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Volatile organic compound emissions from green waste composting: Characterization and ozone formation

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Abstract

Composting of green waste separated from the disposed solid waste stream reduces biodegradable inputs into landfills, and contributes valuable soil amendments to agriculture. Agencies in regions with severe air quality challenges, such as California's San Joaquin Valley (SJV), have raised concerns about gases emitted during the composting process, which are suspected to contribute to persistent high levels of ground-level ozone formation. The goal of the current study is to thoroughly characterize volatile organic compound (VOC) emissions from green waste compost piles of different ages (fresh tipped piles, 3–6 day old windrows, and 2–3 week old windrows). Multiple sampling and analytical approaches were applied to ensure the detection of most gaseous organic components emitted. More than 100 VOCs were detected and quantified in this study, including aliphatic alkanes, alkenes, aromatic hydrocarbons, biogenic organics, aldehydes, ketones, alcohols, furans, acids, esters, ether, halogenated hydrocarbons and dimethyl disulfide (DMDS). Alcohols were found to be the dominating VOC in the emissions from a compost pile regardless of age, with fluxes ranging from 2.6 to 13.0 mg m^{-2} min^{-1} with the highest emissions coming from the younger composting windrows (3–6 days). Average VOC emissions other than alcohols were determined to be 2.3 mg m^{-2} min^{-1} from younger windows, which was roughly two times higher than either the fresh tipping pile (1.2 mg m^{-2} min^{-1}) or the older windrows (1.4 mg m^{-2} min^{-1}). It was also observed that the older windrows emit a slightly larger proportion of more reactive compounds. Approximately 90% of the total VOCs were found to have maximum incremental reactivity of less than 2. Net ozone formation potential of the emissions was also assessed.

Highlights

▸ Characterization of VOC emissions from green waste compost of different ages. ▸ Emissions are dominated by small alcohols ranging from 66–85% of the total. ▸ Young windrows (3–6 days) had the highest flux, but less reactivity to form ozone. ▸ Older compost windrows (2–3 weeks) exhibited lower fluxes, but more reactivity. ▸ Field ozone assays and model calculations confirm low ozone formation potential.

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Keywords

Green waste; Compost; VOC; Organic matter; Chemical emissions

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