

# Worrying insights into the chemicals in plastics

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Plastic is practical, cheap and incredibly popular. Every year, more than 350 million tons are produced worldwide. These plastics contain a huge variety of chemicals that may be released during their

lifecycles—including substances that pose a significant risk to people and the environment. However, only a small proportion of the chemicals contained in plastic are publicly known or have been extensively studied.

A team of researchers led by Stefanie Hellweg, ETH Professor of Ecological Systems Design, has for a first time compiled a comprehensive database of plastic monomers, additives and processing aids for use in the production and processing of plastics on the world market, and systematically categorized them on the basis of usage patterns and hazard potential. The study, just published in the [scientific journal](#) *Environmental Science & Technology*, provides an enlightening but worrying insight into the world of chemicals that are intentionally added to plastics.

## **A high level of chemical diversity**

The team identified around 10,500 chemicals in plastic. Many are used in packaging (2,489), textiles (2,429) and food-contact applications (2,109); some are for toys (522) and medical devices, including masks (247). Of the 10,500 substances identified, the researchers categorized 2,480 substances (24 percent) as substances of potential concern.

"This means that almost a quarter of all the chemicals used in plastic are either highly stable, accumulate in organisms or are toxic. These substances are often toxic to [aquatic life](#), cause cancer or damage specific organs," explains Helene Wiesinger, doctoral student at the Chair of Ecological Systems Design and lead author of the study. About half are chemicals with high production volumes in the EU or the US.

"It is particularly striking that many of the questionable substances are barely regulated or are ambiguously described," continues Wiesinger.

In fact, 53 percent of all the substances of potential concern are not

regulated in the US, the EU or Japan. More surprisingly, 901 hazardous substances are approved for use in food contact plastics in these regions. Finally, scientific studies are lacking for about 10 percent of the identified substances of potential concern.

## **Plastic monomers, additives and processing aids**

Plastics are made of organic polymers built up from repeating monomer units. A wide variety of additives, such as antioxidants, plasticisers and flame retardants, give the polymer matrix the desired properties. Catalysts, solvents and other chemicals are also used as processing aids in production.

"Until now, research, industry and regulators have mainly concentrated on a limited number of dangerous chemicals known to be present in plastics," says Wiesinger. Today, plastic packaging is seen as a main source of organic contamination in food, while phthalate plasticisers and brominated flame retardants are detectable in house dust and indoor air. Earlier studies have already indicated that significantly more plastic chemicals used worldwide are potentially hazardous.

Nevertheless, the results of the inventory came as an unpleasant surprise to the researchers. "The unexpectedly high number of substances of potential concern is worrying," says Zhanyun Wang, senior scientist in Hellweg's group. Exposure to such substances can have a negative impact on the health of consumers and workers and on polluted ecosystems. Problematic chemicals can also affect recycling processes and the safety and quality of recycled plastics.

Wang stresses that even more chemicals in plastics could be problematic. "Recorded hazard data are often limited and scattered. For 4,100 or 39 percent of all the substances we identified, we were not able to categorize them due to a lack of hazard classifications" he says.

## A lack of data and transparency

The two researchers identified the lack of transparency in chemicals in plastics and dispersed data silos as a main problem. In over two and a half years of detective work, they combed through more than 190 publicly accessible data sources from research, industry and authorities and identified 60 sources with sufficient information about intentionally added substances in plastics. "We found multiple critical knowledge and data gaps, in particular for the substances and their actual uses. This ultimately hinders consumers' choice of safe plastic products", they say.

Wiesinger and Wang are pursuing the goal of a sustainable circular [plastic](#) economy. They see an acute need for effective global chemicals management; such a system would have to be transparent and independent, and oversee all hazardous [substances](#) in full. The two researchers say that open and easy access to reliable information is crucial.

**More information:** Helene Wiesinger et al, Deep Dive into Plastic Monomers, Additives, and Processing Aids, *Environmental Science & Technology* (2021). [DOI: 10.1021/acs.est.1c00976](https://doi.org/10.1021/acs.est.1c00976)

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