Effects of RootPipes on Landfill Gas Emissions

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With climate change's increasing impacts, we must reduce anthropogenic greenhouse gas emissions, specifically methane, to lower the intensity of cascading disasters. In 2019, landfills contributed to 15% of the total methane emissions in the US. In landfills, the absence of oxygen causes the anaerobic decomposition of waste, leading to a significant formation of methane. Inefficient extraction systems in current landfills cause 46% of this methane to release into the atmosphere. To create a more sustainable landfill system, RootPipes were developed: they take inspiration from the shape of mangrove roots and reach remote locations of the landfill to optimize gas collection. A 3D-printed prototype of RootPipes was designed and tested by simulating two landfill environments—RootPipe and current landfills. Compostable waste was added into both landfills, which were sealed to promote anaerobic decomposition; the gasses formed were able to exit the compost area through the pipes into a designated empty area. After 5 months of data collection, the pressure of the gasses accumulated was greater for RootPipes than current landfills, indicating that RootPipes could transfer more gasses to the empty area. The temperature of the current landfill was higher, so more methane was trapped in the compost. Overall, RootPipes collected 78% more gasses than the current landfill system. This translates to 91% collection and 9% emissions when scaled to large-scale landfills. Due to thorough extraction, more gasses can be converted to renewable energy, gathering more revenue and removing reliability from fossil fuels.

Awards Won:

Second Award of $2,000