

Innovative Approaches to Accelerated Organic Solid Waste Decomposition: Evaluating the Co-substrate Potential of Sludge, Manure, and Leachate

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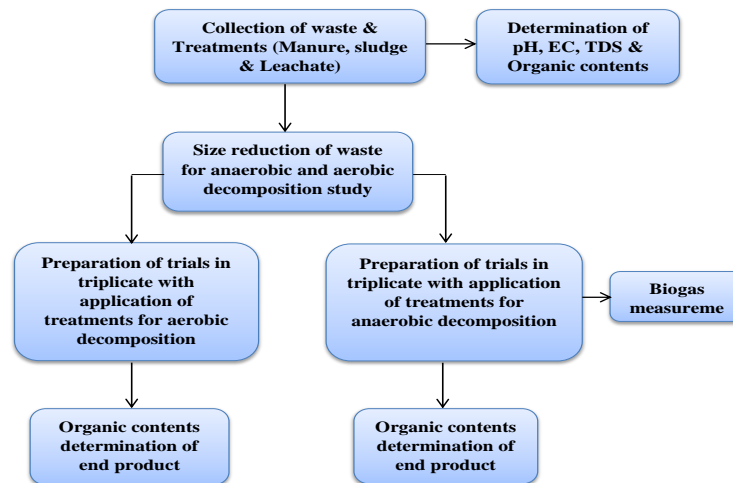
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Introduction:

Presently, the dumping sites in Pakistan do not comply with environmental norms, lacking both biogas facilities and proper leachate collection systems for treatment. In a conventional landfill setting, the biodegradation of organic waste produces landfill gas (LFG), typically consisting of approximately 45–50% carbon dioxide, 50–55% methane, and less than one percent non-methanic compounds (Ozkya et al., 2004). Given that a significant portion of municipal solid waste (MSW) comprises organic content (Hartmann & Ahring, 2006), the anaerobic and aerobic decomposition of MSW leads to the emission of greenhouse gases (GHGs) such as CO₂, CH₄, and NO₂ (Bonger et al., 2011).

Keeping in view the escalating worldwide issue of organic solid waste accumulation, which provokes pressing environmental and public health challenges, this study ventures into the potency of treatments involving leachate, sludge, and manure. Additionally, it investigates their combined impacts on fostering waste decomposition at landfills. Innovative strategies are imperative for sustainable waste management practices, especially as the volume of organic waste generated surpasses the capacities of landfills worldwide.

Methodology:



Results and Discussion:

The results of measurement of gas evolution from anaerobic reactors showed that the highest amounts of the gases were produced from the reactors TL while TB (blank) showed the least. TL produced the highest amount of gas 899 ml followed by TS (535 ml), TMX (432 ml) and TM (197 ml). TL, TS, TMX & TM produced the highest amount of the gas during 2nd week of the anaerobic decomposition. After 2nd week, the gas production

was gradually decreased up to the 70th day. The gases production from TB (trial without addition of any treatment) was increased very slowly and reached to its maximum value 128 ml, during 9th week of the anaerobic decomposition. This showed that reactors containing organic wastes along with addition of various treatments produced higher amount of gases as compared to bank reactor, which confer that reactors with addition of treatments have higher rate of decomposition as compared to the blank.

Leachate was found as the most effective treatment for the production of biogas from the waste. The application of leachate caused highest production of gas 63.25% followed by sludge 47.79%, mixed form 45.36% and manure 9.8%. The organic contents determination of the end products of both aerobic and anaerobic trials confirmed that trial (TL) with addition of leachate caused the highest waste decomposition as compared to other trials. Trial TL showed the highest decomposition of waste 65.53% & 47.76% through aerobic and anaerobic decomposition respectively. Followed by leachate treatment, TS (sludge application) 53.63% & 28.66%, TMX (application with mixed treatment) 45.09% & 24.67% and TM (manure application) 30.50% & 14.44% showed the waste decomposition through aerobic and anaerobic way respectively. Blank TB (without application of any treatment) showed the least waste decomposition through both aerobic (22.11%) and anaerobic (7.77%) way.

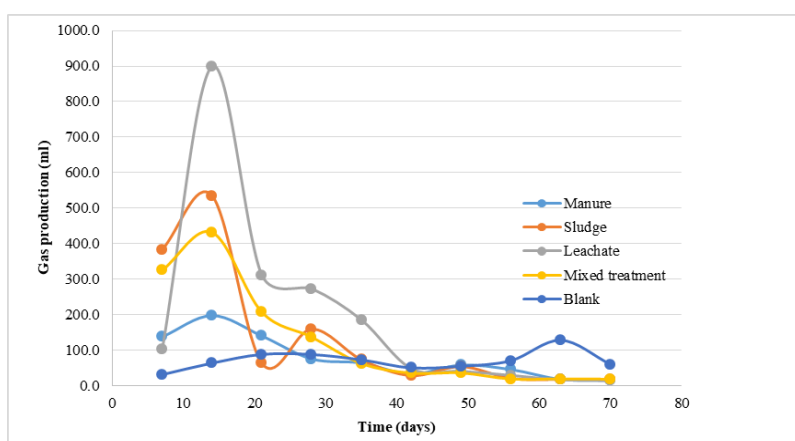


Figure 1: Biogas Production from Organic Solid Waste Using Various Treatment Methods

Conclusions:

The results showed that reactors containing organic wastes along with addition of various treatments produced higher amount of gases as compared to bank reactor. The comparison of the results of both aerobic and anaerobic trials showed that aerobic decomposition resulted in more decomposition of waste as compared to anaerobic decomposition which indicated that aerobic treatment appears to be the most effective option for removal of organic matter. So the application of the leachate, sludge, manure & mixed form of all of the three treatments with municipal solid waste could be an effective way for the more production of biogas through anaerobic decomposition and fast decomposition of the waste through aerobic way.

References:

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