



# MICROPLASTICS: ARE PAPER & BIOPLASTIC ALTERNATIVES THE SOLUTION?

---

NOVEMBER 2023

## WHAT ARE MICROPLASTICS?

Microplastics are plastic fragments, fibres, or particles which are less than 5mm<sup>i</sup>. The abundance of microplastics in marine and freshwater systems, the terrestrial environment and atmosphere have significantly increased in recent decades. They have been found in the deepest oceans, trapped in Arctic snow, and in the soil of all seven continents<sup>ii</sup>.

The build-up of microplastics across all surroundings has become a threat to both environmental and human health. Generally, there are two sources of microplastics, directly from industry or indirectly from physical, chemical, and biological fragmentation of large (>5mm) plastic deposits<sup>iii</sup>. Presently there are 51 trillion particles of microplastics on the surface of the ocean, with the packaging industry performing as one of the major contributors to this issue<sup>iv</sup>.

## WHAT ARE MICROPLASTICS?

Microplastics have been found in a large number of food products, such as bottled water, tap water, table salt, beer and canned food and fish<sup>v</sup>. As well as digestion, it has also been discovered that microplastics can enter the body through inhalation. A study conducted in 2015 found that the total number of plastic particles ingested annually through all streams, by an individual, is estimated to be between 74,000 and 121,000<sup>vi</sup>.

Full understanding of the consequences of microplastics on human health and the environment is still limited. However, current evidence suggests that microplastics can act as carriers, transporting harmful substances, such as pesticides, to the human body, potentially leading to hormonal changes, developmental issue, cancer, and organ inflammation<sup>vii</sup>. Likewise, microplastic are a major environmental concern due to their impact on marine ecosystems. Ingestion of large quantities by marine animals can cause digestive tract blockages, malnutrition and eventually death.

In addition, research has shown that microplastics can interfere with the reproductive system of marine animals, chemically through hormonal change and physically through their abrasive nature, leading to population decline and subsequently altering entire ecosystems<sup>viii</sup>.

## PAPER ALTERNATIVES

Increased awareness regarding the potential harm of microplastics and plastic pollution has led to heightened consumer demand for paper products. This has in turn been complimented by the introduction of the 2022 Plastic Tax in the UK, effecting products that contain less than 30% recycled plastic. Similar plastic tax legislation has also been introduced in other European countries.

### **But are paper products always better for the environment?**

Paper products come with many benefits, such as relatively quick decomposition, they can be easy to recycle, and are made from a renewable resource. However, manufacturing a paper bag has an estimated carbon footprint of 5.52kg CO<sub>2</sub>e compared to 1.58kg CO<sub>2</sub>e for a single use plastic bag or 6.92 CO<sub>2</sub>e for a reusable plastic bag<sup>ix</sup>. Moreover, paper bags tend not to be reusable as they are easily broken, meaning a basic reusable plastic bag only has to be reused once in order to make it more environmentally friendly in terms of its carbon footprint.

Likewise, the chemicals and fertilisers used in the production of paper bags can create additional harm to the environment, and production can contribute to deforestation if paper is not sourced sustainably. It is important to ensure paper products are FSC certified, confirming the forest is being managed in a way that that preserves biological diversity and benefits the lives of local people, whilst ensuring economic validity<sup>x</sup>.

Furthermore, the UK's increasing demand for paper alternatives has outstripped domestic manufacturing capabilities. The UK accounted for 4.3% of global paper imports in 2020, in turn increasing the carbon footprint of paper products through increased transportation.

Estimated Manufacturing Footprint	
Bag Type	Kg CO2e
Plastic Bag (Strong Reusable)	21.51
Plastic Bag (Basic Reusable)	6.92
Paper Bag	5.52
Plastic Bag (Single Use)	1.58

## BIOPLASTICS

The past few years has also seen many advances in bioplastics. Bioplastics, according to the European Bioplastics Association, are either bio-based, biodegradable, or both<sup>xii</sup>. Some examples include: starch based, water soluble, vegetable oil based, and even plastics made from fish waste<sup>xiii</sup>. Though these innovations allow a substantial carbon footprint reduction in the stage of resource extraction, they often come at a much higher cost with generally inferior properties, resulting in limited uptake by businesses; with bioplastics accounting for only 0.6% of total global plastic production in 2019<sup>xiv</sup>.

Moreover, biodegradation is often seen as the most appropriate end of life option for biodegradable bioplastics, though this is not always the case, as biodegradation under landfill conditions leads to high levels of methane pollution, with emissions from landfill accounting for 1.9% of total global GHG emissions in 2016<sup>xv</sup>. Industrial composting is a more sustainable option, as the presence of oxygen substantially decreases methane emissions, though it has been reported that only a small percentage of biodegradable bioplastic is composted.

Bioplastic recycling streams are far less established than those for traditional plastics, and although some bio-based polymers, such as bioPET, bioPE and bioPP, can be recycled in the same facilities as petrochemical-derived plastic, this does not always apply for biodegradable bioplastics<sup>xvi</sup>. It is also important to note that non-biodegradable bioplastics generate the same pollution problems as derived from petrochemical-derived plastics, thus also producing microplastics<sup>xvii</sup>. Since bioplastic production is forecasted to grow, it can be predicted that costs will fall and more desirable properties will be achieved and optimistically, efficient end of life pathways for common bioplastics will be established.

## RESPONSIBLE CONSUMPTION

It is a clear that choosing the right packaging is a complex task, with a no 'one size fits all' solution. All packaging can cause a threat to the environment throughout its lifecycle; microplastics are not an isolated case. Irrespective of material choice, consuming more responsibly is the most sustainable approach, and choosing the right packaging for the right task is important.

Understanding the application, picking the right packaging product and material, and reducing the overall amount of packaging used will reduce the amount of raw materials exploited, will save energy in manufacturing, and will minimise the amount of waste produced.

It can be noted that the responsible disposal of packaging is just as critical, whether that be by consumers or businesses. The environmental impact from packaging pollution, as seen through microplastics, landfill and the manufacturing of virgin materials into additional packaging, outweighs the environmental impact of effective recycling. Extended Producer Responsibility (EPR) legislation has been introduced in many countries. In the UK this will quantify packaging by material, source, and destination, as well as imposing modulated fees to cover the cost of disposing of packaging responsibly (see our EPR white paper). It is forecasted this will improve recycling infrastructure, packaging labelling and consumer awareness.



- i. <https://www.nature.com/articles/s41598-020-61146-4#Bib1>
- ii. <https://www.greenmatters.com/p/microplastics-solutions>
- iii. <https://www.nature.com/articles/s41598-020-61146-4>
- iv. <https://www.packaging-gateway.com/features/addressing-microplastic-pollution-strategies-for-greener-packaging/?cf-view>
- v. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9920460/#:~:text=Microplastics%20are%20small%20plastic%20particles,salt%2C%20honey%20and%20marine%20organisms.>
- vi. [https://link.springer.com/chapter/10.1007/978-3-319-16510-3\\_14](https://link.springer.com/chapter/10.1007/978-3-319-16510-3_14)
- vii. <https://www.webmd.com/a-to-z-guides/news/20221028/microplastics-health-risks-what-do-we-really-know>
- viii. <https://www.mdpi.com/2071-1050/15/14/10821>
- ix. <https://www.co2everything.com/co2e-of/paper-bag>
- x. <https://education.nationalgeographic.org/resource/sustainable-shopping-which-bag-best/>
- xi. <https://anz.fsc.org/whatisfsc#:~:text=FSC%20forest%20management%20certification%20confirms,environmental%2C%20social%20and%20economic%20standards.>
- xii. Materials – European Bioplastics e.V. ([european-bioplastics.org](http://european-bioplastics.org))
- xiii. <https://www.forbes.com/sites/ariellasimke/2020/01/27/a-new-bioplastic-made-from-fish-waste-is-here/>
- xiv. <https://www.sciencedirect.com/science/article/pii/S2542504821000373>
- xv. <https://ourworldindata.org/emissions-by-sector>
- xvi. <https://www.sciencedirect.com/science/article/pii/S2542504821000373>
- xvii. <https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3002045#:~:text=Some%20bioplastics%20are%20neither%20biodegradable,nano%20plastics%20during%20their%20decomposition>