World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:12, No:03, 2018

Acid Soil Amelioration Using Coal Bio-Briquette Ash and Waste Concrete in China

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Abstract : The decrease in agricultural production due to soil deterioration has been an urgent task. Soil acidification is a potentially serious land degradation issue and it will have a major impact on agricultural productivity and sustainable farming systems. In China, acid soil is mainly distributed in the southern part, the decrease in agricultural production and heavy metal contamination are serious problems. In addition, not only environmental and health problems due to the exhaust gas such as mainly sulfur dioxide (SO_2) but also the generation of a huge amount of construction and demolition wastes with the accelerating urbanization has emerged as a social problem in China. Therefore, the need for the recycling and reuse of both desulfurization waste and waste concrete is very urgent and necessary. So we have investigated the effectiveness as acid soil amendments of both coal bio-briquette ash and waste concrete. In this paper, acid soil (AS1) in Nanjing (pH=6.0, EC=1.6dSm-1) and acid soil (AS2) in Guangzhou (pH=4.1, EC=0.2dSm-1) were investigated in soil amelioration test. Soil amendments were three coal bio-briquette ashes (BBA1, BBA2 and BBA3), the waste cement fine powders (CFP) (< 200μm (particle diameter)), waste concrete particles (WCP) (< 4.75mm (< 0.6mm, 0.6-1.0mm, 1.0-2.0mm, 2.0-4.75mm)), and six mixtures with two coal bio-briquette ashes (BBA2 and BBA3), CFP, WCP(< 0.6mm) and WCP(2.0-4.75mm). In acid soil amelioration test, the three BBAs, CFP and various WCPs based on exchangeable calcium concentration were added to two acid soils. The application rates were from 0 wt% to 3.5 wt% in AS1 test and from 0 wt% to 6.0 wt% in AS2 test, respectively. Soil chemical properties (pH, EC, exchangeable and soluble ions (Na, Ca, Mg, K)) before and after mixing with soil amendments were measured. In addition, Al toxicity and the balance of salts (CaO, K_2O, MgO) in soil after amelioration was evaluated. The order of pH and exchangeable Ca concentration that is effective for acid soil amelioration was WCP(0.6mm) > CFP > WCP(2.0-4.25mm) > BB1 > BB2 > BB3. In all AS 1 and AS 2 amelioration tests using three BBAs, the pH and EC increased slightly with the increase of application rate and reached to the appropriate value range of both pH and EC in BBA1 only. Because BBA1 was higher value in pH and exchangeable Ca. After that, soil pH and EC with the increase in the application rate of BBA2, BBA3 and by using CFP, WC(< 0.6mm), WC(2.0-4.75mm) as soil amendment reached to each appropriate value range, respectively. In addition, the mixture amendments with BBA2, BBA3 CFP, WC(< 0.6mm), and WC(2.0-4.75mm) could ameliorate at a smaller amount of application rate in case of BBA only. And the exchangeable Al concentration decreased drastically with the increase in pH due to soil amelioration and was under the standard value. Lastly, the heavy metal (Cd, As, Se, Ni, Cr, Pb, Mo, B, Cu, Zn) contents in new soil amendments were under control standard values for agricultural use in China. Thus we could propose a new acid soil amelioration method using coal bio-briquette ash and waste concrete in China.

Keywords : acid soil, coal bio-briquette ash, soil amelioration, waste concrete
Conference Title : ICASM 2018 : International Conference on Agricultural Soil Management
Conference Location : Madrid, Spain
Conference Dates : March 26-27, 2018