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Exploring imine-based Covalent Organic Frameworks (COFs) for enhanced Bisphenol A ultrasonic removal: a comparative study

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The extensive presence of endocrine-disrupting chemicals (EDCs) in water bodies, such as bisphenol A (BPA), has raised significant concerns due to their high toxicity. Even trace BPA concentrations (below 1 µg m^{-3}) can adversely affect human reproductive and endocrine systems. The present study describes the design of two imine-based covalent organic frameworks (COFs), COF-1 and COF-2, with different pore sizes for BPA adsorption. The experimental maximum adsorption capacities obtained for COF-1 and COF-2 were 2022.0 mg g^{-1} and 2074.8 mg g^{-1}, respectively. Furthermore, the experimental data were well-fitted by the PSO model, IPD, and Dubinin-Radushkevich model, indicating the superior performance of COF-2 in BPA adsorption compared to COF-1. This enhanced performance is primarily due to the higher number of aromatic rings in the structure and the larger pore size of COF-2. Additionally, the possible adsorption mechanism was analyzed using spectroscopic techniques, revealing that Van der Waals forces, π-π interactions, and hydrogen bonding involving N and O atoms from the adsorbent structure play crucial roles in the adsorption process. The regeneration of the adsorbents was evaluated over five cycles using methanol as eluent. This study underscores the synthesis of two imine-based COFs as highly efficient adsorbents for effectively removing BPA from aqueous solutions, addressing a pressing global environmental concern.