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INSTITUTE OF MICROBIOLOGY AND BIOTECHNOLOGY AND „D. GHIȚU" INSTITUTE OF ELECTRONIC ENGINEERING AND NANOTECHNOLOGIES, OF TECHNICAL UNIVERSITY OF MOLDOVA

A LOW-DENSITY POLYETHYLENE DESTRUCTION PROCEDURE

Patent application: s2023 0105/2023.12.29

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PURPOSE:

The purpose was to elaborate a procedure of accelerated biodegradation of low-density polyethylene (LDPE) waste from common single-use plastic bags .

SOLUTION:

The LDPE film destruction procedure consists of 3 consecutive stages: (a) LDPE photooxidation by UV radiation (2 hours), (b) LDPE treatment by a nanocomposite containing magnesium ferrite stabilized by polyvinylpyrrolidone ($MgFe_2O_4$/PVP), and (c) LDPE incubation in a mineral medium (pH=6.5) containing K_2HPO_4 (1 g/L), KH_2PO_4 (1 g/L), NH_4NO_3 (1 g/L), $MgSO_4*7H_2O$ (0.2 g/L), $FeCl_3$ (0.05 g/L), $CaCl_3$ (0.02 g/L) and supplemented with hydrolyzed lignin (33 g/L).

ADVANTAGES:

Pretreatment of polyethylene films by UV light and by the $MgFe_2O_4$/PVP nanocomposite substantially stimulates the microbial activity during the incubation of the polymer in the mineral medium with added hydrolyzed lignin and increases the LDPE degradation rate to the level of 18% in 100 days. Through contributing to recycling LDPE and hydrolyzed lignin wastes the invention offers solutions to the related problems of environmental pollution.

RESULTS:

The introduction of LDPE film strips pretreated by UV light and by $MgFe_2O_4$/PVP (fig. 1) into the mineral medium with added lignin caused a substantial increase in microbial activity comparing to the controls with untreated LDPE and without LDPE: the CO_2 efflux measured on different incubation days was statistically higher in most of the cases, and by the end of the incubation the total CO_2 efflux significantly surpassed the controls by 1.3 and 2.0 times respectively (fig. 2). By the end of the incubation the weight loss in the control with untreated LDPE was negligible, while in the variant with the pretreated LDPE it reached 18.0±5.2%.

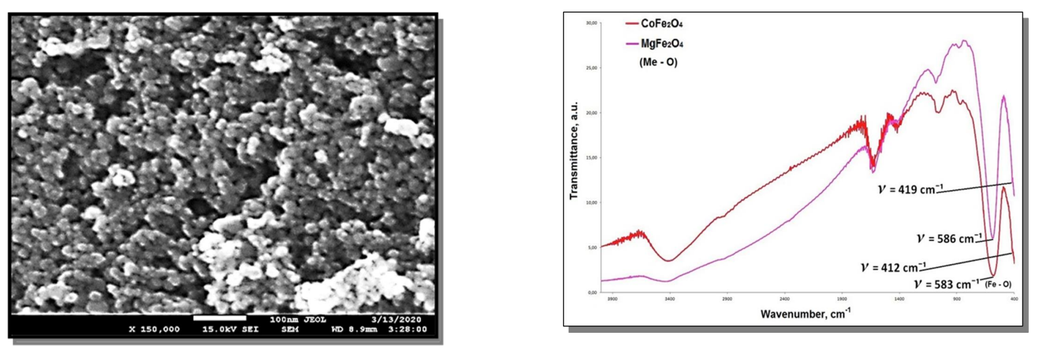
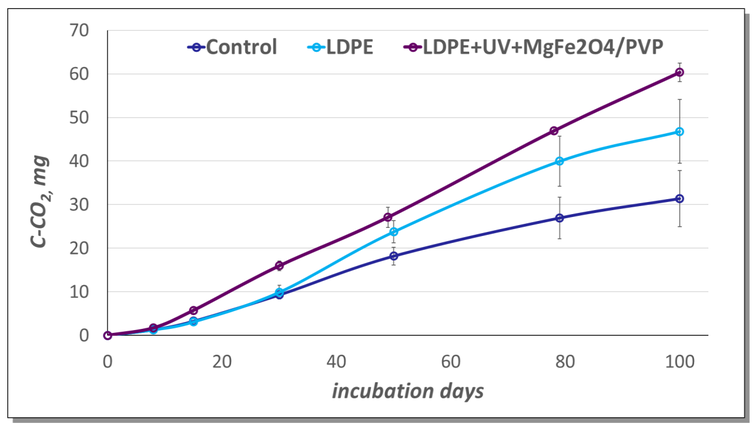


Fig.1. SEM images and FT-IR spectra of the $MgFe_2O_4$/PVP nanocomposite.



The total efflux of CO2 in the variant with pretreated LDPE (LDPE+UV+MgFe2O4/PVP) compared to the controls without LDPE (Control) and with untreated LDPE (LDPE).

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