

PROPERTIES AND APPLICATIONS

Plastic is light-weight, versatile, and inexpensive. Most types of plastics are made with fossil carbon, but renewable carbon sources are increasingly used as raw material.

Since the 1950s, plastic has found countless applications in food packaging items, such as bottles, trays, bags, and films.

Plastic is often used in combination with other materials such as paper & board, metals, glass, printing inks, adhesives, and coatings.

COMPOSITION OF PLASTIC PACKAGING

Plastics consist of polymers forming the structure of the material, and various additives further customize the technical properties. A large variety of different chemicals can be used to produce plastic food packaging. Many of them have hazardous properties, and others lack publicly available toxicity data. In addition, plastics contain so-called non-intentionally added substances, including degradation products, contaminants, and reaction by-products.



CHEMICAL SAFETY

Plastics can transfer chemicals into packaged food or beverages. This process is called [chemical migration](#). In most cases, some of the migrating chemicals are known, while many others are identified only partially or not at all. Chemical migration depends on factors such as food type, temperature, and storage time. Its impact on human health is still not well understood.

MICROPLASTICS

Plastic packaging can also release microplastic particles during production, use, and at the end-of-life. Therefore, it is a source of human and environmental exposure to microplastics that can have unknown consequences.



END-OF-LIFE

End-of-life options for plastic packaging include landfill, incineration, and recycling. However, incorrect disposal and leaching of plastic packaging into the environment leads to severe pollution.



RECYCLING of plastic food packaging

Recycling of plastic food packaging is widely seen as a measure to reduce its environmental impacts. However, plastic food packaging can only be recycled to a limited extent due to its material properties, waste management processes, and chemical safety concerns. In many countries, the recycling of plastic food packaging is regulated.

These rules usually allow only food-grade materials as feedstock and require that the chemical safety of the recycled food packaging be ensured. Therefore, only selected types of plastic are currently recycled into new food packaging, but most plastic food packaging is either not at all recycled or it is downcycled.



How is plastic recycled?

MECHANICAL RECYCLING

Plastic food packaging is almost exclusively recycled by mechanical processes that include collecting, sorting, washing, and grinding of the material. Since the product is not sufficiently clean for food contact at this stage, more decontamination steps are necessary, e.g., high-temperature, vacuum, or inert gas treatments, before it can be remelted and reformed.

CHEMICAL RECYCLING

The principle of chemical recycling is to break down plastic polymers into smaller molecules for reuse in new syntheses. In general, these processes have a high energy demand and generate toxic waste. Therefore, they need to be further developed to make them operable at a large scale.

What needs to be addressed?

QUALITY

During mechanical recycling, the polymer backbone can break into pieces leading to loss of performance. Therefore, plastic cannot be recycled indefinitely. To compensate for lower quality, higher levels of additives and virgin polymer are often needed.

CONTAMINATION SOURCES

In addition to the chemicals present in virgin plastics, recycled plastic food packaging can also contain contaminants originating from other sources, for example, food components or non-food chemicals absorbed during previous use, degradation products in aged plastics, and process chemicals. Recycling streams may also be contaminated with non-food grade plastics (e.g., waste electronic devices).

Does it work?

PET BOTTLES

Recycling of beverage bottles made of polyethylene terephthalate (PET) is the best-known example for recycling of plastic food packaging. The availability and material properties of post-consumer, food-grade PET enable decontamination and recycling processes. In most cases, recycled PET is blended with 60% or more virgin material to achieve the needed material properties and chemical safety requirements.

OTHER PLASTIC PACKAGING

Besides PET, most other types of plastic food packaging are currently only downcycled or not recycled at all. Possible reasons include the lack of waste collection and separation schemes as well as insufficient decontamination processes. For multilayer plastic packaging, no efficient recycling processes exist at all.

