

Sustainable Polymers: Challenges and Opportunities

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Abstract

Sustainability issues in polymer materials is largely centered around the use of fossil derived feed-stocks as building blocks for synthetic polymers and the issue of persistence of used polymeric material in the ecosphere on account of its durability and non-bio-degradability. Many strategies have been explored for shifting the building blocks of synthetic polymers to more sustainable bio derived feed-stocks. While there has been some success, this area is largely beset with problems of high cost of feed-stocks, low economies of scale and inability to build the kind of diversity in structure and properties that synthetic polymers today are capable of. The issue of persistence of synthetic polymers in the eco-sphere and the growing menace of plastic waste is probably a more relevant and emergent driver of issues related to sustainability of synthetic polymers. Here the demands are more severe since the polymers have to be both bio-derived and bio-degradable and only a few polymers qualify to meet both these requirements.

Unfortunately, the realm of sustainable polymers is at this time passing through a “hype-phase” with inflated expectations. Emerging science in this area is lacking in clarity and purpose and technology is unable to meet the material property envelopes that synthetic polymers have proven to be capable of.

In this lecture, I will question some of the common perceptions about sustainability issues related to polymers and frame the questions afresh so that a more rational and informed approach to R&D in this area can be contemplated. We will examine many current premises, such as, whether bio-derived polymers are green, are environmentally degradable, are inexpensive, that they can co-exist in the ecosphere with fossil fuel derived polymers and will make economic sense, sometime in the future. In the context of burgeoning growth of urban solid wastes, it is pertinent to ask whether bio-derived polymers have the potential to offer a sustainable solution. As the world moves from the concept of “re-cycling” to “up-cycling” in the context of a circular economy, we need to reassess the definition of sustainability as applicable to synthetic polymers