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Optimization Of Biogas Production Using Co-digestion Feedstocks Via Anaerobic Technologhy

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Abstract : The demand, high costs and health implications of using energy derived from hydrocarbon compound have necessitated the continuous search for alternative source of energy. The World energy market is facing some challenges viz: depletion of fossil fuel reserves, population explosion, lack of energy security, economic and urbanization growth and also, in Nigeria some rural areas still depend largely on wood, charcoal, kerosene, petrol among others, as the sources of their energy. To overcome these short falls in energy supply and demand, as well as taking into consideration the risks from global climate change due to effect of greenhouse gas emissions and other pollutants from fossil fuels' combustion, brought a lot of attention on efficiently harnessing the renewable energy sources. A very promising among the renewable energy resources for a clean energy technology for power production, vehicle and domestic usage is biogas. Therefore, optimization of biogas yield and quality is imperative. Hence, this study investigated yield and quality of biogas using low cost bio-digester and combination of various feed stocks referred to as co-digestion. Batch/Discontinuous Bio-digester type was used because it was cheap, easy, plausible and appropriate for different substrates used to get the desired results. Three substrates were used; cow dung, chicken droppings and lemon grass digested in five separate 21 litre digesters, A, B, C, D, and E and the gas collection system was designed using locally available materials. For single digestion we had; cow dung, chicken droppings, lemon grass, in Bio-digesters A, B, and C respectively, the co-digested three substrates in different mixed ratio 7:1:2 in digester D and E in ratio 5:3:2. The respective feed-stocks materials were collected locally, digested and analyzed in accordance with standard procedures. They were pre-fermented for a period of 10 days before being introduced into the digesters. They were digested for a retention period of 28 days, the physiochemical parameters namely; pressure, temperature, pH, volume of the gas collector system and volume of biogas produced were all closely monitored and recorded daily. The values of pH and temperature ranged 6.0 - 8.0, and 220C- 350C respectively. For the single substrate, bio-digester A(Cow dung only) produced biogas of total volume 0.1607m3(average volume of 0.0054m3 daily),while B (Chicken droppings) produced 0.1722m3 (average of 0.0057m3 daily) and C (lemon grass) produced 0.1035m3 (average of 0.0035m3 daily). For the co-digested substrates in bio-digester D the total biogas produced was 0.2007m³ (average volume of 0.0067m³ daily) and bio-digester E produced 0.1991m³ (average volume of 0.0066m³ daily) It's obvious from the results, that combining different substrates gave higher yields than when a singular feed stock was used and also mixing ratio played some roles in the yield improvement. Bio-digesters D and E contained the same substrates but mixed with different ratios, but higher yield was noticed in D with mixing ratio of 7:1:2 than in E with ratio 5:3:2.Therefore, co-digestion of substrates and mixing proportions are important factors for biogas production optimization.

Keywords : anaerobic, batch, biogas, biodigester, digestion, fermentation, optimization
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