

It's all about plastics

Waste Management & Research
2022, Vol. 40(6) 607–608
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DOI: 10.1177/0734242X221093821
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Few other materials produced by man and used for daily applications raise a heated discussion as does plastic. In recent years, the mainstream is heading towards the condemnation of plastic, which is perceived as absolute evil. This is fuelled by the impressive images of pristine beaches overwhelmed by plastic debris and marine wildlife trapped in plastic bags or nets.

A recent declaration on plastic (<https://www.plasticstreaty.org/scientists-declaration/>) has been promoted by many scientists, building on the United Nations Environment Programme global assessment on plastic pollution. It reads in part that ‘current practices of production, design, use and disposal of plastics have severe negative consequences for ecosystem health, biodiversity, human health including fertility and cancers, climate, sustainable livelihoods, cultural diversity and therefore human rights worldwide’.

On the contrary, the advocates of plastics, as well as the plastic industry itself, emphasise the crucial role of this material in improving the quality of life in many different fields. The last report by Plastics Europe (<https://plasticseurope.org/wp-content/uploads/2021/12/Plastics-the-Facts-2021-web-final.pdf>) reads,

Today, plastics deliver numerous benefits to society. They help feed the world in a safe and sustainable manner; they contribute to more energy efficient buildings and houses; they allow great fuel savings in all transportation means ensuring the transition to a green mobility, and they can even save our lives.

Undoubtedly, plastics are key materials in innovation and in reducing energy demand while reducing green gas (sic) emissions. And as essential materials for society, our sector must ensure that plastics are sustainable and have a positive impact on people and on the planet.

Is there any chance to find a balance between such opposite perspectives? We are literally surrounded by plastics, and it is difficult to imagine what a world without any plastic would look like. Forget your laptop, all electronic appliances, a great portion of your car. But also trains, aeroplanes, medical devices, and so on. Each time that we want to phase out something which is perceived as negative, we must consider what the alternative would be? And we should scientifically assess whether such alternative is actually more sustainable, leaving aside the purely emotional motivations.

It looks like that the anti-plastic crusade is mainly targeting packaging applications, which accounts for about 40% of plastic usage in Europe. Here, more alternatives to plastics are actually available, paving the way to a more competitive playground. This

is mainly fuelled by consumers’ demand, with companies trying to catch-up and gain market share by changing their original packaging to a more ‘plastic free’ one. This is a typical example of a demand-driven strategy. But in the packaging sector, plastic is without doubt the material that can be adapted to the widest range of applications: from rigid containers for liquids, ranging from water to sodas, milk and detergents, to films for containing or wrapping any type of food. Other materials can compete only in few of the abovementioned applications. Nobody today would ever consider having their soap or laundry detergent contained in a glass bottle. On the contrary, glass is welcomed by consumers as a more sustainable alternative when it comes to water bottles, and the glass industry is under high pressure because of the increasing demand, quite difficult to catch up by an industry based on large-size energy-intensive processes.

Like it or not, in the field of packaging materials plastic will prove to be the most sustainable among all, when a life cycle perspective is taken into account. Life Cycle Assessment studies performed by the worldwide scientific community tend to agree that plastics show the least overall environmental impacts in nearly all categories, when compared with glass, aluminium and composites packaging in general. And there are potential further improvements possible when recycled polymers are increasingly used in the production of new plastic items. To this extent, it is worth observing that the Italian government has recently allowed PET bottles to be manufactured with 100% recycled polymers, targeting a true bottle-to-bottle recycling scheme.

What might be surprising is that plastic bottles might outperform glass ones even when the latter are subject to re-use and not to recycling. The reason is very simple and relies in the extreme lightness of plastics: in order to achieve the same function, 20 times more mass of glass is needed than plastic. And needing a larger mass of material is merciless when it comes to its life cycle assessment, since the mass will heavily affect all life cycle stages, including all transports involved.

However, the light weight of plastic also has drawbacks. Very light materials are more likely to disperse in the environment due to their very nature (a gust of wind will very easily drag small pieces of plastic film into the environment) and due to the perception of a lower value. This was very clear during the recent pandemic, with plastic face masks scattered around the environment, not necessarily always due to misbehaviour. This is what contributes to long-term marine litter, but so far it is something that is not addressed by the Life Cycle Assessment methodology, despite some efforts recently underway to try to include it.

The pandemic has also thrown a different light on plastics. Besides the abovementioned concern towards additional littering by masks and gloves, the public perception on plastic was mixed. On one hand, it was the material that allowed us to stop the diffusion of the potentially contaminated aerosol particles, thanks to the face masks mainly made of plastic polymers and the Plexiglas barriers that were mounted at many places of contact with the public. On the other hand, there is evidence that the virus could survive longer on plastic surfaces than on other materials, thus raising concern about plastic packaging as a potential virus carrier.

This takes us to the first topic of the debate: Is plastic itself the problem or is it the way we abuse and mismanage it, when alternative options are available? The misuse of plastic in single-use applications was probably the greatest mistake we made and are still making. Despite the fact that single usage of some plastics might be the only option in very demanding applications (i.e. the medical sector), it has proven to be a disaster when only the convenience or comfort of the user was at stake. There was a time, back in the post-World War II (WWII) economic boom and up to more recent years, where single-use objects were perceived and communicated as a new opportunity for the well-being and for a prosperous future for mankind. Then, following a new environmental consciousness and the discovery of huge amounts of such items in the oceans or stranded on beaches, we decided to tackle the problem. For example, in 2019, the European Commission issued the Single-Use Plastics (SUP) Directive, which included an EU-wide ban on some single-use plastic items by 2021. The list includes items that are most often found on beaches such as cotton buds, straws, plates, cutlery, beverage stirrers, balloon sticks, oxo-degradable plastics (i.e. plastics incorporating a catalyst to promote quicker degradation in the environment than conventional plastics), expanded polystyrene food containers, beverage containers and beverage cups. But the paradox is that some other items are excluded from the ban, simply because they are not part of the list. Among them we find for example plastic confetti, whose utilisation is on the raise in replacement of traditional paper ones. The difference is that while the latter will be degraded in the environment in a few weeks or months, the former require hundreds of years, like all plastic materials. But their use is not formally banned by law, despite being without any doubt single-use plastic items.

The second topic related to plastics is its origin, since it is made from fossil resources such as oil and gas. And this is becoming an increasingly important issue in a world that is targeting zero carbon emissions and that is realising that almost 60% of oil and gas reserves and 90% of coal must remain in the ground to keep global warming below 1.5°C. Fossil fuels extraction for

plastic production should then remain an option only provided that the carbon will not be emitted in the atmosphere, meaning that conventional energy recovery from non-recyclable plastic waste is not going to be an option anymore, unless carbon dioxide is captured and sequestered. The only solution, if we want to keep the undeniable advantages of this material, is to try our best to make it more circular, that is, to be able to keep it in the commerce loop as long as possible.

Given all of the above, what should be the role of waste managers, professionals and scientists in this overarching issue? They should target first of all the proper collection, sorting and recycling of a waste stream that has become, and is due to become, more and more complex and heterogeneous than it used to be. At the early stages of source separation efforts, the plastic bin typically included only bottles and flasks; now it is composed of a wide range of items with different size, shape and composition. At the sorting stage, the robust income from the recovery and sale of high-quality plastic streams such as PET and PE still helps to financially sustain the management of lower quality items. For the former, bottle-to bottle recycling should be promoted, which enables waste managers to target very high recycled content in new bottles, but this requires a dedicated separate collection, not commingling with other plastic streams. For low-quality plastics, a possible solution might come from chemical recycling, a technology on which high expectations are placed, but which still needs refinement and large-scale demonstration. With chemical recycling, plastic waste might be turned into feedstock for industry, yielding new products and keeping such hydrocarbon-based materials in the loop for much longer.

Obviously, such an effort must be supported by proper science-based evaluations of the overall impact assessment, in order to go beyond a simplification of the issue in terms of 'plastic free', a concept that, together with 'zero waste', is far from being a true support in the solution of the problem. Without forgetting that, once again, we are all called to a behavioural change effort towards a more sustainable way of living.



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