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Editorial corner – a personal view

Becoming the symbol of recycling instead of consumption – 50 years of PET bottles

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Around 30 years after the discovery of poly(ethylene terephthalate) (PET), in 1973, DuPont designer Nathaniel Wyeth developed the first transparent plastic bottle made from this material, which can withstand the pressure of carbonated liquids (https://doi.org/10.1016/j.wasman.2007.11.003). Over the past 50 years, this product has spread worldwide, with about 30 million tons of PET bottles now being produced yearly (https://doi.org/10.1016/j.resconrec.2020.105014), representing about 7% of total plastic consumption. Presumably, this is why the PET bottle has become a symbol of plastics for ordinary people.

The fact is that plastic packaging can increase sales: for example, in Hungary, where good quality drinking water is available in almost every household, in the 1980s, the average person bought 3 liters of bottled mineral water a year, while today it is 130 liters. This is partly thanks to PET bottles: they are stylish and aesthetic, encourage us to buy, and we feel safer drinking packaged water instead of tap water. However, there are many places in the world where PET bottles are the only means of providing people with good quality drinking water (https://doi.org/10.34172/hpp.2021.09); in these areas, they can mean not only comfort but also survival. Like other packaging, the use of bottles is often justified on functional grounds (shelf life, transportability, *etc*.), but in many cases, they are used purely for marketing purposes. In terms of sustainable development, we should strive not to waste the good qualities of plastics: the low weight of the product, its cost-effectiveness, or its aesthetic optical properties, so not to use them unnecessarily. This is not only the responsibility of manufacturers, who primarily satisfy the demand generated by consumers. It is up to each individual to decide what products or packaging they buy, as their purchases can have a knock-on effect on the development directions of manufacturers. Therefore, it is important that, in addition to institutional education and research, polymer experts should also disseminate up-to-date knowledge on plastics to a wide range of society. This would help to raise people's awareness of their personal responsibility for the management of packaging and to emphasize that plastics are not just packaging materials.

PET bottles that end up in nature because of improper waste management are not only unsightly but could also pose a threat to wildlife when they decompose in the natural environment. It has been shown that inorganic and organic substances associated with PET degradation can promote the adsorption of inorganic compounds onto weathered plastic surfaces, with implications for the transfer of hazardous chemicals to marine life (https://doi.org/10.1038/s41529-023-00377-y). Recognizing this, plastic waste recovery from rivers, seas and oceans has started in recent years (https://doi.org/10.1088/1748-9326/abbb4f).

The large amount of PET bottle waste generated has led some to predict an ecological disaster, even though the solution is relatively simple from a technological point of view, and many countries have already achieved good results in terms of professional

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waste management. Once separated from other materials, PET waste can be recycled by physical-mechanical and chemical methods. However, this requires collection and appropriate sorting. Decision-makers and the public in the countries have a role in building the necessary infrastructure and ensuring its efficient operation. The regulation of plastic waste management is becoming more and more stringent to promote the transition to a circular economy. This has led to legislation such as the European Single-Use Plastics Directive, which aims, among other things, to increase the collection rate and implement closed-loop recycling of PET bottles (https://doi.org/10.1016/j.cogsc.2021.100462).

Recycling initially involved the production of low-value textiles and nonwovens from collected PET waste, but in recent decades, a number of technologies have been developed to purify bottle waste to food-grade quality and compensate for molecular weight loss by solid-state polycondensation (https://doi.org/10.1038/s41586-020-2149-4). In addition to the bottle-to-bottle process, it is now possible to develop technical products from waste with a longer lifetime, for example, by improving mechanical properties or flame resistance (https://doi.org/10.1007/s10973-022-11423-3). Increasingly large capacity plants for chemical recycling of more contaminated waste are being built worldwide, mainly based on methanolysis, ammonolysis and glycolysis. New opportunities for biological recycling through enzymatic degradation of PET are also opening up, and PET has been successfully synthesized from the resulting monomers (https://doi.org/10.1038/s41586-020-2149-4).

The rational use and proper post-consumer management of PET bottles minimize the risk of environmental harm. In 50 years, humankind has learned a lot about the benefits and drawbacks of plastic packaging, and hopefully, after an initial, sometimes irrational consumption, their use will be balanced in more and more countries as the best available recycling technologies become more widespread. The aim in the upcoming decades is to continue along this path so PET bottles will become a symbol of renewal and the recycling of materials rather than a symbol of disposable, worthless things.

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Topic editor