

## ***Which hazardous chemicals are associated with plastic packaging?***

### **Introduction**

The use of plastic packaging is increasing globally, causing environmental and human health concerns. In 2015 annual plastic production was 380Mt, of which about 40 per cent was used in packaging, with the majority being used in food packaging <sup>(1)</sup>.

Plastic packaging is a source of chemical exposure to consumers and workers, as chemicals used in the packaging can migrate into foods <sup>(2)</sup> and the environment during manufacturing, use, disposal and recycling <sup>(3)</sup>. It is therefore vital for us to know what chemicals are present in plastic packaging and what the associated risks are, so that we can restrict chemicals that cause harm and replace them with safer alternatives.

### **Creation of a plastic packaging database**

However, it is not straightforward to find out what chemicals are used in the production of plastic packaging as there is no single registry for this information. Scientists at the [Food Packaging Forum](#), started by trawling through data to establish a list of the chemicals used in plastic packaging.

The scientists faced considerable barriers when building the database, due to a lack of information concerning the use of chemicals in plastics manufacturing and the chemicals' presence in final products, often caused by information not being publicly accessible through standard search methods or not being accessible at all. In addition, plastic packaging can contain impurities, degradation products, and contaminants which cannot be exhaustively compiled because many of these chemicals are not yet identified.

The Food Packaging Forum, together with its project partners, pulled the information together in the [Chemicals associated with Plastics Packaging database \(CPPdb\)](#). **The database contains 4283 substances** and, where available, information on their toxicity and uses in plastic packaging, as well as additional regulatory information such as authorization for use in food packaging <sup>(4)</sup>.

The CPPdb covers both food and non-food packaging. It currently contains 906 chemicals most likely to be associated with plastic packaging and the 3377 chemicals that are possibly associated. These chemicals listed in the database are either used in the production of plastic packaging or are present in the final article, e.g. as non-intentionally added substances ([NIAS](#)). NIAS are impurities or contaminants, or due to side reactions of plastics manufacture, or the degradation of additives. The 906 substances which are most likely to be associated with plastic packaging have been published on the [Data Commons website](#).

## Hazardous Chemicals

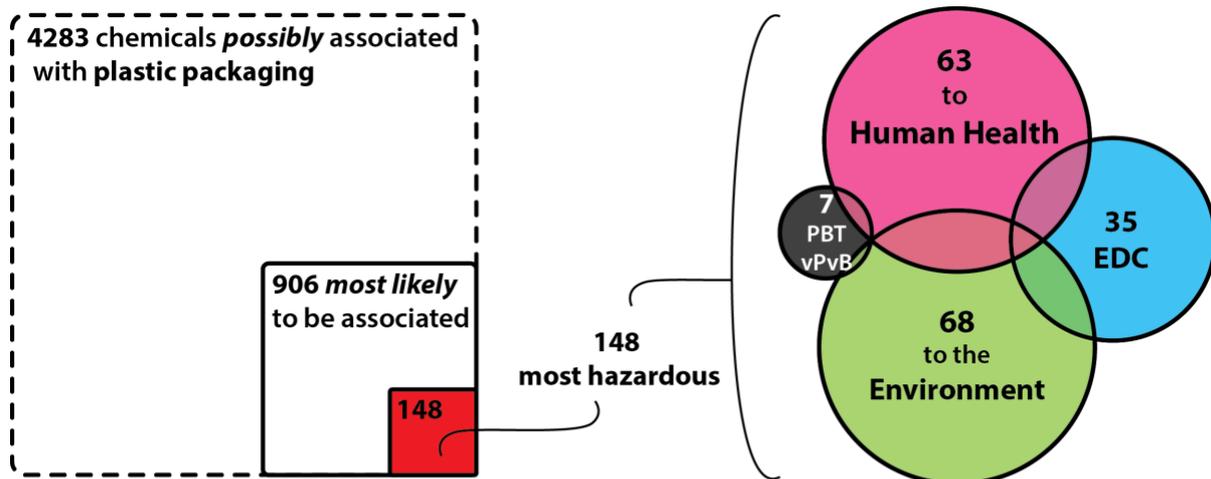
At least **148 of the 906** chemicals most likely to be associated with plastic packaging were identified as particularly hazardous based on several harmonized hazard data sources.

These included:

- Classifications assigned by European Chemicals Agency (ECHA) under the Classification, Labelling and Packaging ([CLP](#)) regulation;
- [EU classification](#) as persistent, bioaccumulative and toxic (PBT) or very persistent, very bioaccumulative (vPvB) substance;
- Identification as an endocrine disrupting chemical (EDC) under the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) legislation;
- Recognition as an EDC or potential EDC in the [2018 report](#) by the United Nations Environment Programme (UNEP).

**35 of the chemicals listed are regarded as endocrine disrupting chemicals (EDCs)**, chemicals potentially causing adverse impacts on the hormone system. These included chemicals such as bisphenol A (BPA) and a number of phthalates, whose use within Europe has been restricted in certain products due to their harmful properties.

The 148 most hazardous chemicals are not a complete list, as harmonised toxicity classification data was not available for most of the other chemicals associated with plastic packaging. Therefore, a complete hazard ranking is not possible at present.



**Figure 1:** Left hand-side: number of chemicals *possibly* and *most likely* associated with plastic packaging. Right hand-side: distribution of the 148 chemicals identified as most hazardous among the most likely associated chemicals according to their hazard category. EDC: Endocrine Disruptor Chemical ; PBT: Persistent, Bioaccumulative and Toxic ; vPvB: very Persistent and very Bioaccumulative. Note: sum in the right hand-side figure is superior to 148 due to overlaps. Data from *Groh et al. 2018*

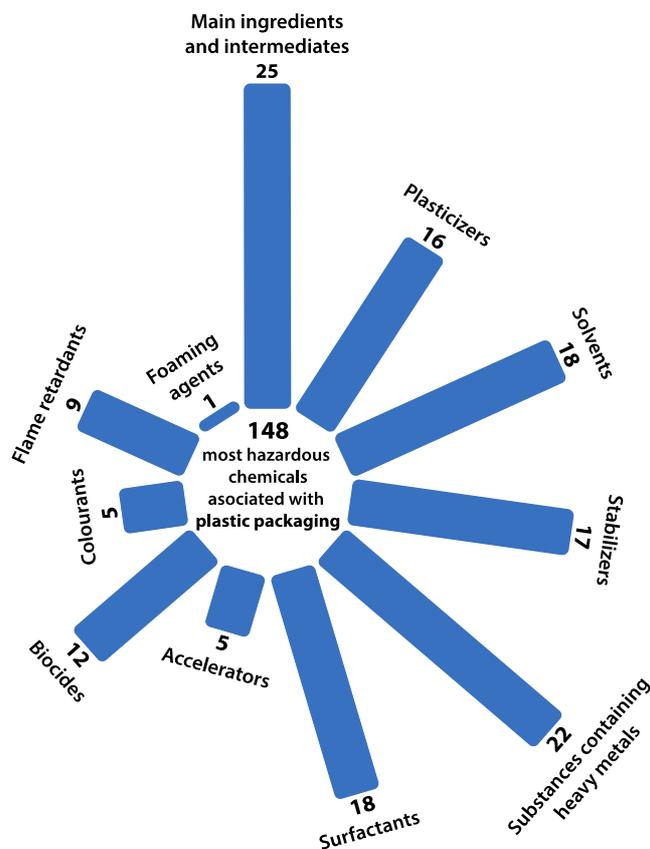
## Chemical uses

The hazardous chemicals identified are not only used as the plastic's building blocks (monomers) to produce the plastic polymer, but are also used for a range of additives with functions from biocides to prevent moulds, flame retardants to increase fire resistance, plasticizers to increase flexibility, dyes, adhesives and many more. Additives are not bound to the plastic polymer and therefore can diffuse (or migrate) out of the plastic packaging.

The following table indicates the function and number of identified hazardous chemicals associated with plastic packaging.

Function of chemical associated with plastic packaging	Number of identified hazardous chemicals
Accelerators (used in adhesives)	5
Biocides (used to prevent packaging from moulds, mildew and bacterial attack)	12
Colourants (dyes and pigments)	5
Flame retardants (e.g. to increase fire - resistance)	9
Foaming agent	1
Main ingredient of the plastic polymer and intermediate ingredients	25
Plasticizers (to increase flexibility)	16
Solvents (e.g. to glue plastics together)	18
Stablizers (to prevent degradation)	17
Surfactants (e.g. used in the production of plastic foams)	18
Substances containing heavy metals (not included in above functions)	22

The full list of the chemicals identified is available [here](#) in the published academic paper.



**Figure 2:** Number of most hazardous chemicals most likely to be associated with plastic packaging organised by function. Data from Groh et al. 2018.

## Some chemical groups of concern

### Hazardous Metals

A group of additives to plastics that consists of substances containing hazardous metals. Four of the heavy metals, cadmium, chromium (VI), lead and mercury, are considered to be highly hazardous to human health because they are carcinogens, can cause permanent changes to the genetic make-up of cells or they can have adverse effects on fertility and sexual function.

### Bisphenols

Three bisphenols are highlighted, BPA, bisphenol S and bisphenol F; these are used in the manufacture of clear polycarbonate plastic, as additives in rigid plastics and in the manufacture of other plastic-related materials, including the lining inside food and drink cans. These bisphenols are known EDCs, and [a recent CHEM Trust report](#) has highlighted the case for the use of the bisphenol group of chemicals to be restricted by regulators.

### Phthalates

The study identifies **14 different hazardous phthalates**, a group of chemicals that are used as plasticizers in plastics. The EU is currently finalising a restriction on the use of four phthalates that are used as plasticizers in plastics due to health worries associated with these chemicals. However, the proposed restriction does not prevent these chemicals being used as food contact materials. [CHEM Trust and the European Environmental Bureau has called for this to change](#). Phthalates are associated with a range of health effects on people including [reproductive disruption](#) and metabolic diseases such as [obesity](#).

### PFAS

Two per- and polyfluoroalkyl substances (PFAS) are identified in the study. [The stability of these chemicals](#), which makes their use attractive in plastic packaging, however, means they are extremely persistent in the environment and can accumulate in the food chain. One of the chemicals identified in the database, PFOA is listed on the European Chemical Agency's list of substances of very high concern, due to its reproductive toxicity and environmental persistence. [CHEM Trust has proposed that these chemicals](#) are part of [the European Human Biomonitoring Initiative \(HBM4EU\)](#), which is coordinating and advancing the measurement of the presence of chemicals in the European population.

## Concerns

The research has highlighted a number of concerns:

- There is a substantial lack of information on what applications specific chemicals are used for when producing plastic packaging and in what quantities they end up in the finished product;
- How difficult it is to get hold of the information as to what chemicals are used and are present, due to confidential business information and lack of disclosure requirements;
- Even for chemicals for which hazards have been identified, there is a lack of harmonized toxicology information;
- We are exposed to 1000s of different chemicals through plastic packaging and we know very little or nothing about the effect of these chemical mixtures on human health.

## Policy recommendations

- We need stronger, faster and more comprehensive regulation of problematic groups of chemicals such as the bisphenols, phthalates and other chemical groups of concern.
- There must be adequate safety data publicly available on all chemicals used in the manufacture of plastic packaging, including chemicals that are present in the final product.
- The public and researchers have a right to know what chemicals are being used in plastic packaging, and the data must be accessible.
- Chemical regulators should consider the reality of exposure to mixtures, including assessment of exposure to non-intentionally added substances
- Chemicals which are classed as being of very high concern within REACH should not be used in plastic packaging.

## Resources and next steps

The academic paper covering the development of the database has been published in the peer-reviewed scientific journal [Science of the Total Environment](#).

Two case studies were carried out prioritizing hazardous chemicals associated with plastic packaging according to their impact on human health and the environment. Five phthalates have been identified for further assessment. Read the [CHEM Trust blog](#) to find out more.

## Project Partners

[Food Packaging Forum](#): Dr. Jane Muncke, Dr. Ksenia Groh, Dr. Birgit Geueke

[University of Gothenburg, Department of Biological & Environmental Sciences](#): Dr. Bethanie Carney-Almroth, Prof. Thomas Backhaus, Dr. Pedro Inostroza

[University of Gothenburg, Centre for Environment & Sustainability](#): Dr. Daniel Slunge

Dr. Maricel Maffini, independent consultant, Baltimore, MD, USA

[New York University, School of Medicine](#): Prof. Leonardo Trasande

[ChemSec International Chemical Secretariat](#): Dr. Anna Lennquist, Dr. Jonatan Kleimark

[CHEM Trust](#): Dr. Michael Warhurst, Dr. Anna Watson, Dr Julie Schneider

## References

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3. Emma L. Teuten, Jovita M. Saquing, Detlef R. U. Knappe et al., 2009. Transport and release of chemicals from plastics to the environment and to wildlife. *Philosophical Transactions of the Royal Society B*, V 364. <https://doi.org/10.1098/rstb.2008.0284>
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