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Comparing the Fate of Biodegradable Products in Seawater Under Laboratory and Natural Conditions

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Abstract

Biodegradable products drive much attention because of their apparent significant impact on the environment. Their degradability under natural conditions is identified as a solution for waste plastic accumulation. Mismanaged non-degradable wastes from islands are carried to the ocean, and cause irreversible damage to organisms, the environment, and human health. The present study was to compare the degradability of three commercial polymer products with "biodegradable", "oxo-degradable", and/or "compostable" labels on them i.e., Garbage Bag (GB), Lunch Sheet (LS), and Salad Plate (SP) in seawater under laboratory and natural conditions. The laboratory setup contained a glass tank filled with seawater, equipped with a wave pump, and kept near a window for simulating natural environment conditions. The natural setup was submerged in the Dikkovita international fishery harbour. Samples were cut into 1-2 g pieces, cleaned, and air-dried until constant dry weights were reached. Prepared samples were separately packed inside nylon mesh pockets and placed in the water column. Samples in the natural setup were placed inside a net-cage to avoid disturbances from known and unknown sources in a functioning harbour. A filter paper (FP) was used as the control. Samples were placed in triplicates, and monthly sampling was conducted. Degradability was assessed as a percentage of Mean loss of weight (MWL%). Results of initial RAMAN analysis confirmed the presence of polyethylene in GB, polybutylene adipate terephthalate and polylactic acid in LS, and cellulose in SP and FP. According to weight loss results, all three products exhibited significantly higher ($p<0.05$) MWL%s in the natural setup when compared to the laboratory setup. The control was completely degraded in 45 days while the SP and LS took 90 days. However, none of them reached complete degradation even after 12 months of sampling under laboratory conditions. The GB showed significantly higher ($p<0.05$) degradation potential under natural conditions, but MWL%s were less than 2% (0.47-1.50%) by 3 months of sampling. The reason for the higher degradation potential under natural conditions might be due to mechanical degradation caused by continuous, strong wind and wave actions.

Keywords: Oxo-degradable, Polyethylene, Mean weight loss, Natural seawater setup, RAMAN spectroscopy