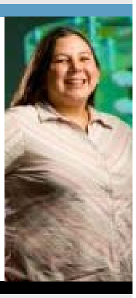

ENVIRONMENTAL AND HYDROSYSTEMS ENGINEERING

Ph.D. and M.S. Abstracts

OVERVIEW

THE EVALUATION OF SPECIALIZED PERMEABLE MEDIA FOR PHOSPHORUS REMOVAL

Level: M.S.
Student: Jennifer Smith
Advisor: A. Scott Weber, Ph.D.

Excessive loadings of phosphorus from anthropogenic sources can cause the development of algal blooms that eventually decompose allowing an increase in the consumption of dissolved oxygen in water bodies. A primary source of phosphorus loading is from wastewater treatment facility effluent. The use of conventional methods to remove excessive loadings of phosphorus from wastewater can be very expensive due to increases in the maintenance and operation cost of facility infrastructure. In reaction to this environmental concern, low cost approaches in lieu of conventional methods have been examined as viable alternatives. Engineered treatment wetlands are a cheap, efficient alternative to traditional methods in the removal of conventional pollutants from wastewater. Phosphorus removal in wetland systems can be achieved by either plant uptake or by removal in the subtrate that supports the aquatic macrophytes. To maximize phosphorus removal, selection of a substrate that demonstrates the physical and chemical properties contributing to phosphorus removal is desirable. Three examples of these substrates are wollastonite tailings, filtralite-P and laterite. Wollastonite is a calcium rnetasilicate that shows promise in the effective removal of phosphorus; it is a relatively cheap and abundant natural material. Filtralite-P is a trademark of Norsk Leca and manufactured in Norway. It is an expensive highly porous clay aggregate that has been proven to efficiently remove phosphorus from wastewater. Laterite is a readily available hydrated mixture of aluminum, iron, and titanium compounds. This study consisted of two major experiments that focused on the use of the three aforementioned potential substrates for the use of phosphorus removal. The potential for each substrate to effectively remove phosphorus from wastewater was first assessed through the use of batch experiments. Overall, the batch experiments determined that wollastonite and filtralite-P were the best phosphorus sorbents. The second major experiment evaluated the use of the more economical substrate (wollastonite) and the more expensive aggregate (filtralite-P) in column studies to simulate subsurface flow through a wetland substrate. The four columns consisted of 100, 95, 90 and 80 percent wollastonite with the remainder comprised of filtralite-P. On average, 92% removal of soluble phosphorus was achieved in the wollastonite only treatment column operated at an hydraulic application rate of 0.91 m3/m2-day. The average effluent phosphorus concentration over the 24 week study period was 0.67 mg/L. The best performance removal observed was achieved within the first few days of the study. Over the same period, the columns containing 95%, 90% and 80% wollastonite tailings achieved a soluble phosphoms removal of 89%, 87% and 76% respectively. The exact removal mechanism used by the substrate was not determined, but due to the highly effective constituent (calcium) of wollastonite, phosphorus removal from the column could be due to the precipitation of calcium phosphates. The column headloss in all four treatment columns remained steady over the length of the experiment. It is assumed that any variation observed in the column headloss was the result of media compaction and aggregation, and minor biological growth within the void space of the media. Overall, this study established that the addition of specialized substrates such as filtralite do not significantly assist in phosphorus removal capabilities of wollastonite tailings, but may hinder removal by affecting the hydraulic properties of the system in the long term.

212 Ketter Hall, Buffalo, New York 14260
PHONE 716-645-2114 x240
FAX 716-645-3733