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Editorial corner – a personal view

Are biodegradable polymers the solution to the world's environmental problems?

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For all their useful properties, polymers are fast becoming a serious environmental hazard. Polymers are normally disposed through landfilling, recycling and incineration. Landfill sites, however, become increasingly scarce, especially in the more populated areas of the world. Incineration contributes to air pollution and global warming, while recycling is still not applied in most countries of the world. The most significant problem is the uncontrolled disposal of plastic waste, which gives rise to a huge amount of plastics ending up in the earth's oceans, where they degrade very slowly into micro-plastics that are consumed and converted to toxic persistent organic pollutants by marine fauna.

Many people consider biodegradable polymers as a solution to these problems. These polymers can be petrochemical- or bio-based, but they have in common that they can be degraded by microorganisms to CO_2, water and biomass through a process of biodeterioration, biofragmentation and assimilation. A large number of bacteria and enzymes have been identified that can biodegrade these polymers, but they cannot universally degrade all kinds of biodegradable polymers, and the effectiveness and/or rate of biodegradation depend on polymer properties such as surface conditions, chemical structure, molecular weight, physical properties, and morphology. In many cases the microbial degradation has to be preceded by UV- or hydrolytic degradation, or a specific composting environment has to be created.

What is the implication of all this? Even if the current problems around the not-so-ideal properties of most of the known biodegradable polymers are solved, and if most of the existing non-biodegradable polymers can be replaced by biodegradable polymers, the challenge will still be the creation of commercial composting sites in all the countries of the world. As in recycling, the different biodegradable polymers will have to be separated, and the different kinds of polymers will have to be composted in environments that contain microorganisms that are effective for the biodegradation of the specific polymer(s). Scientists and policy makers are therefore still faced with two major challenges: (i) Invention/design of completely biodegradable polymers/blends/(nano)composites that can replace all the non-biodegradable polymers that are currently in use, and (ii) recovery of all the biodegradable polymers that reached their end-of-use, and dispose them in suitable commercial composting sites for fast and effective biodegradation.

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