NCASI Fact Sheet

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Paper and Plastic in Marine Environments

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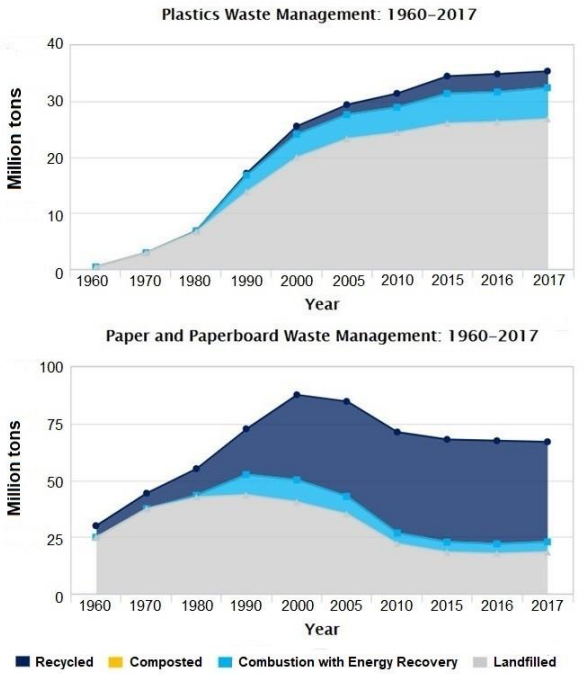
Overview

Paper products are increasingly viewed as a replacement for certain plastic products, given their biodegradability, lower floatability, and lower risk of abandonment in the environment. Life Cycle Assessment (LCA) is often used to compare the environmental performance of paper and plastic products, but with few exceptions, the current body of existing LCA studies generally does not include consideration of material littering in the environment. This fact sheet discusses paper and plastic in the context of marine litter as well as the relevance of marine litter in LCAs comparing products made of these two materials.

Fate of Paper and Plastic in the Environment

Globally, approximately 3.0 and 5.3 million tonnes of macro- and micro-plastics, respectively, are lost to the environment annually (Ryberg et al. 2018). One reason for this is that the recycling rate of plastic is low. For instance, in the US in 2017, only 8.4% of all waste plastics were recycled, in contrast to 65.9% for paper and paperboard (USEPA 2019).

Floating plastics (e.g., plastic bottles and caps, plastic bags) are currently the most abundant items of marine litter, and cigarette butts (plasticized cellulose acetate) are consistently the most commonly occurring item in coastal cleanup survey data (Thevenon et al. 2014). In addition, micro-plastics are either released in the ocean as manufactured (e.g., micro-beads in cosmetic formulations) or arise from degradation of macro-plastics. Paper products are typically not a main component of marine litter surveys (Ocean Conservancy 2018).



SOURCE: Adapted from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/guide-facts-and-figures-report-about-materials#Materials_and_Products

[Bio]Degradability

The longevity of plastics in the environment is receiving increasing scrutiny and has been reported to vary from hundreds to thousands of years (Barnes et al. 2009). Over the long term, plastics in marine environments are degraded into smaller pieces and micro-particles through a variety of mechanisms including prolonged exposure to sunlight, physical abrasion, and some biodegradation by microorganisms. For paper, one study found half-lives in marine environments varying from 173 days in warm waters to less than 5 years in cold waters (Moran et al. 1996).

Effects of Litter on Human Health and Ecosystems

Documented Effects

The long half-life and low recovery rate of plastics contribute to their growing accumulation in the environment. It has been estimated that by 2050 without significant action, the cumulative weight of plastic litter in the ocean will be more than the cumulative weight of all marine fish (World Economic Forum et al. 2016). In the short term, a primary environmental effect of macro-plastics in marine environments is the potential for ingestion, suffocation, and entanglement of marine species (Thevenon et al. 2014). In addition, floating plastics can accumulate pollutants on their surfaces during their long residence time in marine water and can serve as a vector for pollutants that may accumulate in the food web. Over the longer term, micro-plastics can bioaccumulate in the food chain. Ingestion of small plastic debris by small invertebrate organisms (e.g., mussels) may have implications for the rest of the food chain, including for human health (Thevenon et al. 2014).

LCA Indicators

LCA is a tool to assess the environmental performance of products by considering their full life cycle with the objective of including a comprehensive set of relevant environmental aspects. Despite a growing interest in examining environmental and health effects of litter in the marine environment, this aspect is almost never considered in LCAs comparing paper and plastic products. Indeed, there is currently no accepted LCA indicator for doing so. A few LCA studies comparing plastic and paper shopping bags tried to include consideration of product abandonment in the environment (litter) by introducing their own indicators. However, these indicators were limited to an evaluation of the risk for the material to be abandoned and to persist in the environment. No assessment was made of the potential effects of litter on wildlife, ecosystems, or human health. This suggests the need for further research to address these issues and more fully account for the tradeoffs in material choices.

References

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