Environmental Degradation Behaviors of Biodegradable Polymers

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Plastic products are lightweight, durable, and inexpensive had been widely separated as daily-use products, such as packaging films, food containers, disposable utensils and so on. However, the waste plastics also induced environmental problems. Microplastics (MPs), caused by plastic waste, has become a severe problem in marine environments[1-3]. To eliminate MPs in the ocean, the environmental degradation behavior of plastics must be understood[4]. In general, photo-oxidation induced by sunlight and biodegradation by microorganisms dominated the degradation of waste plastics in the environment. The vast majority of polymers manufactured globally are polyolefins. The waste polyolefin products with extremely low biodegradability were degraded to MPs by photo-oxidation and existed for a long period in the environment. Therefore, development of biodegradable polymers, such as poly(butylene succinate) (PBS) and poly(butylene succinate-co-adipate) (PBSA), will is a promising and sustainable way to eliminate MPs problems in environment.

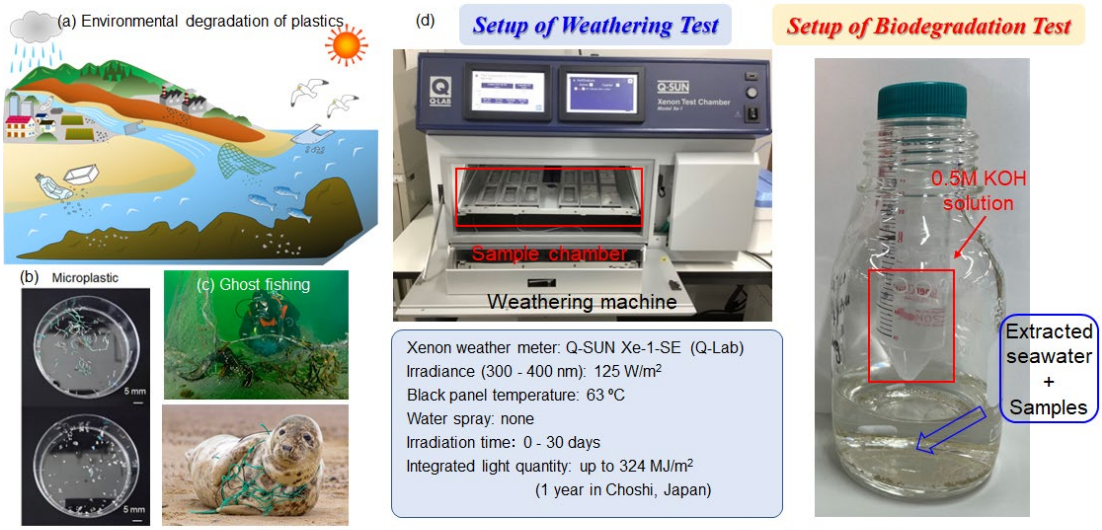

Figure1. (a) Degradation of plastics in environment. (b) Photograph of microplastics. (c) Ghost fishing in ocean. (d) Accelerate weathering test and biodegradation test in laboratory.

In this study, the environmental degradation behaviors of PBS and PBSA films were investigated in a laboratory. An artificial weathering chamber was employed to investigate the photo-oxidative degradation of PBS and PBSA films, whereas the biodegradation experiment was conducted by immersing samples in extracted seawater. After photo-oxidation and biodegradation test, the changes of chemical structure and physical properties of PBS and PBSA films were investigated by FT-IR, SAXS, WAXS, GPC, tensile test, SEM and DSC. The mechanical properties of PBS and PBSA films dropped drastically after UV exposure test, due to the photo-oxidative degradation of amorphous phase. The biodegradability of PBS and PBSA films was promoted by UV exposure.

On the other hand, ghost fishing by lost fishing gears in ocean, which will strongly affect the marine environment, has caused a series of environmental problems[5]. In order to facing this

challenge, it is important to understanding the degradation behaviors of fishing lines in environment. The degradation behaviors of various fishing lines, such as nylon 4, nylon 6, PET and PVDF, were simulated in laboratory. After weathering and biodegradation tests, the changes of surface morphology, thermal properties, as well as mechanical properties were examined. Nylon 4 fishing lines exhibited excellent biodegradability, while PET and PVDF fishing lines cannot be degraded by microorganisms. Nylon 6 fishing lines became biodegradable after UV exposure test. The results suggests that nylon 4 fishing gear will reduce ghost fishing effectively, the use of PVDF fishing gear should be reduced for practical applications. The biodegradation mechanism of nylon 4 will be investigated by comparing biodegradation behaviors of nylon 4, nylon 6, nylon 11 and nylon 12 films.

References:

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