



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Shloka Janapaty	Project Number S1110
Project Title A Novel, Fast, Low-Cost Approach to Achieve Near 100% LDPE Degradation: Bioremedial Landfill Implementation	
<p style="text-align: center;">Abstract</p> <p>Objectives Low-Density Polyethylene (LDPE) is a common plastic that takes 500 years to degrade. Current methods to remove LDPE are unsafe or ineffective, and less than 5.7% is recycled. The goal of this project is to achieve maximum LDPE degradation without producing toxins, in a rapid timeframe, for viable landfill implementation.</p> <p>Methods Research was divided into two phases: achieving near-100% degradation and streamlining for landfill viability.</p> <p>Phanerochaete chrysosporium (PC), an aerobic lignin-degrading fungus, was the biodegradation agent. Landfill leachate, a wastewater, provided a C/N rich source to enhance PC s degradation potential.</p> <p>In Phase 1, the effect of four pretreatments (baking, etching, presence of leachate, and inoculation with PC) on degradation of 3 mg LDPE was tested. The control was LDPE alone. It was hypothesized that if LDPE is baked, etched, exposed to leachate, and inoculated with PC, maximum degradation would occur. Degradation was measured through surface area reduction and byproduct gas production using a self-designed pneumatic trough. Leachate remediation was shown using NH₃-N, NO₃⁻, and NO₂⁻ tests and ESI-MS (Electrospray-ionization).</p> <p>In Phase 2, the most successful group from Phase 1 (Group 8) was adapted for landfill viability. The effect of baking, etching, and inoculation with PC on the degradation of 30 mg of LDPE in a simulated landfill environment was tested. The control was LDPE alone. Surface area reduction was measured.</p> <p>Results In Phase 1, the experimental group in which LDPE was baked, etched, exposed to leachate, and inoculated with PC (Group 8) showed 99.5-99.9% reduction over 6 days for 80 samples. One-way-ANOVA showed $p < 0.001$. Microscopy correlated with this finding. Byproduct production for all groups was in accordance with Ideal Gas Law calculations.</p> <p>ESI-MS data demonstrated that NH₃-N levels decreased by 69% and salt content reduced over 12 days. Tests of PC-treated leachate showed conversion of ammonia to nitrates over 12 days.</p>	
Summary Statement This project develops a novel method to achieve near-100% LDPE degradation in a simulated landfill environment in 6 days using a combination of LDPE pretreatment methods and Phanerochaete chrysosporium bioremediation.	
Help Received I designed and conducted all experiments myself at school. I received technical guidance from Dr. Tracy Hughes (Presentation High School) and Dr. Katherine Walker.	