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Hydrophobic deep eutectic solvents as "green" extraction media for polycyclic aromatic hydrocarbons in aqueous samples

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Highlights

- New, nonionic, hydrophobic deep eutectic solvents (DES) composed of natural compounds
- Inexpensive, nontoxic DES were used as an extracting solvent
- Green sample preparation method
- Easy and sensitive method for monitoring PAHs during wastewater treatment processes

Abstract: The paper presents novel nonionic and hydrophobic deep eutectic solvents which were synthesized from natural compounds, *i.e.,* thymol, ±camphor, decanoic and 10-undecylenic acids. Fundamental physicochemical properties of the synthesized deep eutectic solvents were determined, followed by their application as extractants in ultrasound-assisted dispersive liquid-liquid microextraction to isolate and enrich polycyclic aromatic hydrocarbons from aqueous samples characterized by a complex matrix. The final determination was carried out by gas chromatography-mass spectrometry. The most important extraction parameters were optimized and the procedure was validated. The developed procedure is characterized by low limits of detection and quantitation, equal to 0.0039 – 0.0098 µg/L and 0.012 – 0.029 µg/L, respectively, good precision (RSD < 6.09%), analyte recovery ranging from 73.5 to 126.2%, and a wide linear range. The procedure was applied to analysis of industrial effluents from the production of bitumens before and after treatment by advanced oxidation processes. A total of 16 PAHs at concentrations ranging from 0.12 to 46.2 µg/L were identified and determined.

Keywords: deep eutectic solvents; dispersive liquid-liquid microextraction; sample preparation; gas chromatography; water analysis; polycyclic aromatic hydrocarbons.

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1. Introduction

The term polycyclic aromatic hydrocarbons (PAHs) is used to describe a group of organic compounds consisting of two or more fused aromatic rings and not containing heteroatoms or any substituents. According to the US EPA, 16 PAHs were classified in 1976 as priority environmental pollutants due to their carcinogenic and mutagenic properties and the availability of standards and instrumentation enabling their determination at low concentration levels. It has now been established that also other PAHs, not included in the priority 16 PAHs, play an important role in environmental pollution [1-4]. PAHs are formed mostly as a result of activities of various industries, including oil refinery and petrochemical [5-7],