Developing Inexpensive Calcium Alginate Based Scaffolds for Phosphate Sorption in Stormwater

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Less than 0.01% of all of earth's water is in rivers and lakes, and it is in jeopardy. Excessive concentrations of phosphorous can trigger Harmful Algal Blooms which self-perpetuate and destroy aquatic ecosystems through eutrophication. Wastewater treatment plants employ strategies to remove phosphorous, but most stormwater, which often contains high concentrations of phosphorous, is discharged into detention ponds, streams, rivers, and lakes with little treatment. Macro-scaffolds were constructed using calcium alginate filaments infused with 8% Magnesium-Aluminum Layered Double Hydroxides (Mg-Al LDHs), which cause dissolved phosphates to precipitate and adhere to the scaffold surface. Kinetics and equilibrium experiments on the scaffolds infused with Mg-Al LDHs revealed a maximum removal capacity of 127.5 milligrams of phosphate per gram of the scaffold, far exceeding that of calcium alginate alone. Furthermore, the interlocking design of the scaffold was not only more structurally sound, it also removed phosphorus more efficiently. It is inexpensive - materials costs total only 4 cents per gram of scaffold - and could be deployed in a scaffold housing designed from recycled materials, including hair clips, foam, and tee shirt fabric. Once the scaffold become saturated with phosphorus after a few days, they can be potentially recycled into slow release fertilizer capsules for agriculture, hindering the cycle of phosphate runoff pollution. The scaffolds and housings could be deployed in detention ponds and similar structures with low flow rates to reduce phosphorus pollution before it contaminates streams. They also have to potential to be functionalized for the removal of heavy metals and bacteria, solving many problems with one inexpensive solution.

Awards Won:

First Award of $5,000