HOW CAN ZEOLITES CLOSE THE LOOP OF ENVIRONMENTAL REMEDIATION TECHNIQUES?

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In the quest for a sustainable future, environmental remediation techniques play a pivotal role in mitigating pollution and safeguarding our ecosystems. Among the diverse array of materials available, zeolites have emerged as promising candidates for addressing environmental challenges. [1] With their unique properties, zeolites offer the potential to close the loop of remediation by effectively removing pollutants from aqueous solutions taking into account toxicity effects behind remediation procedure. [2] This contribution focuses on exploring the application of zeolites in the removal of pesticides and other contaminants, highlighting their pivotal role in environmental remediation.

Zeolites and porous materials possess well-defined pore structures, large specific surface areas, and negatively charged frameworks. These features offer opportunities for incorporating various functionalizing phases to enhance their performance and enable tailored removal of specific contaminants. The combination of zeolites with functional materials, such as heteropoly acids/salts [3, 4], functional carbons [5], and conducting polymers [6, 7], has resulted in synergistic effects, enhancing the adsorption capacity, catalytic performance, and overall environmental applicability of these composites. Moreover, the incorporation of antibacterial agents into zeolite composites has shown promise in tackling microbial contamination in water systems. [8]

Furthermore, spent zeolite adsorbents require regeneration and/or reuse. After reaching their adsorption capacity, zeolites can be subjected to regeneration processes, such as thermal treatment [9], desorption, or solvent extraction or they can be further treated to produce novel materials for electrochemical applications. [10] The reuse in subsequent remediation cycles and the onset of new applications minimize waste generation and promote resource efficiency.

By harnessing the unique properties of zeolites, we can pave the way for efficient and sustainable solutions to addressing environmental pollution challenges. Understanding the adsorption mechanisms, catalytic and regeneration processes, and the subsequent reuse of zeolites is crucial for developing effective remediation strategies and achieving a cleaner and healthier environment.

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