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Editorial corner – a personal view

Ionizing radiation: An effective aid in the recycling of polymer waste

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Most people, when they hear the word 'radiation', immediately think of the nuclear disasters that happened in Chernobyl and Fukushima. However, when used under the right conditions, ionizing radiation has many useful applications, such as the X-ray machine or the gamma knife. It has many utilizations in the industry as well, *e.g.*, in the manufacturing of heat-shrink tubes or polymerization without an initiator, but most importantly, the sterilization of medical equipment. These devices are mostly used once, then discarded, but if properly collected, cleaned, and sterilized, these products would be reusable, which is a high level of the recycling pyramid. This shows the importance of sterilization, which is crucial in the current coronavirus pandemic, as it allows the reuse of masks worn against COVID-19.

One of the major problems of today's consumer society is the generation of a huge amount of waste. Polymers are a large proportion of this; annual plastic production is approximately 370 Mt, which will mainly end up in landfills. In the European Union, just over 30% of the collected polymer waste is recycled; the remaining is deposited in landfills or incinerated (acc. PlasticsEurope). This is disadvantageous for the implementation of a circular economy and for reducing the environmental impact of plastics.

The interactions between radiation and polymers date back a long time. Charlesby published his book (ISBN: 9781483181301) in 1960, summarizing and explaining these phenomena. Due to the high energy of ionizing radiation, molecules can become free radicals, which will initiate various reactions. One possible way is to form crosslinks, within a given phase or between different materials in a mixture (https://doi.org/10.1016/j.radphyschem.2011.11.058). The latter plays a significant role in establishing compatibility in blends (https://doi.org/10.1002/app.35675). The high energy of ionizing radiation can also break the bonds in macromolecules. This is an unfavorable process for thermoplastic polymers, but it has a significant positive effect on crosslinked polymer waste (*e.g.*, rubbers or composite parts), which is of paramount importance, as the recycling of these materials is one of the greatest challenges of polymer science nowadays. These materials cannot be processed by conventional methods due to their covalently linked chains, and the selective scission of these bonds greatly facilities the reclaiming of these materials. The degree of degradation can be varied through controlling the radiation conditions, leading to low molecular weight components, which can be used as feedstock (to synthesize new materials) or additives (https://doi.org/10.1016/S0969-806X(01)00443-1).

Altogether, ionizing radiation is a clean, productive, and long-researched area that holds a great deal of promise for recycling various types of polymer waste. Therefore, the use of radiation should not be 'written off' because of past disasters when it can be used safely. Further research into radiation technologies could bring us closer to solving the problems caused by polymer waste.

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