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Adsorption characteristics of a novel ceramsite for heavy metals removal from stormwater runoff

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Abstract: Urban sediments have rapidly increased in recent years around the world, and their effective management has become an important problem. To remove heavy metals from stormwater runoff and use sediments as a resource, a novel ceramsite was developed using sewer pipe sediments (SPS), river bed sediments (RBS), urban water supply treatment sludge (WSTS), and wastewater treatment plant excess sludge (WWTS). The optimal composition was determined based on the Brunauer–Emmett–Teller specific surface area and an orthogonal test design. The adsorption characteristics of the novel ceramsite for dissolved heavy metals (Cu^{2+} and Cd^{2+}) were investigated through adsorption isotherms and kinetic experiments at 25(±1) °C. Both Cu^{2+} and Cd^{2+} were effectively removed by the novel ceramsite, and their equilibrium adsorption was 4.96 mg/g and 3.84 mg/g, respectively. Langmuir isotherms and a pseudo-first-order kinetic equation described the adsorption process better than other techniques. Characterization analysis of the ceramsite composition before and after heavy metal adsorption showed that the Cu^{2+} and Cd^{2+} contents in the ceramsite increased after adsorption. The results revealed that adsorption is both a physical and chemical process, and that ceramsite can be used as a bioretention medium to remove heavy metals from stormwater runoff while simultaneously converting problematic urban sediments into a resource.

Keywords: Urban sediments, ceramsite, heavy metals, stormwater runoff

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