SOP – Simulation of consumer use, collection, and transport of packaging waste

NTCP

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1 Introduction

1.1 NTCP

The National Test centre for Circular Plastics (NTCP) in Heerenveen (The Netherlands) was established in 2018 to facilitate the development of sorting of the different plastic streams from municipal waste in industrial sorting facilities. A pilot scale sorting line and washing line are available to support the development of more efficient plastic recycling. This is done by facilitating the design process (support design for recyclability), facilitating technology development (real life testing of the process on pilot scale) and the development data-driven decision models for sorting.

1.2 Background

For the recycling of flexible plastic packaging to work, it is essential that the packaging ends up in the intended output streams. Before packaging waste enters an output stream it will undergo consumer use, collection, transport and sorting steps that can influence its appearance that can have an effect on the sortability itself.

1.3 Objective(s)

The goal of this SOP is to offer a representative method to simulate the consumer use, collection, transport, and sorting of plastic packaging material and quantify the effects on the appearance of the packaging.

2 Materials & equipment

2.1 Equipment

For this SOP, the following equipment is needed.

2.1.1 Material preparation

- cement mixer, approx. 180 l as shown in Figure 1;

Figure 1. Cement mixer.

- vertical baling press as shown in Figure 2.

Figure 2. Vertical baling press.

2.1.2 Sorting friction

- A functioning sorting line for packaging material.

2.1.3 General

- digital camera;

- analytical scale;
- micrometre;
- boxes, buckets, etc.
- ruler or other measuring device.

2.2 Materials

2.2.1 Material preparation

Within this SOP, the term SKU (stock keeping unit) is used to indicate an individual sample of a specific packaging.

- 50 pieces of each SKU; in case the product is viscous or sticky, *e.g.* ketchup or honey, the SKUs should be filled with the product;
- fines (< 40 mm) material coming from waste; *e.g.* from RDF fraction;
- 50 kg real packaging waste, retrieved from a source separated PMD stream in the Netherlands.

3 Method

For the assessment, the following steps are performed for each SKU:

- SKU registration
- Consumer use simulation (e.g. product residue)
- Collection and transport simulation (contamination and compression)
- Sorting friction (only needed when no subsequent sortability trial is performed)

3.1 SKU registration

All SKUs used in the assessment are registered in the following way:

1. Take photographs of the pristine SKU and where needed of different parts of the SKU.
2. Record all quantities shown in the table below and report them using this table as template.

<SKU ID & description>	**<image of the SKU>**	**<image of the SKU>**	**<image of the SKU>**
	Part 1 type	**Part 2**	**Part 3**
Mass [±0.5 g]			
Material			
Size [mm x mm x mm] as received			
Colour			
Transparency			
Film thickness [±10 µm]			
Mass prepared SKU [±0.5 g]			
m / A prepared SKU [g / m^2]			
Use			
Remarks			

3.2 Consumer use simulation

For each SKU, estimate how the SKU is used by the consumer before disposal. This can be different for each SKU. Aspects to consider are:

- Pouches with spout will be thrown away with cap.
- Packaging designed for viscous liquids and gels should be empties as a consumer would do.
- Tear-off parts should be removed (if testing of this part is needed, that is done separately).
- Packaging should always be opened and deformed as a consumer would do.

The use simulation consists of the following steps:

1. Filled SKU items are opened and emptied.
2. Determine the mass of the contained product and store in a bucket or other container.
3. In case SKU items are delivered empty, they are contaminated with their own product or a similar product.
4. Photos are taken of the SKU items before and after the process.
5. Quantification of changes in the SKU items (*e.g.* sleeve removal or damage, cap removal, or torn packaging).

3.3 Collection and transport simulation

This step mimics the contamination and compression of the packaging that would normally occur during collection transport, and storage. Pictures before contamination, after contamination, and after compression will provide an indication of the effect of collection and transport on the appearance of the packaging. Packaging containing paper can absorb substantial amounts of water. Therefore, this packaging material does not follow exactly the same protocol.

1. 50 items of each SKU are compressed, together with household packaging waste, in a baling press with a compression rate of 1/5 for 5 minutes.
2. Open the press and mix the material; compress with the same settings three time uninterruptedly.
3. Add the SKU items to a concrete mixer together with in total 350 g of fines.
4. For paper containing SKUs also add 100 g of water to the mixer.
5. Mix the material for 10 minutes to simulate friction and contamination.
6. Take a photo of the contaminated SKU items.
7. Quantification of changes in the SKU items (*e.g.* sleeve removal or damage, cap removal, or torn packaging).
8. The SKU items are compressed again in the baling press with a compression rate of 1/5.
9. The SKU items are subsequently mixed in the concrete mixer for 10 minutes to simulate more friction.
10. The mass of the SKU items is measured at the end of the process and added to the table with the SKU description.
11. Take photos of the prepared SKU items.
12. Quantification of changes in the SKU items (*e.g.* sleeve removal or damage, cap removal, or torn packaging).

Steps 1 and 3 simulate the compression and contamination in a dumpster truck that picks up the waste, whereas steps 6 and 9 simulate the dumping and the transport to the sorting installation.

3.4 Sorting friction

The sorting line at NTCP is designed in a loop using standard industrial equipment.

The assessment is performed as follows:

1. The sorting line is put in operation at its standard settings; settings are recorded and reported.
2. The drum feeder is fed with approx. 75 kg PMD which is looped over the sorting line.
3. At least 50 items of the SKU are fed one-by-one into the sorting line in the already present PMD stream.
4. After 10 minutes of running the line, the SKUs are collected from the line.
5. Take photos of the SKU items after sorting friction.
6. Quantification of changes in the SKU items (*e.g.* sleeve removal or damage, cap removal, or torn packaging).

4 Reporting

The results of the assessment are reported in the NTCP report template, including at least:

- Reference to this protocol.
- Detailed SKU description as shown in paragraph 3.1.
- Photos of pristine SKU, contaminated SKU items, prepared SKU items, and of SKU items after sorting friction.
- Quantification of changes in the SKU along the process.

References

1. **RecyClass.** *Sorting evaluation protocol for plastic packaging.* s.l. : RecyClass, 2021. Protocol. Version 1.0.