Abstract

"*The use of plastics that biodegrade in the open environment must be limited to* [...] *specific applications where* [...] *the full removal, collection, and recycling of plastic products is not feasible*" [COM(2022) 682 final], as stated in official EU policy documents, illustrates the delicate balance decision-makers must strike in facilitating the transition to a circular economy. But how can this restriction to niche applications, and thus not advocating for widespread use of biodegradables, be reconciled with the well-recognized problem of (micro)plastic pollution? The answer lies in complexity—or, more scientifically, in *entropy*. Circularity, and recycling in particular, can be understood as entropy management, and the introduction of new plastics into an already intricate market risks disrupting the system as a whole, by increasing its entropy. From a recycler's perspective, biodegradable plastics with a small market share act as impurities, increasing sorting and refining costs and thus impeding circularity. Yet there is no inherent chemical or technological reason why biodegradable plastics should be inferior in terms of recyclability; recyclability is largely a system property. In fact, biodegradable plastics tend to be hydrolysable, allowing for the development of highly targeted recycling techniques. Biodegradability should therefore not preclude recyclability, although the transition may be challenging. Moreover, these plastics are closer in composition (expressed as carbon oxidation state) to living organisms and CO_2, which aligns more closely with the vision of a future bio-economy. With advanced assessment tools, legislative guidance, and strategic planning, biodegradability could become a more universal and valuable feature of plastics, which hopefully curbs the environmental accumulation of plastics.

Biography

Pieter Billen is a chemical engineer, professor at the Department of Biochemical and Chemical Engineering of the University of Antwerp and a member of the CAPTURE Resources platform. His research topics evolved from solving waste problems to managing materials, in line with our societal transition towards a circular (plastics) economy. He currently leads the research group iPRACS, where various advanced computational and engineering methods are integrated to translate chemistry (and catalysis) to process and value chain designs. Important ambitions include the debottlenecking of nascent depolymerization technologies, create radically new processes, and expand the utility of entropy as a metric for decision making.