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Editorial corner – a personal view
Are polyolefins outdated?

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It seems to become fashionable these days, even among scientists, to denounce conventional polymers as outdated dinosaurs posing an enormous threat to the planet and life on it (https://doi.org/10.3144/expresspolymlett.2019.81). The solution would be a move into bio-based and preferably biodegradable polymers with advanced structures and controlled self-organization, being free of toxic components and not producing dangerous waste.

Fact is, however, that limited progress has been made in performance and production volumes of these 'new polymers' over the last 20 years. Their market share is still in the range of 1% of the global market, for which only a somewhat smaller fraction of the global starch and sugar production are used, and more than half of them is not bio-degradable. Poly(lactic acid) still crystallizes poorly under processing conditions, and nucleation will not help here, as the low crystal growth rate is the real problem (https://doi.org/10.1016/j.progpolymsci.2012.07.005). Neither the thermo-mechanical performance nor the actual biodegradability are convincing (https://doi.org/10.1021/acs.est.5b00277), and already minor amounts can contaminate recycling streams critically.

The balance is hardly better of the two other 'big' bio-degradable polymers, poly-β-hydroxyalkanoates (PHA) and thermoplastic starch (TPS). New ideas are only taking off slowly, often for a lack of resource base: The idea of using a limonene-based monomer for synthesizing a bio-based substitute for the bisphenol-A (BPA) in polycarbonate (https://doi.org/10.1021/acscatal.7b00770) may sound alluring, until one considers the globally available amount of that base material. In 2015, about 13 mio tons of lemons were harvested globally. Essential oil content in citrus peel is about 0.4 wt%, giving 26 000 tons of oil which can be reacted with CO_2 to give maybe 40 000 tons of poly(limonene)dicarbonate, equivalent to ~1% of the global PC market. Even if one adds other citrus fruit, the further uses of limonene, like in the fragrance and detergent industry, must not be neglected and the overall outlook remains dire.

At the same time, the 'conventional' and – for some – 'obsolete' polyolefins are making up more than 50% of the global plastics market, constantly conquering new applications and improving their performance. High voltage DC cable connections with up to 525 kV based on high-purity low density polyethylene (LDPE) necessary for off-shore wind parks or carbon-fibre reinforced polypropylene (PP) with elastic moduli up to 17 GPa in combination with a density of only 1140 kg/m^3 (https://doi.org/10.1016/j.repl.2016.05.002) are only two recent examples. The raw material base for olefin monomers is constantly getting wider, ranging from biological material to recycled polymers. It is quite clear that further efforts in both mechanical and chemical recycling will be required for closing the loop (https://doi.org/10.1016/j.wasman.2017.07.044), and more producers than today should assume responsibility in this area. Furthermore, there is no way to rapidly replace the production capacity for presently 74 mio tons of PP and 94 mio tons of PE by alternative units, without an overall increase in CO_2 emissions, so we better intensify the efforts of polymer science in understanding, improving and recycling them!

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