; Ruiz-Perez, C.; Afonso, A. M. The Metal-Organic Framework HKUST-1 as Efficient Sorbent in a Vortex-Assisted Dispersive Micro Solid-Phase Extraction of Parabens from Environmental Waters, Cosmetic Creams, and Human Urine. *Talanta* **2015**, *139*, 13–20. DOI: [10.1016/j.talanta.2015.02.032](https://doi.org/10.1016/j.talanta.2015.02.032).
- [223] Vicario, A.; Aragon, L.; Wang, C. C.; Bertolino, F.; Gomez, M. R. A Simple and Highly Selective Molecular Imprinting Polymer-Based Methodology for Propylparaben Monitoring in Personal Care Products and Industrial Waste Waters. *J. Pharm. Biomed. Anal.* **2018**, *149*, 225–233. DOI: [10.1016/j.jpba.2017.11.002](https://doi.org/10.1016/j.jpba.2017.11.002).
- [224] Fountoulakis, M.; Drillia, P.; Pakou, C.; Kapioti, A.; Stamatelatou, K.; Lyberatos, G. Analysis of Nonylphenol and Nonylphenol Ethoxylates in Sewage Sludge by High Performance Liquid Chromatography following Microwave-Assisted Extraction. *J. Chromatogr. A* **2005**, *1089*, 45–51. DOI: [10.1016/j.chroma.2005.05.109](https://doi.org/10.1016/j.chroma.2005.05.109).
- [225] Núñez, L.; Turiel, E.; Tadeo, J. L. Determination of Nonylphenol and Nonylphenol Ethoxylates in Environmental Solid Samples by Ultrasonic-Assisted Extraction and High Performance Liquid Chromatography-Fluorescence Detection. *J. Chromatogr. A* **2007**, *1146*, 157–163. DOI: [10.1016/j.chroma.2007.01.101](https://doi.org/10.1016/j.chroma.2007.01.101).
- [226] Santos, J. L.; Aparicio, I.; Alonso, E. A New Method for the Routine Analysis of LAS and PAH in Sewage Sludge by Simultaneous Sonication-Assisted Extraction Prior to Liquid Chromatographic Determination. *Anal. Chim. Acta* **2007**, *605*, 102–109. DOI: [10.1016/j.aca.2007.10.027](https://doi.org/10.1016/j.aca.2007.10.027).
- [227] Villar, M.; Callejón, M.; Jiménez, J. C.; Alonso, E.; Guirám, A. Optimization and Validation of a New Method for Analysis of Linear Alkylbenzene Sulfonates in Sewage Sludge by Liquid Chromatography after Microwave-Assisted Extraction. *Anal. Chim. Acta* **2007**, *599*, 92–97. DOI: [10.1016/j.aca.2007.07.065](https://doi.org/10.1016/j.aca.2007.07.065).
- [228] Guan, Z.; Huang, Y.; Wang, W. Carboxyl Modified Multi-Walled Carbon Nanotubes as Solid-Phase Extraction Adsorbents Combined with High-Performance Liquid Chromatography for Analysis of Linear Alkylbenzene Sulfonates. *Anal. Chim. Acta* **2008**, *627*, 225–231. DOI: [10.1016/j.aca.2008.08.035](https://doi.org/10.1016/j.aca.2008.08.035).
- [229] Bengoechea, C.; Cantarero, A. S. Analysis of Linear Alkylbenzene Sulfonate in Waste Water and Sludge by High Performance Liquid Chromatography: An Exercise of Validation. *J. Surfact. Deterg.* **2009**, *12*, 21–29. DOI: [10.1007/s11743-008-1100-8](https://doi.org/10.1007/s11743-008-1100-8).
- [230] Jiménez-Díaz, I.; Ballesteros, O.; Zafra-Gómez, A.; Crovetto, G.; Vílchez, J. L.; Navalón, A.; Verge, C.; de Ferrer, J. A. New Sample Treatment for the Determination of Alkylphenols and Alkylphenol Ethoxylates in Agricultural Soils. *Chemosphere* **2010**, *80*, 248–255. DOI: [10.1016/j.chemosphere.2010.04.032](https://doi.org/10.1016/j.chemosphere.2010.04.032).
- [231] Cantarero, S.; Zafra-Gómez, A.; Ballesteros, O.; Navalón, A.; Vílchez, J. L.; Verge, C.; De Ferrer, J. A. Matrix Effect Study in the Determination of Linear Alkylbenzene Sulfonates in Sewage Sludge Samples. *Environ. Toxicol. Chem.* **2011**, *30*, 813–818. DOI: [10.1002/etc.447](https://doi.org/10.1002/etc.447).
- [232] Yu, C.; Hu, B. Novel Combined Stir Bar Sorptive Extraction Coupled with Ultrasonic Assisted Extraction for the Determination of Brominated Flame Retardants in Environmental Samples Using High Performance Liquid Chromatography. *J. Chromatogr. A* **2007**, *1160*, 71–80. DOI: [10.1016/j.chroma.2007.05.042](https://doi.org/10.1016/j.chroma.2007.05.042).
- [233] Pobozy, E.; Krol, E.; Wojcik, L.; Wachowicz, M.; Trojanowicz, M. HPLC Determination of Perfluorinated Carboxylic Acids with Fluorescence Detection. *Microchim. Acta* **2011**, *172*, 409–417. DOI: [10.1007/s00604-010-0513-z](https://doi.org/10.1007/s00604-010-0513-z).
- [234] Kowalski, B.; Mazur, M. The Simultaneous Determination of Six Flame Retardants in Water Samples Using SPE Pre-Concentration and UHPLC-UV Method. *Water Air Soil Pollut.* **2014**, *225*, 9.
- [235] Peixoto, P. S.; Tóth, I. V.; Segundo, M. A.; Lima, J. L. F. C. Fluoroquinolones and Sulfonamides: Features of Their Determination in Water. A Review. *Int. J. Environ. Anal. Chem.* **2016**, *96*, 185–202. DOI: [10.1080/03067319.2015.1128539](https://doi.org/10.1080/03067319.2015.1128539).
- [236] Seifrtová, M.; Nováková, L.; Lino, C.; Pena, A.; Solich, P. An Overview of Analytical Methodologies for the Determination of Antibiotics in Environmental Waters. *Anal. Chim. Acta* **2009**, *649*, 158–179. DOI: [10.1016/j.aca.2009.07.031](https://doi.org/10.1016/j.aca.2009.07.031).
- [237] Kozłowska-Tylingo, K.; Namieśnik, J.; Górecki, T. Determination of Estrogenic Endocrine Disruptors in Environmental Samples—A Review of Chromatographic Methods. *Crit. Rev. Anal. Chem.* **2010**, *40*, 194–201. DOI: [10.1080/10408347.2010.490488](https://doi.org/10.1080/10408347.2010.490488).
- [238] Corradini, D. *Handbook of HPLC*, 2nd ed.; Taylor & Francis, **2010**.
- [239] Fekete, A.; Malik, A. K.; Kumar, A.; Schmitt-Kopplin, P. Amines in the Environment. *Crit. Rev. Anal. Chem.* **2010**, *40*, 102–121. DOI: [10.1080/10408340903517495](https://doi.org/10.1080/10408340903517495).
- [240] Huang, K.-J.; Wei, C.-Y.; Xie, W.-Z.; Liu, Y.-M.; Chen, Y.-H.; Zhang, J.-F. LC Analysis of Aliphatic Primary Amines and Diamines After Derivatization with 2,6-Dimethyl-4-Quinolincarboxylic Acid N-Hydroxysuccinimide Ester. *Chromatographia* **2009**, *70*, 747–752. DOI: [10.1365/s10337-009-1256-z](https://doi.org/10.1365/s10337-009-1256-z).
- [241] Bornick, H.; Grisczek, T.; Worch, E. Determination of Aromatic Amines in Surface Waters and Comparison of Their Behavior in HPLC and on Sediment Columns. *Fresenius. J. Anal. Chem.* **2001**, *371*, 607–613. DOI: [10.1007/s002160101011](https://doi.org/10.1007/s002160101011).
- [242] EPA, U. SW-846 Test Method 8330A: Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), part of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (PDF).
- [243] Gaurav, D.; Malik, A. K.; Rai, P. K. High-Performance Liquid Chromatographic Methods for the Analysis of Explosives. *Crit. Rev. Anal. Chem.* **2007**, *37*, 227–268. DOI: [10.1080/10408340701244698](https://doi.org/10.1080/10408340701244698).
- [244] Lindahl, S.; Gundersen, C. B.; Lundanes, E. A Review of Available Analytical Technologies for Qualitative and Quantitative Determination of Nitramines. *Environ. Sci. Processes Impacts* **2014**, *16*, 1825–1840. DOI: [10.1039/C4EM00095A](https://doi.org/10.1039/C4EM00095A).
- [245] Shah, A. D.; Dai, N.; Mitch, W. A. Application of Ultraviolet, Ozone, and Advanced Oxidation Treatments to Washwaters to Destroy Nitrosamines, Nitramines, Amines, and Aldehydes Formed during Amine-Based Carbon Capture. *Environ. Sci. Technol.* **2013**, *47*, 2799–2808. DOI: [10.1021/es304893m](https://doi.org/10.1021/es304893m).
- [246] Mercader, F. d M.; Voice, A. K.; Trap, H.; Goetheer, E. L. V. Nitrosamine Degradation by UV Light in Post-Combustion CO₂ Capture: Effect of Solvent Matrix. *Energy Procedia* **2013**, *37*, 701–716. DOI: [10.1016/j.egypro.2013.05.159](https://doi.org/10.1016/j.egypro.2013.05.159).
- [247] Nawrocki, J.; Andrzejewski, P. Nitrosamines and Water. *J. Hazard. Mater.* **2011**, *189*, 1–18.