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Potential of Compost-Derived Actinomycetes for Low-Density Polyethylene Degradation

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The growing concern over the long-term persistence of plastic waste has driven research into biological methods of breaking down polymers. This study investigated a process that combines physicochemical pretreatment and biodegradation of low-density polyethylene (LDPE) using bacterial strains isolated from commercial compost. Four bacterial strains were genetically identified and classified as Actinomycetes. Exposure of LDPE to these selected strains resulted in a measurable reduction in polymer sample weight, accompanied by alterations in surface hydrophobicity. Furthermore, the chemical modifications at the films' surfaces were confirmed by the spectra obtained by Fourier transform infrared spectroscopy (FTIR). The microbial colonisation of plastic surfaces plays a key role in the overall biodegradation process. The formation of a biofilm and the subsequent morphological changes on the LDPE surface were revealed by scanning electron microscopy (SEM). The modification of the polyethylene surface by nitric acid treatment was found to be a promising strategy for enhancing the LDPE degradation. The acid-treated films exhibited the greatest weight loss, the greatest increase in carbonyl index values, and the greatest change in hydrophobicity following microbial exposure. Moreover, it was found that biodegradation under these conditions resulted in the lowest levels of phytotoxic byproducts. The transformation of polyethylene surface properties—from hydrophobic to hydrophilic—combined with the presence of oxidized functional groups made it easier for microorganisms to degrade LDPE.

Metryczka

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