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Predicting Phosphorus Sorption onto Steel Slag Using a Flow-through approach with Application to a Pilot Scale System

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Author(s)

Chad J. Penn, Joshua M. McGrath

ABSTRACT

Reducing phosphorus (P) loads from soils to surface waters is necessary for solving the problem of eutrophication. Many industrial by-products have been shown to sorb appreciable amounts of dissolved P from solution and it has been proposed to use P sorption materials (PSMs) such as steel slag in landscape scale "filters" for trapping dissolved P in runoff. The objective of this study was to model the effect of retention time (RT) and P concentration on P sorption by steel slag and a surface modified slag in a flow-through system. Sorption of P onto steel slag and rejuvenated-modified steel slag was measured using a traditional batch isotherm and a flow-through setting at several RTs and P concentrations. Flow-through data were used to produce a model that estimated P sorption based on RT and P concentration. The model was tested on a pilot-scale pond filter consisting of the same slag materials. For both the materials, flow-through tests indicated an increase in RT increased P removal efficiency but decreased the total amount of P removed at saturation. The Langmuir model developed from batch isotherms overestimated and underestimated P sorption in normal and rejuvenated slag respectively, relative to flow-through. Normal and rejuvenated slag removed 38 and 36% of P in the pilot-scale pond filter after 2 weeks of pumping. The Langmuir equation poorly predicted P sorption in the pond filter while the flow-through model produced reasonable estimates. Results suggest that flow-through methodology is necessary for estimating P sorption in the context of landscape P filters.

KEYWORDS

Phosphorus, By-Products, Phosphorus Removal Structure

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