Functional classification and material characterization of plastic packaging in land litter to support effective reduction policies

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1. Introduction

Littering of plastics has received increasing attention from the scientific community over the last decade. The majority of studies focus on plastic marine litter and microplastics. However, most marine plastics originate from land-based sources, such as litter, and were transported via rivers and wind to the seas and oceans (Jambeck et al., 2015). Hence, to tackle the marine litter problem at source, effective measures have to be taken to reduce littering on land. Unfortunately, only very little information is available with regard to functional and material composition of land litter, making it hard for policy makers to define effective reduction measures. Therefore, this work presents an elaborate functional classification and material characterization of plastic packaging in land litter representatively sampled in Flanders, the northern region of Belgium. Moreover, based on the results, measures to reduce plastic packaging litter are suggested.

2. Materials and methods

The plastic packaging litter samples classified and characterized in this work, were collected in the context of a comprehensive study to determine litter composition in Flanders, which was organized by the Flemish Public Waste Agency between 2019 and 2021 (OVAM, 2022). To sample litter in a representative way, the public domain in Flanders was divided in 10 m x 10 m grid squares. From these, the number of grid squares needed to obtain a sample with a confidence level of 95% and a maximum margin of error of 5% were randomly selected. In the selected squares, all litter was collected and subsequently sorted into 29 fractions, of which 8 contained plastic packaging. In this work, the packaging items in these 8 fractions were further classified with regard to their function. A distinction was made between beverage packaging (bottles, bottle caps, cups and lids, and beverage pouches), food packaging (rigid packaging and films) and non-food packaging (rigid packaging, films and bags).

Next, each item in the sorted functional fractions was scanned with a handheld NIR-scanner (Thermo Scientific microPHAZIR PC) to determine the polymer type (PP, PET, PE, PS, XPS, PA, PLA, PVC). Unidentified plastics (e.g., laminates), plastic films with an aluminum barrier and black plastics were each sorted separately. All sorted material fractions were weighed on a balance with a precision of 0.01 g (Mettler-Toledo MS3002TS/00). Additionally, the number of items in each material fraction was determined.

3. Results and discussion

Figure 1 shows that in mass, plastic bottles clearly constituted the largest fraction in plastic packaging litter (50.4%), obviously making it the fraction with the highest potential to reduce litter mass. Packaging films (food and non-food combined) are the second most important fraction in terms of mass (19.2%), closely followed by rigid packaging (food and non-food combined, 18.2%).

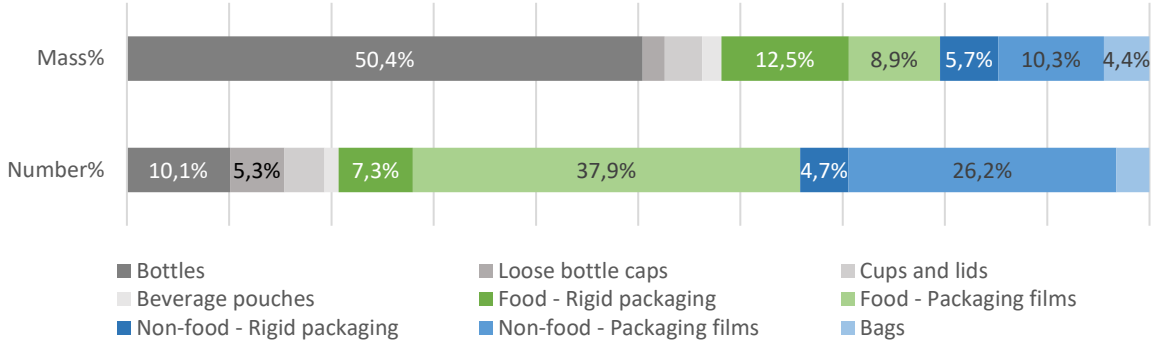

Figure 1: Mass and number shares (%) of the different functional fractions in plastic packaging litter sampled in Flanders (Belgium), 2021

In contrast, in number, plastic bottles only took up the third largest share (10.3%), after food (37.9%) and non-food (26.2%) packaging films. The difference between number and mass% for plastic packaging films can be

explained by the fact that these films largely consisted of small and lightweight items, such as cookie wrappers and fragments of torn-open packaging.

With regard to polymer type, Figure 2 clearly shows that the bottles fraction consisted almost entirely of PET. Other fractions that merely consisted of one polymer type were non-food packaging films (PE), bags (PE), loose bottle caps (PE) and beverage pouches (aluminum barrier). The 'cups and lids', food and non-food rigid packaging and the food packaging films consisted of a variety of polymer types, with PP, PET and PE being the most abundant polymers in different ratios. In the 'cups and lids' fraction, also PS was one of the main polymer types, whereas the food packaging films also consisted for a considerable share (30%) of plastics with an aluminum barrier.

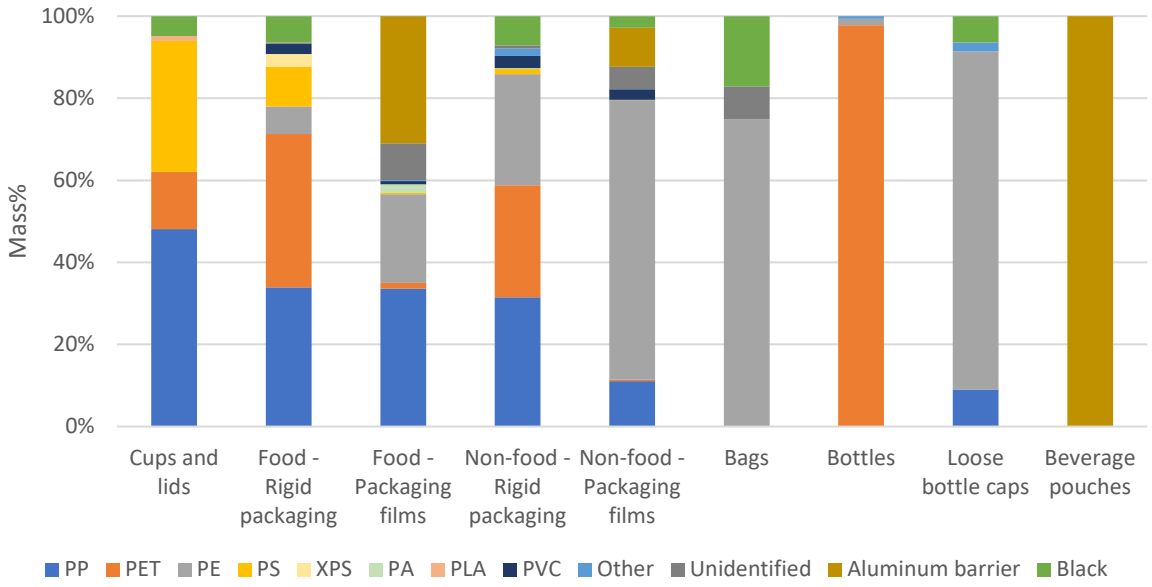

Figure 2: Polymer and plastic type shares (mass%) per functional fraction in plastic packaging litter sampled in Flanders (Belgium), 2021

4. Conclusions

Within the plastic packaging litter analyzed in this study, bottles were the largest fraction in mass (about 50%) and the third largest fraction in number (about 10%). Hence, measures focusing on avoiding plastic bottles in litter, such as a deposit return system, could reduce a considerable part of the plastic packaging mass littered into the environment. However, since the share of plastic packaging in the total collected land litter was only 14%, the overall effect of such a measure on the litter mass will be limited.

In terms of numbers of items, food and non-food packaging films such as cookie wrappers constituted the largest fraction in plastic packaging litter (about 65%), indicating their high 'likeliness-to-get-littered'. Effective policies to avoid littering of these types of packaging seem to be key here. In that respect, the proposal by the European Commission on packaging and packaging waste that restricts single-use grouped packaging and single-use packaging for individual portions of certain products such as coffee creamer in the HORECA sector, is a first step.

5. References

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