Stormwater wet detention ponds are utilized as the preferred stormwater management throughout the state of Florida. Previous research has found that accumulations of nutrients, algae, heavy metals, pesticides, chlorophyll a, fecal coliform bacteria and low concentrations of dissolved oxygen (DO) are some of the common characteristics of stormwater wet detention ponds. Although these pollutant levels are not regulated within the ponds, states are required to compute the pollutant load reduction through relevant the total maximum daily load (TMDL) programs to meet the water quality requirements addressed by the Clean Water Act (CWA). In this study, field sampling data of stormwater ponds throughout Florida are presented to identify symptoms of the main contaminants in wet detention ponds, targeted sources, possible removal mechanisms via the use of specific sorption media, and posed ecological and human health risks. Nutrients were found as a main pollutant of concern, of which orthophosphate, total phosphorus, ammonia, nitrate, and total nitrogen were targeted whereas some heavy metals, such as copper, exhibit minor concerns. The accumulation of high nutrient concentrations may be mitigated by the adoption of best management practices (BMPs) utilizing biosorption activated media (BAM) to remove phosphorus and nitrogen species through physical, chemical, and biological processes. This study aims to increase overall scientific understanding of phosphorus removal dynamics in sorption media systems via Langmuir and Freundlich isotherms and column studies. The removal of phosphorus (P) was proven effective through mostly a chemophysical process. The maximum orthophosphorus adsorption equilibrium capacities were determined under varying conditions of the media within the columns, which were found up to 0.000534 mg-P adsorbed per gram BAM with influent concentrations of 1 mg/L-P distilled water and 1 hour residence time. Under the same conditions but using spiked pond water, the adsorption capacity was increased about 30 times to 0.01507 mg-P/g BAM due to the properties and concentrations of ions in question (Fe, Al, Ca) affecting the diffusion rate regulating the surface reactions with orthophosphate. These values were used to calculate the life expectancies of the media under varying residence time and influent concentrations of treatment. The chemophysical and biological removal capabilities of total nitrogen, ammonia, and nitrate were proved effective in columns using 1100 g of BAM. In flow-through column conditions, ammonia had a consistent ~95% removal while effluent nitrate concentrations were highly variable due to the simultaneous nitrification-denitrification processes within the column once an aerobic-anaerobic environment was established. Batch reactions on the column experiment simulating paused flow within a baffle box concluded comparable ortho-P removals with the flow through, increased total phosphorus effluents indicative of chemical precipitation of orthophosphorus, increased ammonia due to organic N conversions, and increased nitrate removal. Although the nutrient removal media may show great removal efficiency, concern lies in the susceptibility of nutrient-removing biofilm’s bacterial colonies to anthropogenic input of other inorganic contaminants in stormwater runoff, shown to change the structure, physiology, and metabolism of biofilms. A literature review of plausible “green” copper removal materials and Freundlich and Langmuir isotherm tests concluded a successful copper removal mix with removal efficiencies up to 96% as well in this study.

Major: Environmental Engineering

Educational Career:
Bachelor’s of Biology, BS, 2010, Washington College

Committee in Charge:
Ni-Bin Chang, Chair, Civil, Environmental, and Construction Engineering
Martin Wanielista, Civil, Environmental, and Construction Engineering
Patrick Bohlen, Biology
The public is welcome to attend.