A Novel, Fast, Low-Cost Approach to Achieve Near 100% LDPE Degradation: Bioremedial Landfill Implementation

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Low-Density Polyethylene (LDPE) is a widely-used plastic with an annual production of 64 Million metric tons. It takes 500 years to degrade. Naturally-degrading LDPE emits methane and ethylene and contributes the most to climate change of all plastics. Current methods for end-of-life-LDPE are unsafe or ineffective- less than 5.7% is recycled. The goal of this project is to achieve maximum LDPE degradation without producing toxins, in a rapid timeframe, and for viable landfill implementation. This project was divided into two phases: achieving near-100% LDPE degradation and streamlining for landfill viability. Phanerochaete chrysosporium (PC), a common, aerobic fungus, was used to safely biodegrade LDPE. LDPE was made susceptible to degradation with pretreatments of baking and etching. Leachate, a landfill wastewater, promoted fungal growth. It was hypothesized that the combination of pretreatment methods and PC would maximize degradation. In Phase 1, surface area reduction and byproduct gas production were measured. In the presence of PC, baking, etching, and leachate, 99.5 to 99.9% LDPE surface area reduction was observed in 6 days for 80 trials. Leachate remediation was observed through ESI-MS and indicator tests. CO_2 was observed as the byproduct. In Phase 2, the approach developed in Phase 1 was streamlined for landfill implementation. Under simulated landfill conditions, LDPE surface area was reduced by 99.3% with PC, baking, etching, and leachate over 30 trials. This project developed a novel method to achieve near-100% LDPE degradation in a simulated landfill environment in 6 days by combining bioremediation and pretreatment methods.

Awards Won:

Second Award of $1,500