

Exploration of Source-Specific Markers for Secondary Microplastics Derived from Polyolefin-Coated Fertilizers

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Abstract:

Polyolefin-coated fertilizers, widely used in Japanese agriculture, were analyzed to identify characteristic additives that could serve as source-specific markers for secondary microplastic originating from them. Four types of polyolefin-based samples were examined, revealing polyethylene as the main polymer component, along with poly(vinyl acetate), starch, and clay minerals as minor components. Thermal desorption gas chromatography–mass spectrometry led to the identification of three plasticizers, three fatty acids, and levoglucosan, a thermal degradation product of starch. Among these compounds, characteristic fatty acids and levoglucosan were found not only in unused commercial products but also in environmental samples and laboratory-degraded materials exposed to heat and ultraviolet radiation. These findings demonstrate their utility as markers of fertilizer-derived microplastics. Based on these findings, a stepwise identification framework was constructed and applied to white secondary microplastics collected from agricultural soil, with the origin of 14 out of 15 microplastic samples being attributed to polyolefin-coated fertilizers. Thus, we present a practical framework for source attribution of microplastics in agroecosystems.

* Excerpted from online journal website (Click the title)

Frontier Labs Products used:

Multi-Shot Pyrolyzer (EGA/PY-3030D), UA-DTM-2.5N, Ultra ALLOY⁺-5, Eco-cup LF