Factsheet 07 | How can sorting procedures for packaging waste be organised?

This factsheet outlines the key elements of sorting processes and explains how they work. It also discusses ways in which the system operator (PRO) can carry out its responsibilities with regard to sorting packaging waste.

Both collection and sorting of packaging waste are integral parts of EPR systems. Packaging waste can be collected as a single material (for example if collection covers PET bottles or metal cans only) or as a mixed fraction (e.g. mixed lightweight packaging[1]). > See Factsheet 06 In both cases, further sorting is usually required in order to separate out marketable fractions.

The EPR system is responsible for organising sorting so that specific mono-material packaging fractions can be separated from collected waste and then recycled. This is a key task of the system operator (PRO); it is down to the system operator to organise and finance the sorting activity required after the packaging is collected. The necessary arrangements may be made on the basis of tender processes specifically for sorting waste, or using combined tenders covering both collection and sorting.

Manual and automated sorting

As shown in Photo 1, sorting large quantities of lightweight packaging requires significant sorting capacity.

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[1] The term 'lightweight packaging' refers to packaging made of plastics, metals or composites (such as beverage cartons).

Photo 1: Collecting mixed lightweight packaging in Germany (© cyclos 2019)

Sorting collected packaging waste is an essential requirement for mono-material collections (for instance collections of PET bottles only). Before the packaging can be delivered to recycling plants, any residues, contamination and/or impurities must be removed, and the packaging must be sorted by colour to improve the market value.

Packaging collected in mono-material collections has to be re-sorted prior to recycling to filter out any material that is contaminated or has been wrongly assigned to the collection, as these materials would make the waste less suitable for recycling and reduce its commercial value. Packaging collected as mixed lightweight packaging needs to be sorted into marketable fractions and pressed into transportable bales. The photos in Figure 3 provide an overview of the most important fractions obtained by sorting plastic packaging, which are then delivered to plants for recycling or energy recovery.

Photo 2: Separate collection of PET bottles, from a project in Beijing, China (© cyclos 2019)

Photo 3: Various sorted plastic fractions (from mixed lightweight packaging collection) (© cyclos 2018)

Sorting using manual processes

In low- and middle-income countries, sorting is often a manual process. The mixed fractions are separated and the recyclable fractions are then sorted by hand, rather than using mechanised sorting systems. The advantages of sorting waste by hand are that it requires a small investment, it is easy for workers to do (particularly if they have conveyer belts to help them), and is a reliable method, as the basic technical equipment required is less prone to breakdowns than more advanced systems. As it is a labour-intensive process, manual sorting also creates jobs.

On the other hand, the amount of waste that can be sorted using a manual system is comparatively limited, as is the quality of the recyclable waste. Sorting waste into various plastic fractions by hand requires considerable expertise and is a time-consuming process. Moreover, as the system relies on the abilities of individual workers, more errors tend to be made than with an automated system. Identifying different fractions is difficult; for example, manual sorting systems struggle to sort metals beyond the two basic categories of ferrous and non-ferrous.

Photo 4: Sorting mixed lightweight packaging manually in Beijing, China (© cyclos 2019)

Photo 5: Sorting PET bottles in Accra, Ghana (© cyclos 2019)

To compensate for these disadvantages, manual sorting is often supported by various technical equipment, generally including tools for separating and classifying material flows (e.g. bag openers or screens) and equipment for separating ferrous metals (magnetic separators). This makes it much easier to remove fine residues and ferrous metals before the material is sorted manually. Systems can be gradually expanded to cover more fractions and can be adapted to take account of developments in local markets.
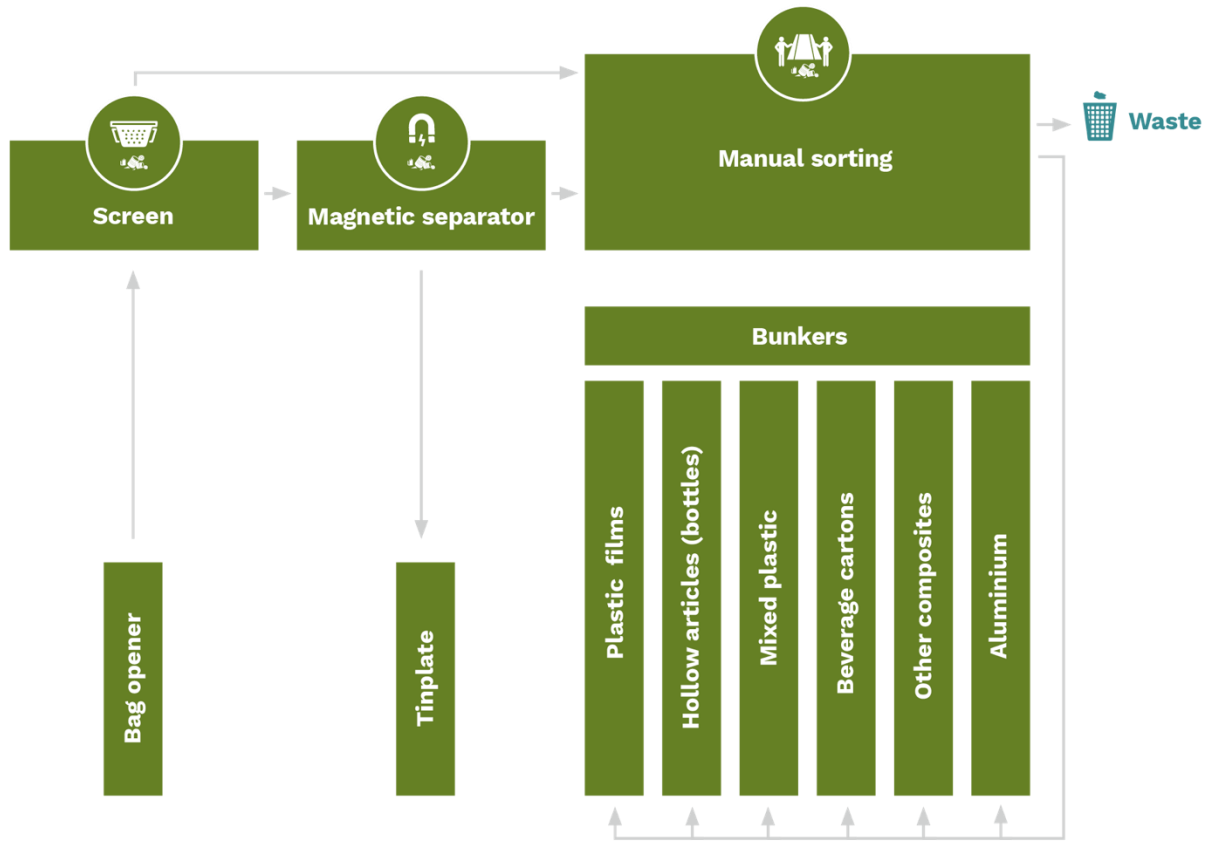
Figure 1: Outline of a simple sorting process for lightweight packaging in which most sorting is done manually

Waste pickers working in the informal sector can be easily integrated into the sorting process, especially for labour-intensive manual systems. > See Factsheet 08 Such manual systems are therefore best suited to EPR systems in low- and middle-income countries, where they can be used effectively to sort collected packaging waste at smaller, decentralised facilities where most sorting is done by hand.

In areas where very large quantities of packaging are collected separately through the EPR system every day, small sorting plants operating mostly by hand may not have the capacity to sort the required quantities of waste. This is a particular problem in megacities. In this situation, it is a good idea to set up larger-scale, predominantly automated, sorting systems.

Automated sorting

Most modern sorting plants are almost completely automated and use a multitude of separation tools. These automated systems replace manual sorting and produce highly-differentiated material flows, which can then be marketed directly to recycling companies.
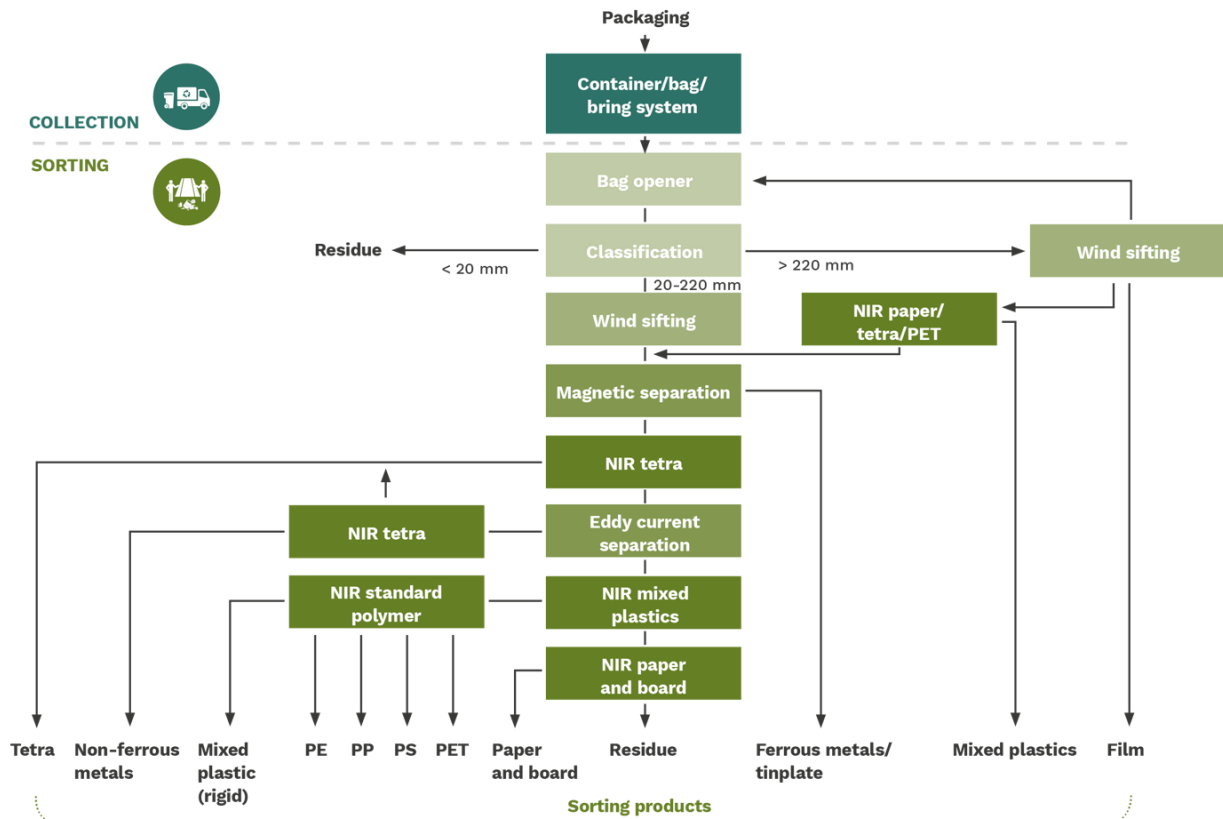
Figure 2: Flow chart of a modern, state-of-the-art lightweight packaging/material sorting process (Source: Institut cyclos-HTP, own representation)

A good automatic sorting system for lightweight packaging should include the following:

- A bag opening mechanism for separating mixed packaging (if it is collected in bags).
- A classification system. This system screens the material collected and assigns it to between 3 and 5 different categories according to the size and coarseness of individual particles. This allows the system to filter out fine particles and organic material, and to remove large pieces of material that might cause disruption during sorting. The rest of the material will be of more or less average size (the exact size depends on the size of the packaging) and easy to sort.
- A wind-sifting system for separating film and paper.
- A magnetic separation system for recovering ferrous metals/tinplate.
- Eddy current separation for separating out non-ferrous metals.
- Sensor-based optical sorting.

State-of-the-art facilities in Europe often have more than 20 of these sorting machines, set up to identify, sort and separate different types of plastic (PE, PP, PET, PS) and liquid packaging board (LPB)[2]. In addition to pure NIR[3] separators, a specific process can also be used to carry out multiple

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[2] Liquid Packaging Board is not an end product as such, but is intended to be used for production of beverage cartons. It cannot be used for card-based products other than beverage cartons.

[3] Near-infrared (NIR) reflectance spectroscopy. NIR is the most important detection method in for sorting light packaging/materials, and is used to differentiate between plastics and other materials containing hydrocarbons. The detector is positioned over an accelerator belt, just ahead of a belt transfer point, and measures radiation from a conventional halogen light source, reflected from the near-

different detection tests (e.g. NIR, colour measurement, form recognition and eddy current separation[4]) from a single machine (known as a multi-sensor separator). This is very useful for separating bottles from trays, for instance.

Photo 6: A sorting plant for lightweight packaging in Rotterdam, the Netherlands (© SUEZ 2019)

Larger, more modern sorting plants process huge quantities of waste, of around 200,000 tonnes per year. Setting up plants like these in low- and middle-income countries can be difficult, due to the nature of the equipment required and the associated investment costs, which can amount to around €15m.

Sorting residual waste

In many countries, the first stage of the sorting process is to sort recyclables from residual waste. This part of the sorting process removes the need for separate recyclables collections. However, sorting this way also comes with several disadvantages:

- Huge quantities of waste have to be brought to the sorting plant to find a very small proportion of packaging.
- The collected waste contains a considerable proportion of organic waste. This organic waste contaminates the sorted recyclables and thus reduces their economic and recycling value. In some cases, it may make them impossible to recycle.

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surface layers of an object. These measurements are fed back to a computer, which compares the spectrum emitted from the object to reference spectra. If the object is positively identified as belonging to a certain fraction, a jet of compressed air is fired at the object to push it off the belt and into the area reserved for its particular frac

[4] Eddy current separation is used to separate metallic from non-ferromagnetic components. The system is set up in such a way that any liquid cartons with aluminium coatings that have not already been separated out by an upstream NIR beverage carton sorting system are discharged into the product flow. This flow then has to be purified in an NIR separation stage. The principle behind eddy current separation is based on the induction of electrical currents in electrically-conductive materials using a high-frequency alternating magnetic field.

- The huge amount of organic waste causes odour pollution and leads to poor working conditions.
- The technical equipment in the sorting plant quickly becomes contaminated by the large amounts of organic waste. Cleaning the plant to deal with this problem can be very expensive.

Photo 7: Residual waste being sorted in a pilot plant in Amman, Jordan (© cyclos 2019)

Photo 8: Contaminated PET bottles separated from residual waste (© cyclos 2019)

Key readings and other sources

PREVENT Waste Alliance (2021).

Video series:

EPR Explained! (07) Sorting of packaging waste

Institut cyclos-HTP (2019). Verification and examination of recyclability. Available at http://cyclos-htp.de/fileadmin/user_upload/2019_Katalog/Verification_and_examination_of_recyclability_-_Revision_4.0.pdf

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