ABSTRACT:

A molecularly imprinted polymer film using catechol for the template (Cat-MIP) was designed for adsorption of a range of phenols from water. Systematic experiments were performed to improve the imprinting and the extraction efficiency of the target phenols. Ultra-performance liquid chromatography with UV-vis diode array detection (UPLC-PDA) was used for the determination of trace levels of 11 phenols in seawater and produce water samples. Analysis of spiked water samples using the MIP-UPLC-PDA method gave method detection limits (DL) between 0.1 and 2 μg/L, a limits of quantification (LOQ) between 0.5 and 10 μg/L, and a linear ranges from 10-120 μg/L for phenol (ph), 5-120 μg/L for 2-methylphenol (2-MP), 3-methylphenol (3-MP), 2-chlorophenol (2-CP), and 2,4-dimethylphenol (2,4-DMP), 0.5-120 μg/L for 4-chloro-3-methylphenol (CMP) and 2,4-dichlorophenol (2,4-DCP), 0.5-1000 μg/L for 2,4,6-trichlorophenol (2,4-6-TCP), 5-3000 μg/L for pentachlorophenol (PCP), 1-3000 μg/L for 4-teroctylphenol (4-OP), and 3-3000 for 4-nonylphenol (4-NP) with R²> 0.99. The accuracy and precision for the MIP-UPLC-PDA method were assessed using recoveries of the phenols at three concentration levels in deionized water (DI), seawater (SW), and produced water (PW) showing good performance even in complex matrices. In addition to the usual analytical figures of merit, four isotherm models (Langmuir (LI), Freundlich (FI), Langmuir–Freundlich (L-FI), and Brunauer, Emmett, and Teller (BET)) were used to study the adsorption and the cross-reactivity of this MIP formulation for the target phenols. The MIPs exhibited a high degree of homogeneity with well-defined binding sites. The L-FI model helped to understand the cross-reactivity behaviour in terms of total binding sites, site affinity and heterogeneity for the smaller phenols (ph, 2-MP, 3-MP, 2-CP, 2,4-DMP, CMP, and 2,4-DCP). The recognition of the larger phenols (2,4,6-TCP, 4-OP, PCP, and 4-NP), which have much higher binding affinities than the smaller phenolic compounds, was better fit with the BET isotherm model. Details of the development process, both for production of the MIPs and the analytical method, along with highlights from the adsorption isotherm studies will be discussed.