GRID ARENDAL
A UNEP Partner

BASEL CONVENTION

Fact Sheet #5

For more information consult "Drowning in Plastics - Marine Litter and Plastic Waste Vital Graphics" publication by UNEP, the BRS Secretariat and GRID-Arendal. Available from link https://bit.ly/3GOrz8E

Plastic additives

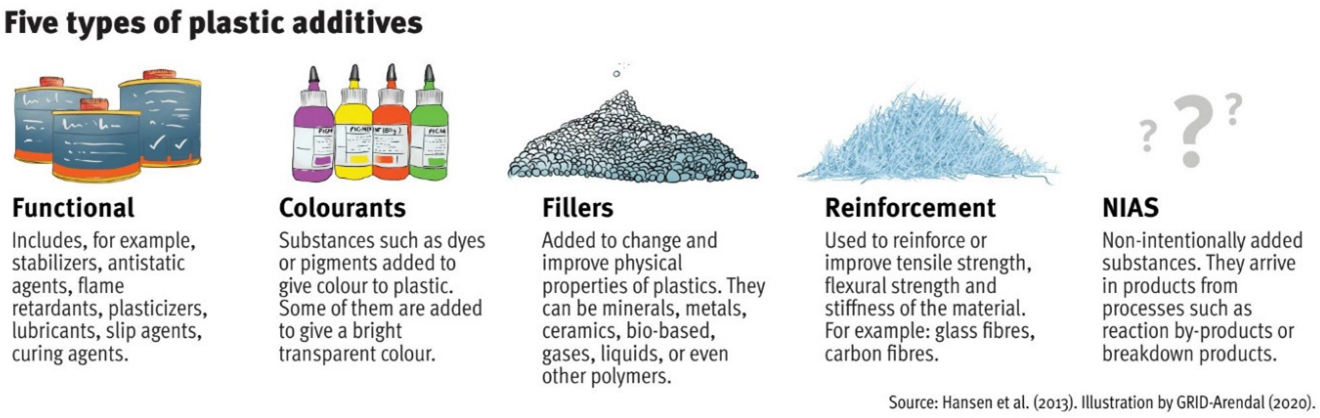
Every plastic item contains additives that determine the properties of the material and influence the cost of production (Stenmarck et al. 2017). Typical additives include stabilisers, fillers, plasticisers, colourants, as well as functional additives such as flame retardants and curing agents (Figure 1). Some plastic additives are hazardous to human health and the environment (Stenmarck et al. 2017, Wiesinger et al. 2021). The amount of additives contained in plastics varies depending on the additives' function. For example, additives in polyvinyl chloride (PVC) can constitute up to 80% of the total volume (Hahladakis et al. 2018).

Many different chemicals are used as plastic additives. A randomly chosen plastic product generally contains around 20 additives (van Oers et al. 2011). Flick (2004) lists 7,000 plastic additives. Nevertheless, the identities and concentrations of additives are generally not listed on products. The most commonly used additives are fillers (50% of the world additives market), followed by plasticisers (22%, of which more than 80% are phthalate plasticisers; van Oers et al. 2011). According to the European Chemicals Agency (ECHA), over 400 plastic additives are used in the EU in high volumes (ECHA 2021).

Leakage and degradation

Plastics are composed of chains of polymers. Additives may be weakly bound to the polymers or react in the polymer matrix. The weakly bound additives can leach out of the plastics during normal use, when in landfills, or following improper disposal in the environment (Wagner and Schlummer 2020). Additives may also degrade to form other toxic molecules. Plastic fragmentation into microplastics and nanoplastics can allow chemical additives to move in the environment far from the point of use (Hahladakis et al. 2018). Once released, some additives and derivatives may persist in the environment and bioaccumulate in organisms. They can have adverse effects on human health and biota (Stenmarck et al. 2017). A recent review revealed that out of 3,377 chemicals potentially associated with plastic packaging and 906 likely associated with it. Of the 906, 63 were ranked by ECHA as "highest for human health hazards" and 68 as "highest for environmental hazards" (Groh et al. 2019).

Figure 1: Five types of plastic additives

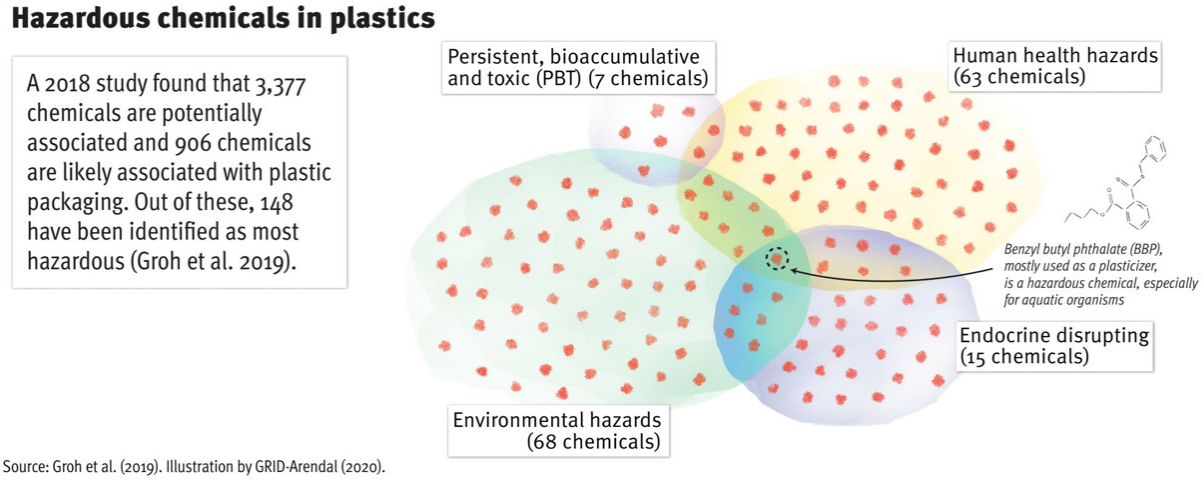


Source: Hansen et al. (2013). Illustration by GRID-Arendal (2020).

End of life phase

Additives present risks in recycled products, as they are difficult to remove. When plastic products are recycled, it is highly likely that the additives will be integrated into the new products (Wagner and Schlummer 2020). Absence of transparency and reporting across the value chain often results in lack of knowledge concerning the chemical profile of the final products. For example, products containing brominated flame retardants have been incorporated into new plastic products (Leslie et al. 2016, Pivnenko 2016, Stenmarck et al. 2017, Kuang et al. 2018, Turner 2018). Flame retardants are a group of chemicals used in electronic and electrical equipment, textiles, furniture and construction materials which should not be present in food packaging or child care products. A recent study found brominated dioxins as unintentional contaminants in toys made from recycled plastic electronic waste that contained brominated flame

Figure 2: Hazardous chemicals in plastics



Source: Groh et al. (2019). Illustration by GRID-Arendal (2020).

retardants (Petrlík et al. 2018). Brominated dioxins have been found to exhibit toxicity similar to that of chlorinated dioxins. They can have negative developmental effects and negative effects on the nervous system and interfere with mechanisms of the endocrine system (Piskorska-Pliszczyńska et al. 2014).

Additives can also be problematic if waste is burned, especially when burning is uncontrolled or takes place in low-technology incinerators, as is common in many developing countries. Incomplete combustion can cause emissions of hazardous substances such as acid gases and ash which can contain persistent organic pollutants (POPs) such as dioxins (Hahladakis et al 2018).

Action at the global level

A number of additives identified as hazardous to humans and/or the environment are regulated internationally (Rodrigues et al. 2018). The Stockholm Convention on POPs is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment. It requires Parties to prohibit, eliminate and/or restrict the production, use, import and export of listed intentionally produced POPs. It also requires them to reduce or eliminate releases from unintentionally produced POPs and has provisions on the environmentally sound management of stockpiles and wastes consisting of, containing, or contaminated with POPs. Each Party to the Convention is to develop and update an implementation plan to limit or phase out production, use and releases of the POPs. Currently, the Convention regulates a small fraction of the hazardous chemicals contained in plastics and plastic waste. Some of these chemicals are still used as a result of exemptions. Moreover, a large number of additives and associated derivatives still do not fall under current regulations.

Other additives proven to be harmful such as cadmium, chromium, lead and mercury (regulated under the Minamata Convention on Mercury) which have previously been used in plastic production are banned in many jurisdictions. Nevertheless, they are still routinely found in some plastic packaging, including food packaging (Whitt et al. 2016, Lahimer et al. 2017, Alam et al. 2018). The use of the additive bisphenol A (BPA) in plastic baby bottles is banned in a number of countries, but is not restricted in some low-income countries (Yates et al. 2021).

For more information, please visit: http://www.basel.int/

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