Institute of Chemical Engineering

Plastic biodegradation by bacterial strains isolated from areas surrounding petrochemical plants

Publication date:	28.12.2023
Publication title:	Plastic biodegradation by bacterial strains isolated from areas surrounding petrochemical plants
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Journal information:	Prace Naukowe Instytutu Inżynierii Chemicznej Polskiej Akademii Nauk
Tags:	biodegradation, plastics, microorganisms

Summary: Nowadays, plastics are widely used in all aspects of life. This is related to their physicochemical properties, high strength, durability, and low production costs. An alternative to conventional plastic waste management methods is environmentally friendly biodegradation. The importance of microorganisms in the biodegradation of plastics cannot be overstated. Bacteria, the most common organisms on Earth, are capable of surviving in various, even extreme, natural conditions. Hydrocarbon degrading bacteria are believed to be an important factor in the formation of biofilm on the surface of petroleum-based polymers. The degradation of plastics occurs due to the metabolism of these bacteria, which can utilize hydrophobic hydrocarbons as a source of carbon and energy. Bacteria capable of breaking down aromatic hydrocarbons, such as benzene and styrene, have been isolated from soil samples taken near industrial plants. For further research, we selected strains OR13, OR23.1, and OR23.2, which exhibited the
fastest styrene decomposition and the most intense biomass growth. The isolated strains showed morphological and biochemical diversity.
The biodegradation of LDPE by strains OR13, OR23.1, and OR23.2 was assessed by measuring changes in film mass after incubation in bacterial cultures. The OR23.1 strain exhibited the highest biodegradation efficiency of LDPE at 1.49%. The biodegradation of LDPE by strains OR13, OR23.1, and OR23.2 was assessed by measuring changes in film mass after incubation in bacterial cultures. The OR23.1

strain exhibited the highest biodegradation efficiency of LDPE at 1.49%. The polyethylene films for strains OR13 and OR23.2 exhibited 1.29%, and 1.11% degradation efficiencies, respectively. The control sample did not experience a decrease in biomass. It has been established that the products of polyethylene biodegradation are safe for wheat, as their toxicity level did not exceed 20% for the tested strains. The experiments demonstrated that the tested strains affect the hydrophobicity of LDPE, increasing its sensitivity to biodegradation. The OR13 strain had the greatest impact, resulting in the largest decrease in contact angle when interacting with the polyethylene foil. Fourier-transform infrared spectroscopy (FTIR) showed changes in peak size and functional groups, confirming the modification of the polymer surface after biological treatment. The strains OR13, OR23.1, and OR23.2 were found to increase the carbonyl index of the biodegraded film. This is probably due to the biological activity of the microorganisms, which leads to the formation of new ketone or aldehyde C=O groups and indicates a higher degree of polymer oxidation.

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Zeszyt 27 (2023) pdf, 3.31 MB

Published by:	Artur Wojdyła
Published at:	18.09.2025 09:07
Number of downloads:	119

Tagi: biodegradation, plastics, microorganisms

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Published by:	Artur Wojdyła
Published at:	18.09.2025 11:29
Last edited by:	Artur Wojdyła
Last edited at:	18.09.2025 11:57
Number of views:	112