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Study Surface Emission Quantification of Trace Gasses (CH_4, NH_3, H_2S, And VOC) in a Specific Blend of Compost and Soil

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Abstract

This study was to determine how methane (CH_4), ammonia (NH_3), hydrogen sulphide (H_2S), and volatile organic compounds (VOCs) from particular compost and soil mixtures changed over time and under varied environmental conditions. The research objective was to analyse the surface emission of trace gasses from particular compost and soil mixtures to study the gas formation process and variations over time. The experimental design has involved collecting soil (red-yellow podzolic soil from A horizon) and compost samples (municipal solid waste compost), conducting initial analyses, and preparing different compost-soil mixtures. Selected mixtures, such as compost 40:soil 60(C4S6), compost 50:soil 50(C5S5), and compost 60:soil 40(C6S4), were prepared in large polythene pots, alongside control experiments using only soil and only compost, to assess and compare their effects. Closed chamber flux with gas sensors was used to investigate trace gasses. Gas flux measurements were based on determining the gas concentration inside the chamber placed on the surface (chamber volume=0.0018 m^3, chamber surface area=0.0123 m^2). Material temperature was measured, and atmospheric conditions (temperature, wind speed, humidity, atmospheric pressure) were diligently noted during each gas data collection. Infrared spectroscopy study of the material has revealed the presence of particular functional groups relevant to gas formation in the system (O-H, N-O, C-O, and N-H). Compost samples have the highest conductivity (1.5 µS/cm). The research revealed a correlation between compost maturity and methane emissions, with a decrease in methane levels as compost with time (mean 10.7 ppm). Strong positive correlations of CH_4 emission concerning time were found between specific compost and soil mixtures, such as C4S6, C5S5, and C6S4 (R=0.94, 0.99, and 0.99, respectively). In contrast, NH_3 emissions showed a lower positive association with raw soil and C4S6 (R=0.16 and 0.25, respectively), while H_2S emissions exhibited weak to moderate correlations with different variables. Compost and all compost-soil mixtures exhibit relatively high VOC emissions (R from 0.50 to 0.60). The PCA analysis investigated the effect of different atmospheric conditions and gas emissions (temperature, wind speed, humidity, pressure, and soil temperature). Soil temperature exhibits a moderate positive correlation with CH_4, while NH_3, H_2S, VOCs, and atmospheric temperature demonstrate a weak negative association with methane levels, providing valuable insights into the intricate dynamics of these interactions.

Keywords: Pot experiment, Time series, Correlation, Environment