Dr. Chin-Min Cheng, a Senior Research Associate in the Department of Civil, Environmental, and Geodetic Engineering at Ohio State University completed an Ohio WRC funded project via OWDA titled **"Separation of Phosphorous- and Nitrogen Nutrients from agriculturally Degraded Waters Using Previous Filter Material Developed from Industrial By-products"**. The goal of the project was to demonstrate the feasibility of applying low-cost and environmentally-sustainable approach to agriculture drainage water (ADW) handling and treatment.

Excessive releases of phosphorous (P) and nitrogen (N) from soil to drainages is a leading cause of eutrophication in of water bodies. To prevent accumulation of nutrients in surface waters, reduction of nutrient concentrations in ADW is required. While many best management practices focus on source reduction and minimizing transport, these methods have not proven to prevent dissolved phosphorous loses, which is the most readily available to aquatic organisms. Instead, end-of-tail filtration has been suggested as a better approach, although ideal filter materials have yet to be identified.

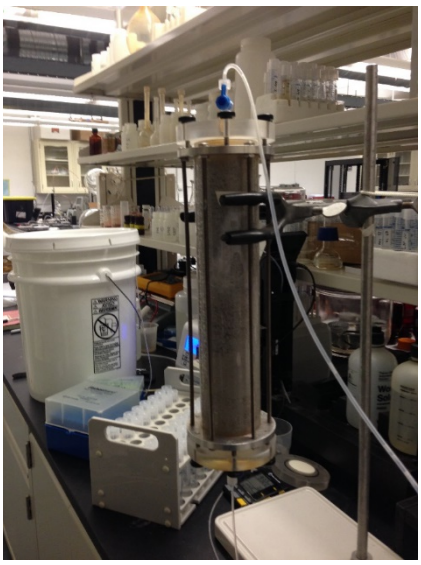

Figure 1 Laboratory set up of column test sorption experiments

In this study, Dr. Cheng with his students modified compositions of coal fly ash, stabilized flue gas desulfurization (FGD) materials (P-type), and bauxite leaching residual (red mud)(N-type) in order to improve selective nutrient-adsorbing capabilities of potential end-of-tail filter for ADW. A series of batch and column tests (Figure 1) were carried out and the results suggest that the filter material containing red mud did not have the expected adsorption effect on nitrate. However, the pervious filter material made from the coal combustion by-products, i.e., fly ash and stabilized FGD material, was found to be able to effectively remove phosphate and potentially nitrate from ADWs (Figure 2). The results showed over 77% of nitrate removal was achieved after one pore volume passing through the column, and increased to 98% after 168 hours. For phosphate, over 99% of removal was achieved after 28 pore volumes, an increase from the 82.5% observed after one pore volume. The reduction of nitrate is unlikely through an adsorption mechanism and other processes might have contributed to the observed nitrate reduction. This study suggests an end-of-tail filtration approach using agricultural and industrial wastes can be developed as an alternative to current BMPs to reduce nutrient discharges from crop lands and produce value-added products containing concentrated phosphate.

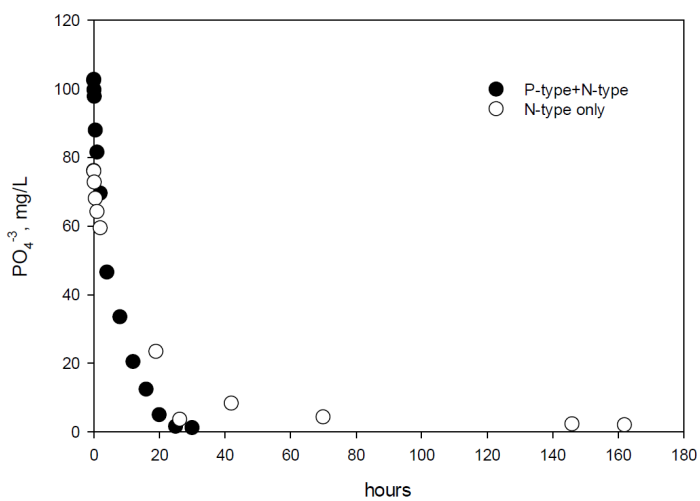

Figure 2 Temporal trend on phosphate removal in the clos- loop column system using two types of the studied materials

<u>Researcher Profile:</u> Dr. Chin-Min ("Jason") Cheng earned both his PhD and MSc in Civil Engineering, with a specialization in Environmental Engineering and Water Resources, from The Ohio State University. He is a registered professional engineer in the state of Ohio. His research interest include Applying principals of geochemistry in exploring beneficial use of industrial wastes and assessing the associated environmental responses and Membrane-based wastewater treatment technology.