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The mechanism of biodegradation of polyethylene

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Abstract

LDPE films have been exposed to abiotic and biotic environments. The films were UV irradiated for periods of 0, 7, 14, 26 and 42 days before being mixed with water and soil.

Degraded LDPE films were examined by infra-red spectroscopy. The carbonyl peak increased with time in the abiotic environment and the oxidative degradation reported in our earlier works was confirmed.

In the presence of a biotic atmosphere, however, this peak decreased. At the same time there was an increase in double bonds which was related to weight loss. An explanation of this behavior is presented as a proposed mechanism for the biodegradation of polyethylene.

This mechanism is compared, on the one hand, with abiotic photooxidation, Norrish type I and II degradation, and, on the other, with the biotic paraffin degradation. Abiotic, as well as biotic, ester formation mechanisms are also presented

as well as biotic, esterification mechanisms are also presented.

An ESR spectrum confirms the presence of radicals on the polyethylene samples.

At the beginning of the degradation the main agents seem to be UV light and/or oxidizing agents. When carbonyl groups have been produced, these are attacked by microorganisms which degrade the shorter segments of polyethylene chains and form carbon dioxide and water as end products.

There is a synergistic effect between photooxidative degradation and biodegradation. The biodegradation of polyethylene can be compared with the biodegradation of paraffin.



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