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Transforming Waste into Wealth: Development of a Feedstock-Specific Auto-Thermal Pyrolyzer for Carbonizing Compost Residues in Sri Lanka

MSK Ranaweera[1#], EANK Edirisinghe[2], M Narayana[3], BCL Athapattu[4], DGC Wickramasinghe[3], and M Vithanage[1]

[1]Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka
[2]National Engineering Research and Development Centre of Sri Lanka, IDB Industrial Estate, Sri Lanka
[3]Faculty of Engineering, University of Moratuwa, Sri Lanka
[4]Faculty of Engineering Technology, The Open University of Sri Lanka, Sri Lanka

[#]sashikamran@gmail.com

In developing countries, improper disposal of Municipal Solid Waste (MSW) often results in open dumps, with composting only partially managing biowaste. MSW composting yields 50% as residue and hence returns to the dumpsites. This study aimed at designing and developing a gasifier combustor and a pyrolysis reactor to pyrolyze the compost residue. The gasifier combustor provides heat for the pyrolysis process and converts feedstock to biochar through indirect heating. Coconut shell (CS), coconut husk (CH), wood (WD), and a mixture of residue (MR) were used as feedstocks pyrolyzed at temperatures ranging from 500-600°C for 1.5-2 hours and characterized biochar using proximate and ultimate analyses. The results showed that the biochar had volatile content ranging from 33.18 to 47.19%, with moisture contents ranging from 3.29 to 9.43%. The ash content varied from 14.25 to 25.17%, indicating less impurities. The fixed carbon contents ranged from 27.98 to 41.39% while biochar from MR showed the highest value, indicating superior carbon sequestration and biochar stability. Meanwhile, carbonization of CS, WD, and MR yielded 32.91, 27.18, and 28.95% respectively, while CH had the highest yield of 48.52%. These results demonstrated that biochar from compost residue has the potential to enhance compost quality and treat leachate from composting facilities. Further, the carbonization process would benefit municipalities by converting compost residue into a value-added product for various environmental applications.

Keywords: *compost residue, carbonization, biochar*