



GENERAL NOTICE 67

Impact of sleeves on the sorting and recycling of PET bottles

SUMMARY







The purpose of this general notice is to assess the sorting and recycling potential of PET bottles featuring sleeves. Sleeves have already been studied by COTREP and been the subject of a number of publications.











In this notice, COTREP wished to further its analysis of the end-of-life of rigid PET packaging with sleeves made of PETG, PS, PETG/PS, PE, PO, PET with a density lower than 1, crystallised PET or PVC by conducting new sorting tests and broadening its recommendations to all sleeves available on the French market.

Given the current state of equipment and techniques used in France, the tests and studies conducted by COTREP on PET packaging items show that not all sleeves react in the same way. COTREP recommends using a label or partial sleeve to maximise capture of the packaging at sorting centres and guarantee transfer to regeneration plants. **Only sleeves with a density lower than 1 are partially compatible with PET bottle recycling.**

To facilitate sleeved bottle sorting and recycling, the use of perforations can help with sleeve removal during the collection and sorting stages, thereby making bottle recycling easier. The perforation criteria are set out in section 6 below.

Sorting and recycling potential of PET packaging items with sleeves (< 60µm thick)

MATERIAL	IMPACT DURING SORTING AND REGENERATION		COTREP'S OPINION
PE	 Sorting	A full sleeve reduces sorting efficiency and directs the bottle to the coloured PET stream.	Partial compatibility – tolerated
	 Regeneration	Compatible but resulting in greater losses and waste at regeneration plants.	
PO	 Sorting	A full sleeve reduces sorting efficiency and directs the bottle to the coloured PET stream.	Partial compatibility – tolerated
	 Regeneration	Compatible but resulting in greater losses and waste at regeneration plants.	
PET D<1	 Sorting	A full sleeve directs the bottle to the clear PET, coloured PET or rejects stream (random).	Partial compatibility – tolerated
	 Regeneration	Some bottles rejected. No impact on regeneration if the bottles pass through the optical sorting process.	

CRYSTALLISED PET	 Sorting	A partial sleeve directs the bottle to the clear PET or coloured PET stream. A full sleeve directs the bottle mainly to the coloured PET stream, with a small proportion directed to the clear PET stream.	Limited compatibility – should be avoided on coloured PET bottles and dispenser bottles Non-compatible and/or disruptive on clear PET bottles and dispenser bottles
	 Regeneration	Flakes from printed crystallised PET sleeves mainly sink with bottle PET flakes → risk of contaminating the clear PET stream. Used on coloured PET bottles, the sleeve material is compatible with coloured rPET where inks are tolerated.	
PETG	 Sorting	The bottle will be directed to the coloured PET stream.	Non-compatible and/or disruptive
	 Regeneration	Some bottles rejected. Process pollution, losses and deterioration of rPET quality.	
PS	 Sorting	The bottle will be directed to the clear PET stream.	Non-compatible and/or disruptive
	 Regeneration	Some bottles rejected via optical sorting. Deterioration in rPET quality.	
PETG/PS	 Sorting	The bottle will be directed to the clear PET stream.	Non-compatible and/or disruptive
	 Regeneration	Some bottles rejected via optical sorting. Deterioration in rPET quality.	
PVC	 Sorting	A full sleeve directs the bottle to the rejects stream.	Non-compatible and/or disruptive
	 Regeneration	Significant rPET losses and deterioration of rPET quality.	

COTREP is monitoring developments in the sleeved bottle market and may review its opinion with regard to the volumes placed on the market, progress in recognition at sorting centres, perforation and compatibility between the materials used for sleeves and bottles.

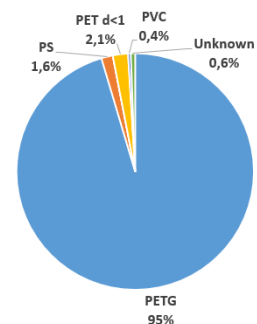
1. CONTEXT

Labels and sleeves are essential components of plastic bottles for household use. They enable manufacturers to meet their obligations regarding consumer information, giving details relating to the brand, product composition, use-by date, usage precautions where applicable and the procedure to follow for recycling the packaging after use.

In recent years, the use of sleeves has developed on the French market, in some cases to perform a particular function (conceal product decanting, add a light barrier without requiring additives to PET, etc.) and in other cases for marketing purposes.

Sleeves can be partial or cover the full body of the bottle. Their main difference with labels is that they do not require adhesive as they

Sleeve materials on PET packaging (excluding PE sleeves)



Source: COTREP survey, 2018, updated in 2021

are generally heat- or steam-shrunk to the body (except for PE stretch sleeves, in which case the material's elasticity suffices to hold the sleeve in place).

In 2021, there were 12,500 tonnes of PET bottles with full sleeves¹ on the French market, i.e., 3% of bottles. This market is experiencing significant growth as a 120% increase was observed compared with 2018 data (5,700 tonnes). 98% of PET bottles with full sleeves are made of clear PET. PETG and PS are the main components of sleeves on the French market.

These sleeved PET bottles are rarely recycled at present as explained in previous COTREP notices. COTREP wished to deepen understanding of this packaging's sorting and recycling potential to help the companies concerned better understand the issue and identify appropriate solutions.

2. MATERIALS USED FOR SLEEVES

There are two types of sleeves on PET bottles available on the French market:

1. PE stretch sleeves
2. Shrink sleeves made of:
 - PETG,
 - PS,
 - PETG/PS,
 - Polyolefins,
 - PET d<1,
 - Crystallised PET²,
 - PVC.

All the sleeve types listed above were assessed in the context of this notice.

3. POTENTIAL AT SORTING CENTRES

The sorting potential of PET bottles with sleeves during the optical sorting phase when passing through sorting centres depends on several factors:

- **Sleeve thickness:** in theory, the thicker the sleeve, the more difficult it will be to identify the material of the bottle beneath it. The sleeves tested by COTREP have a thickness of between 40 and 60 microns (representative of the market) and these thicknesses enabled the PET to be identified beneath the sleeve. These thicknesses are not a limiting factor for sorting. We recommend limiting the sleeve thickness.
- **Coverage rate:** the size of the sleeve will affect the bottle's sorting efficiency. On bottles with a volume of 500 ml or more, a sleeve covering 70% of the bottle's body at most is recommended to improve the capture rate. On bottles with smaller volumes, a proportion of 50% of the bottle's body at most is recommended. Transparent areas can improve bottle capture, particularly when they are at the top or bottom of the sleeve.

It should be noted that optical sorting cannot identify the colour of the bottle beneath the sleeve if it covers the majority of the bottle's body. Clear PET cannot be distinguished from coloured PET and so **the use of clear PET is advised with a full sleeve.**

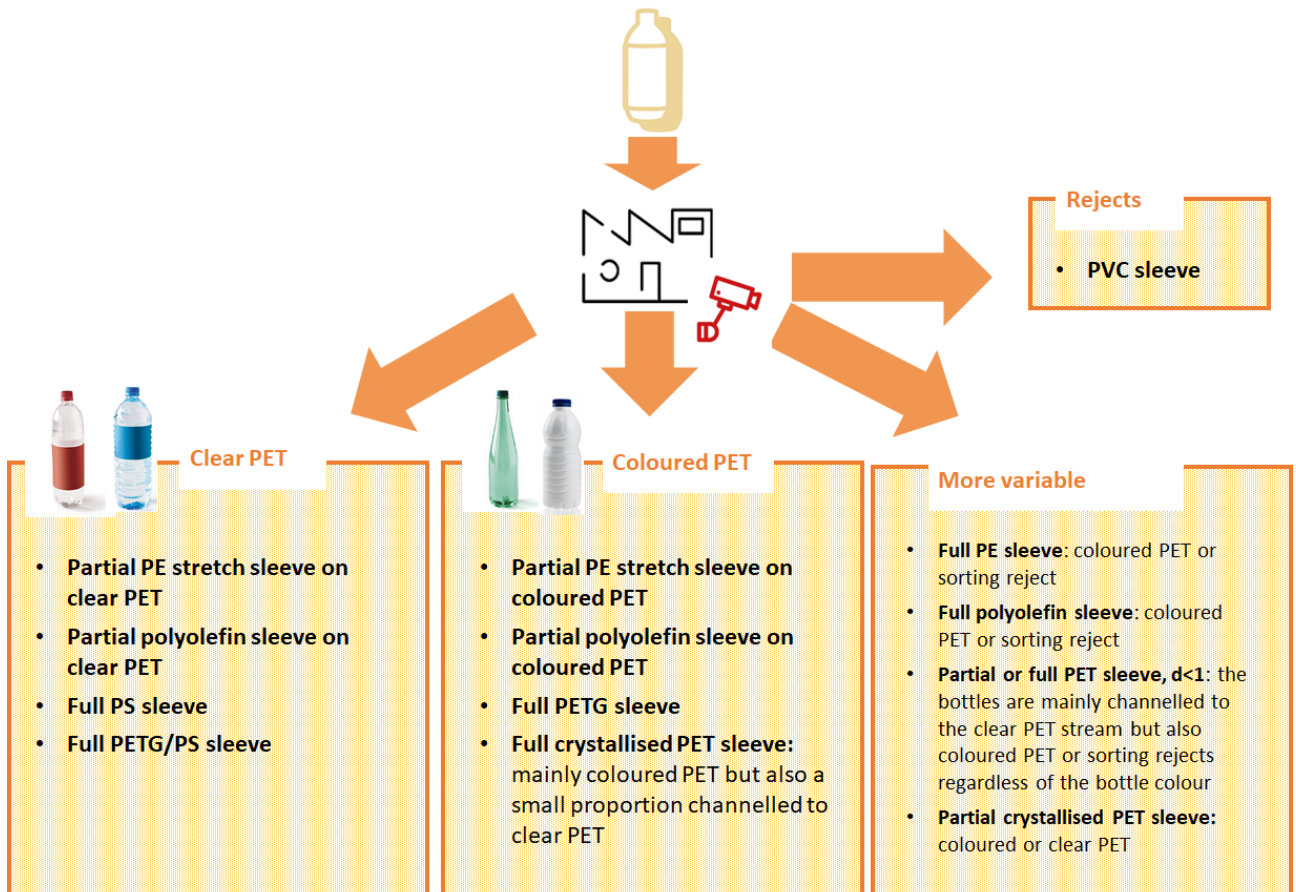
- **Printing:** a metallised sleeve for design purposes renders the bottle undetectable by optical sorting systems, as the NIR radiation will not be able to identify the bottle. A large solid black fill on the inner or outer surface can also adversely affect sorting or block radiation at the sleeve surface material.
- **Sleeve resin:** optical sorters scan the combination of bottle resin and sleeve resin to determine channelling at the sorting centre.

¹ Confidential survey conducted by COTREP in 2018-2019 and updated in 2021

² Crystallised PET is a trade name that describes a type of sleeve whose crystallinity is similar to bottle-grade PET resin. It is different from the crystallised PET resin used for trays.

The diagram below shows the results of COTREP tests simulating the technologies and configurations currently used at French sorting centres.

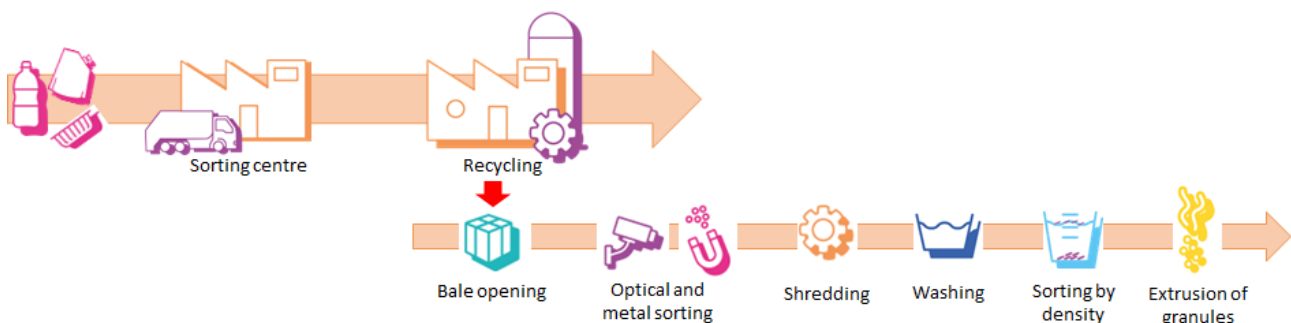
During manual filtering, which occurs after optical sorting at sorting centres or regeneration plants, COTREP notes that a significant proportion of bottles with full sleeves are processed as sorting rejects and subsequently sent for energy recovery in the majority of cases. This additional filtering is aimed at preventing disruption during the regeneration phase by removing bottles that are not compatible with the processes or the required recycled material quality as early as possible. During this phase, the sleeve's resin is not an issue as identification is visual.



Summary of sleeved PET bottle channelling at sorting centres tested by COTREP

4. POTENTIAL DURING CLEAR PET REGENERATION

Six types of sleeved bottles were identified as being fully or partly channelled to clear PET bales at sorting centres: partial PE stretch sleeves and partial polyolefin sleeves on clear PET, full PS, full PETG/PS, PET $d < 1$ and crystallised PET. These bales are then regenerated and mainly used to produce bottles, trays and fibres according to the following procedure:



Clear PET bottles with a partial PE or polyolefin sleeve that arrive at regeneration plants are recycled and the sleeve is separated from the bottles during the flotation stage that follows the shredding process. The majority of sleeves are directed to energy recovery and a small proportion to the cap recycling stream.

PET bottles with a full PS or PETG/PS sleeve are mainly rejected and so sent for energy recovery during bottle sorting. In the event of sorting errors and the presence of these bottles in the clear PET recycling streams, the use of coloured PET beneath the sleeve and the use of PS and PETG/PS disrupt recycling, as explained in notices AG 42 and AG 44.

PET bottles with a PET sleeve of density lower than 1 ($d < 1$) that arrive at regeneration plants mainly remain in the process and a small proportion will be processed as rejects during optical sorting. The proportion of bottles remaining in the process increases in the presence of a partial sleeve on a clear PET bottle. They are then recycled and the sleeve is separated from the bottles during the flotation stage that follows the shredding process. The majority of sleeves are directed to energy recovery and the remainder are directed to the cap stream.

Channelling of **clear PET bottles featuring a partial or full sleeve made of crystallised PET** is more variable: the bottles may be directed to either the clear PET or coloured PET stream.

COTREP has not tested the regeneration potential of crystallised PET sleeves (material and printing), and in particular their potential for reintegration into food-grade packaging. In the current situation, COTREP considers crystallised PET sleeves as disruptive for recycling in the clear PET stream. Flakes from printed crystallised PET sleeves mainly sink with bottle PET flakes, and this risks contaminating the clear PET stream for reintegration into packaging. COTREP recommends additional tests on both the sleeve material and inks. Crystallised PET sleeves are therefore not compatible for use on clear PET bottles.

Regarding de-labeller technology, designed to remove any labels remaining on the bottles prior to sorting, it is important to note that:

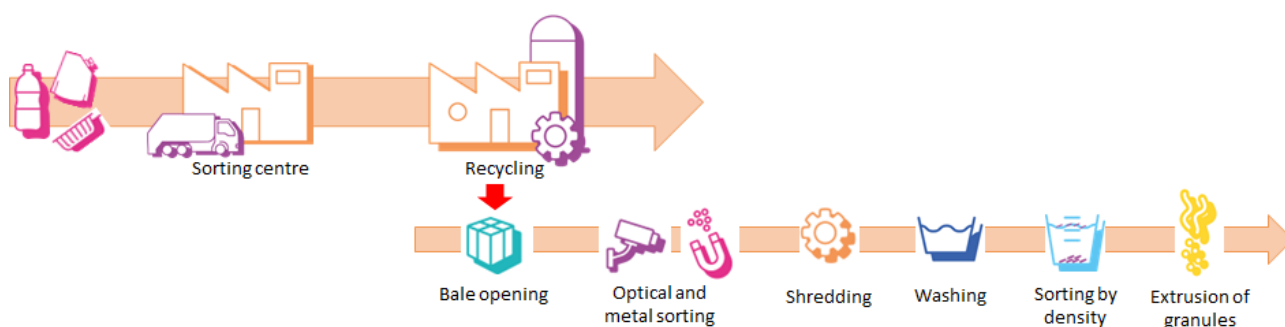
- Only some regeneration plants which target food contact (bottle grade) compliant rPET are equipped with this technology.
- De-labellers were designed for labels and are currently not able to remove sleeves efficiently, or else cause unacceptable loss of PET that could otherwise be recovered.

Pre-washing of entire bottles is not current practice, and the use of a sleeve with a water-soluble strip included in its composition will not facilitate sleeve removal prior to shredding if there is no pre-washing phase.

It should lastly be noted that sleeves add quantities of ink to wash water which bear no comparison to ink bleeding from labels. With a view to preserving the quality of food contact rPET as much as possible, **COTREP recommends using solutions that reduce bleeding into water**: choice of ink and sandwich printing.

5. POTENTIAL DURING COLOURED PET REGENERATION

Six types of sleeved bottles were identified as being fully or partly channelled to coloured PET bales at sorting centres: partial PE stretch sleeves and partial polyolefin sleeves on coloured PET, full polyolefin, PET with density < 1 , full PETG and crystallised PET. These bales are then regenerated and mainly used to produce fibres and strapping according to the following procedure:



Coloured PET bottles with a partial PE or polyolefin sleeve are recycled. The majority of sleeves are directed to energy recovery and a small proportion to the cap recycling stream.

PET bottles with a full sleeve made of polyolefin or PET with a density lower than 1 ($d < 1$) that arrive at regeneration plants mainly remain in the process and a small proportion will be processed as rejects during optical sorting. The bottles that remain in the process are recycled and the sleeve is separated from the bottles during the flotation stage that follows the shredding process. The majority of sleeves are directed to energy recovery and the remainder are directed to the cap stream.

PET bottles with a PETG sleeve are identified as sleeveless coloured PET bottles. Some recycling operators use manual filtering to remove the majority of these bottles at line entry. For bottles that pass through the process or do not undergo manual filtering, PETG disrupts recycling, as explained in COTREP's notice AG 44.

Coloured PET bottles with a partial or full crystallised PET sleeve are mainly directed to the coloured PET stream. COTREP's research has shown that the presence of bottles with a crystallised PET sleeve has no impact on fibre production. However, given the current transition nationwide on the development of streams including recycling to food contact grade, this type of sleeve will thus have limited compatibility for use on coloured PET bottles. COTREP recommends additional tests on both the sleeve material and inks for such use.

Coloured PET regeneration plants are not generally equipped with de-labellers or pre-wash systems for entire bottles.

6. SLEEVE PERFORATION

To facilitate sleeved bottle sorting and recycling, the use of perforations meeting the criteria listed below can help with sleeve removal during the collection and sorting stages and so make bottle recycling easier. As separation is not systematic, the recommendations regarding the material chosen remain unchanged: to date **only sleeves with a density lower than 1 allow all or some of the PET bottles to be recycled.**

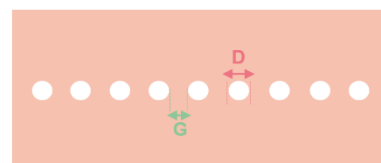
The criteria are:

- D:G ratio (perforation diameter:spacing between perforations) greater than or close to 3;
- D value close to 1.2mm;
- Use two perforation lines positioned between 90° and 180° around the bottle.

TECHNICAL CONCLUSIONS

Given the current state of equipment and techniques used in France, the tests and studies conducted by COTREP on PET packaging items with sleeves lead to the following conclusions:

- Partial PE and PO sleeves do not disrupt sorting and regeneration.
- Full PE and PO sleeves reduce sorting efficiency and direct bottles to the coloured PET stream. They are compatible with regeneration streams but result in greater losses and waste at regeneration plants.
- Full PET sleeves with a density lower than 1 direct bottles to the clear PET, coloured PET or rejects streams at random. They are compatible with regeneration streams but result in greater losses and waste at regeneration plants.
- PETG sleeves direct bottles to the coloured PET stream. They are not compatible with the regeneration stream as they pollute the process and cause losses and deterioration of rPET quality.
- PS sleeves direct bottles to the clear PET stream. They are not compatible with the regeneration stream as they cause losses and deterioration of rPET quality.
- PETG/PS sleeves direct bottles to the clear PET stream. They are not compatible with the regeneration stream as they cause losses and deterioration of rPET quality.
- PVC sleeves mainly direct bottles to rejects; they hence reduce the capture of packaging at sorting centres and, regardless of the coverage rate, are not compatible with the regeneration stream as they cause losses and deterioration of rPET quality and limit potential energy recovery from regeneration plant rejects.
- Depending on the coverage rate, crystallised PET sleeves are directed mainly to coloured PET streams (case of full sleeves), or



randomly to clear or coloured PET streams (case of partial sleeves). As separation by density between sleeve flakes and PET bottle flakes is not possible, crystallised PET sleeves are not compatible with the clear PET regeneration stream. These sleeves have limited compatibility if used on a coloured PET bottle.

COTREP recommends using designs that maximise capture of the packaging at sorting centres and guarantee transfer to regeneration plants.

Given the current state of knowledge, only sleeves with a density lower than 1 are partially compatible with PET bottle recycling.

COTREP is monitoring developments in the sleeved bottle market and may review its opinion with regard to the volumes placed on the market and progress made in terms of eco-design, sorting and regeneration of PET bottles.

For further information:

- General Notice 12 – Introduction to labels and sleeves
- General Notice 08 – PVC sleeve on PET
- General Notice 17 – PE stretch sleeve on PET
- General Notice 42 – PS sleeve on PET
- General Notice 44 – PETG sleeve on PET