Graphene Enhanced Concrete Roads for Runoff Management

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Abstract

Pervious concrete pavement is a unique and effective means to address environmental problems and support sustainable growth. By capturing stormwater and allowing it to seep into the ground, pervious concrete is instrumental in recharging groundwater, reducing stormwater runoff, and meeting United States Environmental Protection Agency (EPA) stormwater regulations. In this experimental research, crushed granite aggregates were coated with reduced graphene oxide (RGO) and incorporated into a pervious concrete (PC) mix to enhance its capacity for removing heavy metals. The RGO in aqueous form, at concentrations of up to 0.03 wt%, was introduced into the PC mixture. The aggregate and binder interfaces were strengthened by the RGO, improving the concrete compressive strength by 25%. The addition of RGO reduced the formation of capillary pores in the cement matrix by 33%, resulting in much better resistance to the leaching of calcium ions from cement matrix in strong acids. The average removal of copper, zinc, lead, and cadmium from the desecrate water in this RGO decorated concrete reached 98%, 92%, 96% and 94%, but this removal was reduced when these ions were mixed in the wastewater and passed at the same time. Immobilized heavy-metal ions were detached from cement sites when a strong acid was passed through the concrete samples, but this desorption was reduced in the RGO-treated samples. Overall, the nano-engineering exhibits multiple benefits, and the increased use of graphene-decorated PC as a permeable road surface can remediate heavy metal pollution from urban runoff.