Abstract

[Research Title]

Development of Accelerated Weathering Tests to Explore Fragmentation of Marine Plastic Debris, and Assessment of Actual Behavior in the Environment Considering Influence of Additive Chemicals

Project Period (FY) :	2021-2023
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Keywords :	Marine plastics, Microplastics, Degradation, Fragmentation, Additives

[Abstract]

The degradation and fragmentation of marine plastics are considered significant sources of micro and nanoplastics. However, due to the lack of test methods to simulate degradation and fragmentation in the marine environment, quantitative assessment of degradation rates has been challenging. This study aimed to develop a method for estimating the degradation and fragmentation of plastics in the marine environment through accelerated degradation tests. Furthermore, the study aimed to quantitatively evaluate the effects of stabilizers on the degradation and fragmentation of marine plastics.

In Sub-theme 1, we developed an accelerated degradation test method to determine the degradation and fragmentation rates of marine plastics. We developed accelerated degradation tests, outdoor exposure degradation tests, and fragmentation tests mimicking the physical effects of the marine environment. Eventually, we established a method by organizing the degradation rate and acceleration coefficient by UV intensity.

In Sub-theme 2, using the accelerated degradation tests developed in Sub-theme 1, we demonstrated that degradation and fragmentation rates in plastics containing stabilizers were reduced by approximately 0.45 times for PP and 0.07 times for PE. Applying this to the actual marine plastics containing additives corrected significant errors in estimates.

This is the first study to quantify the formation of micro- and nano-plastics by reproducing the physical effects of waves in a coastal environment, and is expected to make an important contribution to the field. The study is also novel in that it quantitatively clarified the effects of stabilizers and shapes on degradation and miniaturization rates. The methodology developed in this study enables short-term degradation and fragmentation tests, contributing to the development of materials that

are resistant to fragmentation in the ocean. In addition, by quantifying the generation of micro and nanoplastics from marine plastic debris, it can contribute to the development of effective strategies to mitigate their production. Additionally, this research provides foundational insights for evaluating the risks posed to ecosystems.

[References]

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This research was funded by the Environment Research and Technology Development Fund (ERTDF).