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An Approach to Study the Biodegradation of Low Density Polyethylene Using Microbial Strains of Bacillus subtilus, Aspergillus niger, Pseudomonas fluroscence in Different Media Form and Salt Condition

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Abstract : The global production rate of plastics has increased enormously and global demand for polyethylene resins –High-density polyethylene (HDPE), Linear low-density polyethylene (LLDPE) and Low-density polyethylene (LDPE) is expected to rise drastically, with very high value. These get accumulated in the environment, posing a potential ecological threat as they are degrading at a very slow rate and remain in the environment indefinitely. The aim of the present study was to investigate the potential of commonly found soil microbes like Bacillus subtilus, Aspergillus niger, Pseudomonas fluroscence for their ability to biodegrade LDPE in the lab on solid and liquid media conditions as well as in presence of 1% salt in the soil. This study was conducted at Indian Institute of Technology, Delhi, India from July to September where average temperature and RH (Relative Humidity) were 33 degrees Celcius and 80% respectively. It revealed that the weight loss of LDPE strip obtained from market of approximately 4x6 cm dimensions is more in liquid broth media than in solid agar media. The percentage weight loss by P. fluroscence, A. niger and B. subtilus observed after 80 days of incubation was 15.52, 9.24 and 8.99% respectively in broth media and 6.93, 2.18 and 4.76 % in agar media. The LDPE strips from same source and on the same were subjected to soil in presence of above microbes with 1% salt (NaCl: obtained from commercial table salt) with temperature and RH 33 degree Celcius and 80%. It was found that the rate of degradation increased in the soil than under lab conditions. The rate of weight loss of LDPE strips under same conditions given in lab was found to be 32.98, 15.01 and17.09 % by P. fluroscence, A. niger and B. subtilus respectively. The breaking strength was found to be 9.65N, 29N and 23.85 N for P. fluroscence, A. niger and B. subtilus respectively. SEM analysis conducted on Zeiss EVO 50 confirmed that surface of LDPE becomes physically weak after biological treatment. There was the increase in the surface roughness indicating Surface erosion of LDPE film. FTIR (Fourier-transform infrared spectroscopy) analysis of the degraded LDPE films showed stretching of aldehyde group at 3334.92 and 3228.84 cm-1,, C–C=C symmetric of aromatic ring at 1639.49 cm-1.There was also C=O stretching of aldehyde group at 1735.93 cm-1. N=O peak bend was also observed which corresponds to 1365.60 cm-1, C–O stretching of ether group at 1217.08 and 1078.21 cm-1.

Keywords : microbial degradation, LDPE, Aspergillus niger, Bacillus subtilus, Peudomonas fluroscence, common salt
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