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Abstract

The Water Framework Directive (WFD), Directive 2000/60/EC, was introduced in 2000 with the aim of member countries attaining 'good status' in water bodies that are below good status at present, as well as retaining good or better status where it already exists by 2015. According to WFD [1] 41 priority substances and a further 25 priority hazardous substances were identified to be included in water monitoring programmes. These substances can be divided into four main groups: pesticides, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and metals and trace elements.

A standardised, reliable and efficient method, incorporating both sample preconcentration and analysis steps, is required to facilitate these monitoring programmes. As popular techniques currently in use involve solid-phase extraction (SPE), or liquid chromatography (LC), a critical evaluation has been carried out on their applications, with regard to priority pollutants and hazardous substances. SPE is used for sample pre-concentration and cleanup, for removal of specific substances from aqueous solutions, and for the purification of various chemicals, while LC is used for the separation and subsequent detection of analytes.

Table 1 – Priority Pollutants and examples of commonly employed methods of analysis

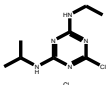
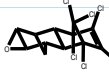
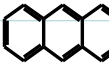
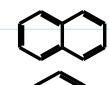
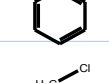
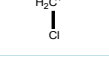
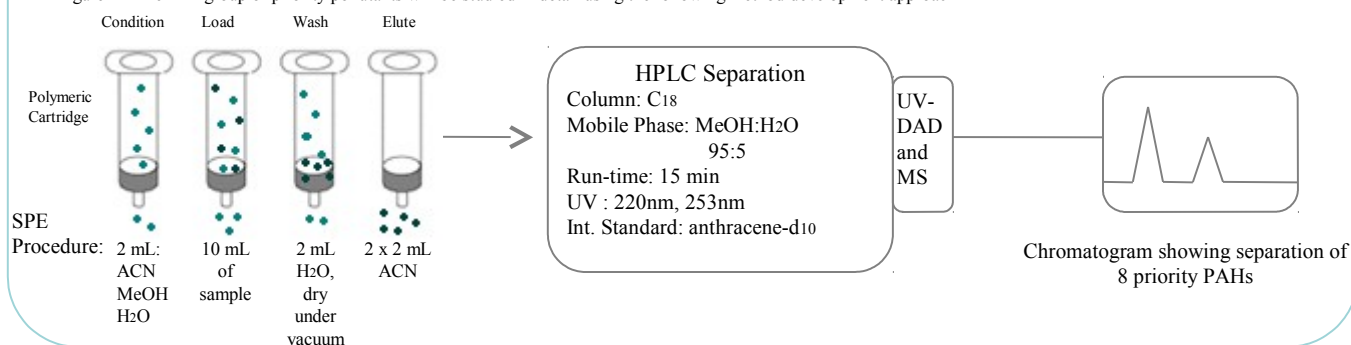
Pollutant	Dielectric Constant	Structure	Solubility	Group	SPE Method		HPLC Method	
					Cartridge	Solvents	Method	Detector
Atrazine			33 ppm in water	Pesticide	HLB,C ₁₈ , Polymeric	MeOH, H ₂ O, ACN	H ₂ O,MeOH,ACN C ₁₈	MS/MS
Dieldrin			0.1 ppm in water at 25°C	Pesticide	HLB,C ₁₈ , polymeric	MeOH, H ₂ O, ACN	H ₂ O, MeOH ACN C ₁₈	MS/MS
Anthracene	2.3 at 20°C		0.032-0.085 mg L ⁻¹ at 20°C	PAH	Polymeric,C ₁₈	ACN, CH ₂ Cl ₂ , MeOH,H ₂ O	MeOH/H ₂ O ACN/H ₂ O C ₁₈	UV or Fluorescence
Naphthalene	2.5 at 20°C		30 mg L ⁻¹ at 20°C	PAH	Polymeric, C ₁₈	ACN,CH ₂ Cl ₂ , MeOH,H ₂ O	MeOH/H ₂ O ACN/H ₂ O C ₁₈	UV or Fluorescence
Benzene	2.3 at 20°C		0.188% at 23°C	VOC	Polymeric	ACN, H ₂ O,MeOH	MeOH/H ₂ O ACN/H ₂ O C ₁₈	(LC or GC) MS/MS
Dichloromethane	9.1 at 20°C		slightly sol 13.7g L ⁻¹ at 20°C	VOC	Polymeric	ACN, H ₂ O,MeOH	MeOH/H ₂ O ACN/H ₂ O C ₁₈	(LC or GC) MS/MS
Arsenic	Varies with compound	As	Has polar compounds	Trace Element	Graphitised Carbon, anion exchange	MeOH,H ₂ O, CH ₃ COOH	Phosphate Buffer, acetate, malonate anion exchange	MS/MS, ICPMS, GFAAS
Lead	Varies with compound	Pb	Insoluble, heavy metal compounds	Metal	Graphitised Carbon, anion exchange (modified)	MeOH,H ₂ O, CH ₃ COOH	MeOH,H ₂ O,ACN Modified C ₁₈	MS/MS, ICPMS, GFAAS

Figure 1 - The PAH group of priority pollutants will be studied in detail using the following method development approach



References: [1] Water Framework Directive (2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy)