World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:17, No:08, 2023

Investigating the Application of Composting for Phosphorous Recovery from Alum Precipitated and Ferric Precipitated Sludge

Authors : Saba Vahedi, Qiuyan Yuan

Abstract : A vast majority of small municipalities and First Nations communities in Manitoba operate facultative or aerated lagoons for wastewater treatment, and most of them use Ferric Chloride (FeCl3) or alum (usually in the form of Al2(SO4)3 ·18H2O) as coagulant for phosphorous removal. The insoluble particles that form during the coagulation process result in a massive volume of sludge which is typically left in the lagoons. Therefore, phosphorous, which is a valuable nutrient, is lost in the process. In this project, the complete recovery of phosphorous from the sludge that is produced in the process of phosphorous removal from wastewater lagoons by using a controlled composting process is investigated. Objective The main objective of this project is to compost alum precipitated sludge that is produced in the process of phosphorous removal in wastewater treatment lagoons in Manitoba. The ultimate goal is to have a product that will meet the characteristics of Class A biosolids in Canada. A number of parameters, including the bioavailability of nutrients in the composted sludge and the toxicity of the sludge, will be evaluated Investigating the bioavailability of phosphorous in the final compost product. The compost will be used as a source of P compared to a commercial fertilizer (monoammonium phosphate MAP) Experimental setup Three different batches of composts piles have been run using the Alum sludge and Ferric sludge. The alum phosphate sludge was collected from an innovative phosphorous removal system at the RM of Taché . The collected sludge was sent to ALS laboratory to analyze the C/N ratio, TP, TN, TC, TAl, moisture contents, pH, and metals concentrations. Wood chips as the bulking agent were collected at the RM of Taché landfill The sludge in the three piles were mixed with 3x dry woodchips. The mixture was turned every week manually. The temperature, the moisture content, and pH were monitored twice a week. The temperature of the mixtures was remained above 55 °C for two weeks. Each pile was kept for ten weeks to get mature. The final products have been applied to two different plants to investigate the bioavailability of P in the compost product as well as the toxicity of the product. The two types of plants were selected based on their sensitivity, growth time, and their compatibility with the Manitoba climate, which are Canola, and switchgrass. The pots are weighed and watered every day to replenish moisture lost by evapotranspiration. A control experiment is also conducted by using topsoil soil and chemical fertilizers (MAP). The experiment will be carried out in a growth room maintained at a day/night temperature regime of 25/15°C, a relative humidity of 60%, and a corresponding photoperiod of 16 h. A total of three cropping (seeding to harvest) cycles need be completed, with each cycle at 50 d in duration. Harvested biomass must be weighed and oven-dried for 72 h at 60°C. The first cycle of growth Canola and Switchgrasses in the alum sludge compost, harvested at the day 50, oven dried, chopped into bits and fine ground in a mill grinder (< 0.2mm), and digested using the wet oxidation method in which plant tissue samples were digested with H2SO4 (99.7%) and H2O2 (30%) in an acid block digester. The digested plant samples need to be analyzed to measure the amount of total phosphorus.

Keywords : wastewater treatment, phosphorus removal, composting alum sludge, bioavailibility of pohosphorus
Conference Title : ICW 2023 : International Conference on Wastewater
Conference Location : Vancouver, Canada
Conference Dates : August 03-04, 2023