

From persistence to desistance: on the environmental fate of biodegradable polymers

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Most of the conventional plastics are designed to last. If these conventional plastics enter the open environment, they persist and accumulate. The resulting plastic pollution has received significant attention not only by researchers but also by the public and the media. There is consensus that the inadvertent release of plastics to the environment needs to be stopped. However, there are specific applications in which plastics are directly used in the open environment, thereby largely increasing the risk that plastics remains in the environment after use if recollection of the plastics is incomplete. These applications include agricultural plastics, including mulch foils used to cover soils, as well as fishing lines and nets. For these specific applications, it has been suggested to replace conventional ‘persistent’ polymers by biodegradable polymers that are designed to undergo complete microbial degradation to CO₂ (as well as CH₄ under anoxic conditions) and microbial biomass, thereby circumventing accumulation.

This contribution will provide an Environmental Chemist’s perspective on various aspects of biodegradable plastics. Besides defining plastic biodegradability (and specifying which criteria need to be fulfilled by biodegradable plastics), I will address both “dos and don’ts” of assessing polymer biodegradability in the open environment and provide insights into the fundamental steps involved in plastic biodegradation. Soil biodegradable mulch films composed of polyesters—and experimental data on their conversion to carbon dioxide and microbial biomass during soil incubations—will serve as illustrative examples. Understanding polymer biodegradability on a fundamental level is a prerequisite to designing sustainable biodegradable polymers of the future. While biodegradable polymers are not the silver bullet to the global plastic pollution, these materials have a high potential to play important roles in specific plastic applications in the future.