Anaerobic Co-Digestion of Cow Manure with Food Waste Using Bio- Based Activated Carbon Modified Bentonite as Accelerant

Wajid Azam[1,2*], Ayaz Mehmood[1], Shah Rukh[2], Mazhar Hussain[1], Mohsin Tariq[1], and Kouser Majeed Malik[3]

[1]*Department of Soil and Climate Sciences, University of Haripur, Pakistan*

[2]*National Centre of Excellence in Geology, University of Peshawar, Pakistan*

[3]*Soil and Water Testing Laboratory for Research, Rawalpindi 46300, Pakistan*

[*]*Email: wajidazam994@gmail.com*

In this study, cow manure was co-digested with food waste through the process of anaerobic digestion using clay mineral bentonite and bio-based activated carbon as an accelerant. Bio-based activated carbon and bentonite may enhance anaerobic digestion through Direct Interspecies Electron Transfer (DIET) both contain metal oxides, for example, iron oxides. The objectives of the study were to check the sole as well as the combined effect of bentonite and bio-based activated carbon on biogas yield and digestate nutrients (NPK) contents. Anaerobic co-digestion of cow manure and food waste with a ratio of 3:1 with 30% inoculum (Intestinal fluids) was used in each digester. Different treatments were made using various concentrations of bentonite (2, 2.5, 3.0 g L^{-1}) and bio- based activated carbon (0.25, 0.5, 1.0 g L^{-1}) and combined bentonite and bio-based activated carbon (1+ 0.125, 1.25+ 0.25, 1.5+ 0.5 g L^{-1}). Biogas yield, volatile solids (VS), total solids (TS) reduction rate, and nutrient (NPK) contents of the digestate were measured. Treatment with 1 g L^{-1} bio-based activated carbon produced the highest cumulative biogas yield (417 mL g^{-1} VS) and treatment with 3g L^{-1} bentonite produced (409 mL g^{-1} VS) both had the highest amount of gas produced which are statistically similar in comparison to the control or reference group (240.11 mL g^{-1} VS). The treatment having bio-based activated carbon 1 g L^{-1} achieved the highest TS and VS reduction rates of 36.9 ± 0.54% and 38.4 ±0.29 %. The maximum COD removal rate was observed from the treatment containing bio-based activated carbon (1.0 g L^{-1}) i.e. (41 ± 0.31%) followed by (40.2 ± 0.29%) from the digester which contains the bentonite

concentration of 3 g L^{-1}. Nutrient (NPK) content was measured, the digestate containing 1 g L^{-1} bio- based activated carbon yielded the highest overall nutritional content of 5.73% followed by bentonite at 3.0 g L^{-1} at a percentage of 5.65% and the control group at 4.56%. It is concluded from the study that bentonite 3.0 g L^{-1} and bio-based activated carbon 1.0 g L^{-1} enhance biodegradation of organic waste through an anaerobic digestion process and digestate can be used as organic fertilizer.