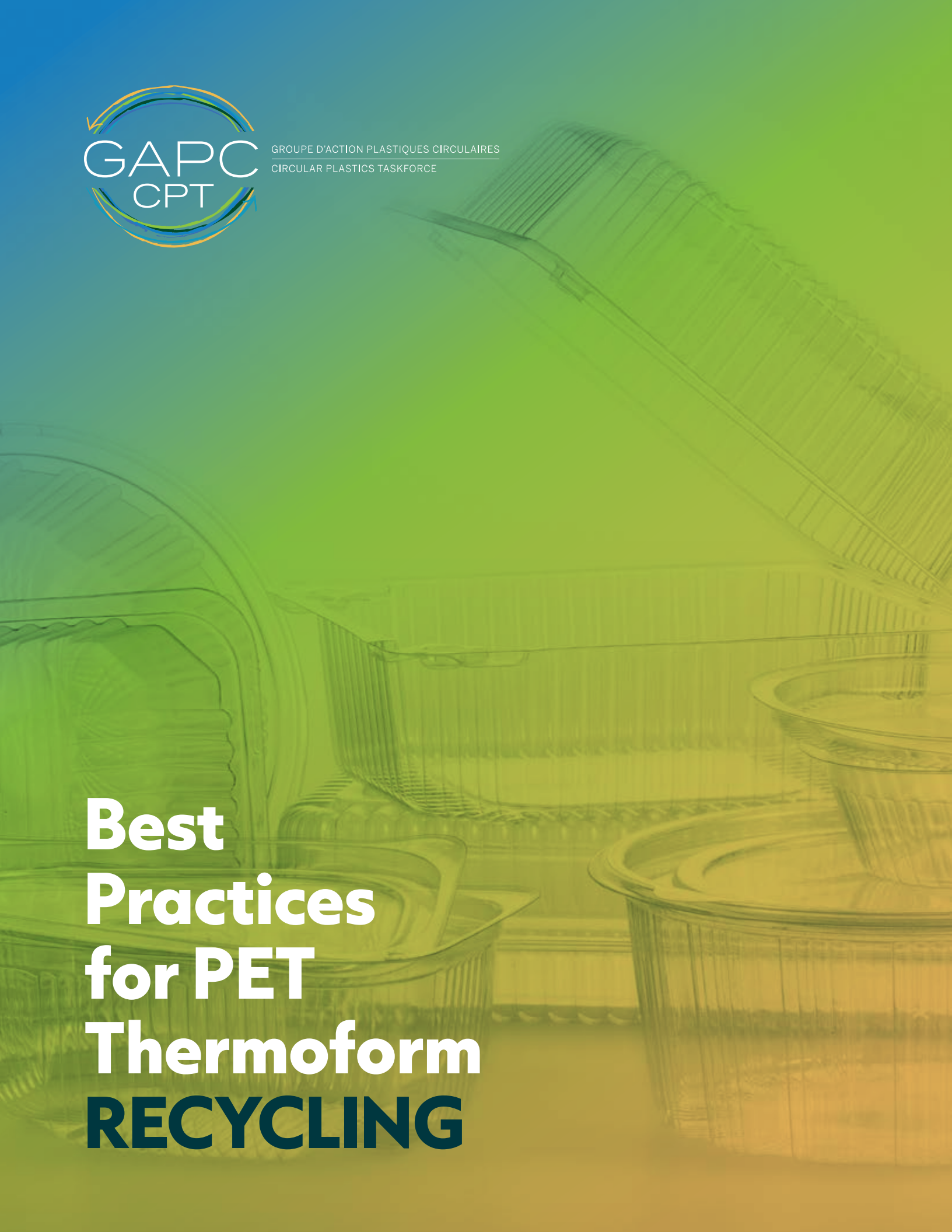
GAPC CPT

GROUPE D'ACTION PLASTIQUES CIRCULAIRES

CIRCULAR PLASTICS TASKFORCE



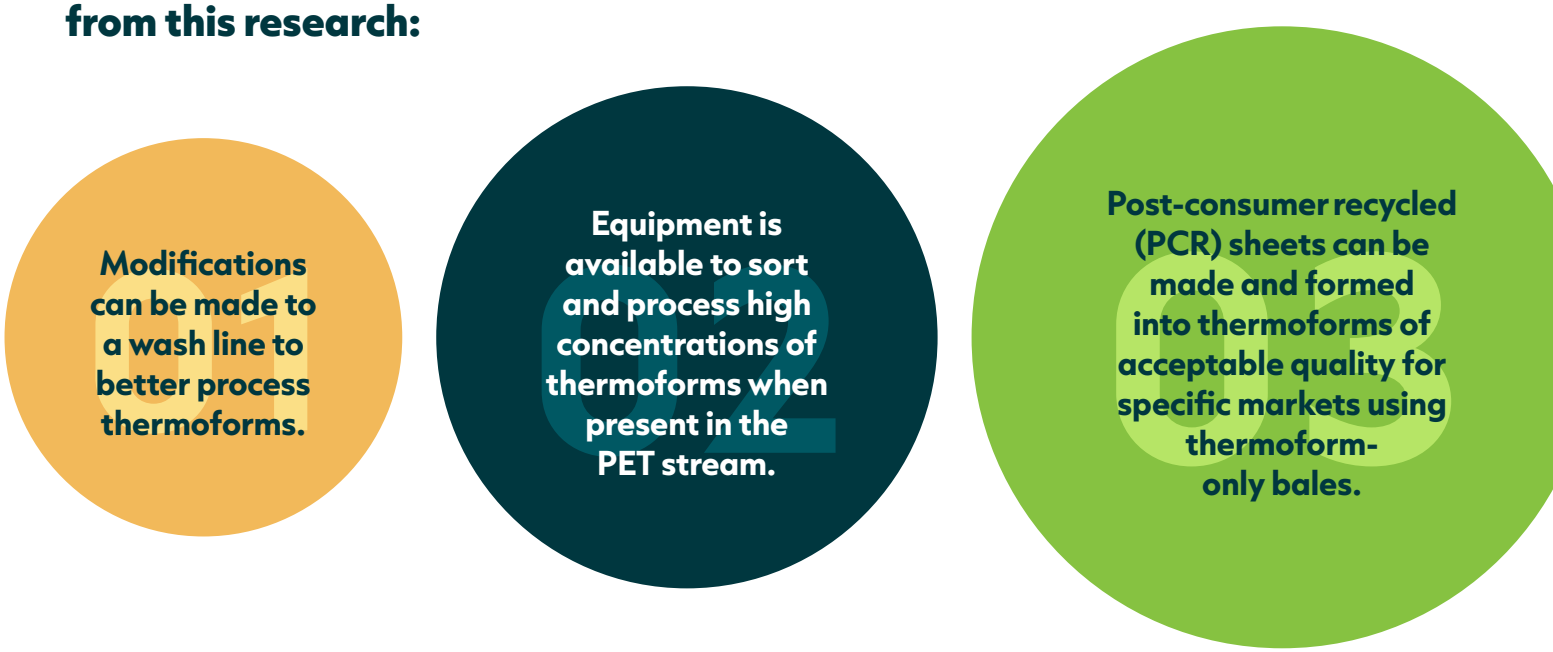
Best Practices for PET Thermoform RECYCLING

For more than 30 years, PET bottles have been collected and recycled in North America. In the last 15 years, PET thermoforms (PET TF), such as trays and clamshells, have also been introduced in the recovery stream. Since then, processing PET TF for recycling has become common practice in Canada, where over 90% of the population has access to a recycling program that accepts PET TF, with an estimated collection rate of over 50%.

However, it is considered that processing PET bottles together with thermoforms can lower the overall recycling yield and affect the quality of the recycled output, which could limit its use in some end-markets. While some reclaimers can handle a higher proportion of PET TF, whether mixed with bottles or not, both the feasibility and viability of increasing thermoform concentration in the PET recycling stream are challenged by industry players.

To look into this assertion, the Circular Plastics Taskforce (CPT) performed a study to test the ability of recyclers to efficiently process PET bales containing higher levels of thermoformed containers.

Three main conclusions emerged from this research:



While the research had its limitations due to the small sample size of the study, it demonstrated that the mechanical recycling of PET thermoforms has room to grow. In this context, this document presents best practices that can be implemented throughout the value chain by producers, materials recovery facilities (MRFs) and reclaimers to raise the capacity and improve the efficiency of PET TF recycling.

The CPT would like to thank Novaxia Inc. (collection and sortation), MG Solutech Inc. (processing) and Éco Entreprises Québec (packaging design) for their technical expertise and support in building this document. We would also like to thank the Association of Plastics Recyclers (APR) and PET recycling line manufacturers Amut, Krones, Sorema and STF for their contribution.

TARGETED audience

→ **JURISDICTIONS**
wishing to implement a PET TF recycling program

→ **SERVICE PROVIDERS**
(such as haulers, MRFs) that are required to collect and sort PET TF

→ **PRODUCERS**
that supply PET TF on the North American market

→ **RECLAIMERS**
that process PET TF, whether mixed with bottles or as thermoform-only bales

Best practices in COLLECTING AND SORTING PET TF

01 REDUCE
packaging compaction during collection

PET TF tend to have a lower resistance to pressure compared to PET or HDPE bottles. The level of compaction in collection trucks should therefore be limited to prevent PET TF deformation and reduce breakage of the material's fibers. If too compacted, the risks are that PET TF will be conveyed with the two-dimensional flow of fibers or entangled with other materials, reducing the potential for efficient capture.

TO GO EVEN FURTHER

Trucks with auger compaction systems should be avoided, as they can cause irreversible damage to more fragile materials such as PET TF.

02 MAXIMIZE
consolidation of PET TF on the container line

Bales with higher concentrations of PET TF tend to also contain other types of packaging that are difficult to distinguish from PET, such as ones made from PVC, PLA or polystyrene (PS). To lower bale contamination, the container sorting line should at minimum be equipped with near infrared (NIR) optical sorters to separate PET from other container and packaging types. In single stream MRFs, it is recommended for the optical sorters to be installed in the front end.

TO GO EVEN FURTHER

State-of-the-art optical sorters are also able to differentiate between PET TF and other items such as PET bottles, multi-layer packaging and opaque bottles with a TiO_2 opacifier, enabling the production of bales that meet recycler specifications.

03 SORT OUT
plastics on the fiber line and return PET TF to the container sorting line

Even when applying the above recommendations, some PET TF will continue to flow on the fiber sorting line, as they will behave like a 2D format product and can easily be camouflaged by paper, cardboard and films. Adding optical sorters on the fiber line serves to both maintain the quality of the fiber stream and ensure the capture of other materials such as PET TF, provided that they are subsequently directed to their dedicated channel and not to the rejects.

TO GO EVEN FURTHER

In single stream MRFs, consider using closed-loop systems where missorted materials are redirected to the appropriate stream.

04 STABILIZE
materials and standardize their distribution on equipment

Whenever possible, the design of a sorting system should promote uniform distribution of materials across all equipment to optimize performance.

More precisely

- → On a container sorting line, the acceleration conveyor upstream of an optical sorter must have a minimum length of 6 meters (around 20 feet), or according to the supplier specification, to allow moving containers to stabilize throughout the conveyor run.
- → On a fiber sorting line, the acceleration conveyor upstream of an optical sorter should ideally be fitted with wind tunnel stabilization equipment to prevent volatility.

TO GO EVEN FURTHER

To help stabilize materials and ensure better distribution, the use of equipment such as vibrating or rotary tables is recommended, especially when making the transition between two conveyors of different widths or involving a change of orientation.

05 USE
state-of-the-art equipment to remove disruptive components

Optical detection of PET TF can be distorted by the presence of labels or sleeves made of different materials than the main body. Recent technological developments in optical sorters have made it possible to ignore the label or sleeve, and instead target the main body material at the periphery of the item, enabling MRFs to improve capture rates.

TO GO EVEN FURTHER

Dark PET TF, which are harder to sort as they are more difficult to detect, are increasing on the market. To solve this issue, advanced AI and object recognition technologies should be installed.

OTHER GOOD sorting practices

While not only applicable to PET TF, applying the two practices below will increase PET TF capture rate performance:

→ **INSTALL**
material return systems at quality control (QC) stations to return PET TF to dedicated storage areas.

→ **ADOPT**
a maintenance, inspection and preventive maintenance plan for equipment and the entire sorting system.

Best practices in PET TF PROCESSING

01 USE
a dedicated PET TF Recycling line

It is agreed that when using a standard PET line designed to only handle PET bottles, increasing the level of thermoforms negatively affects the quality of the output. To optimize yield, minimize lost of PET fines and optimize washing efficiency, most manufacturers can provide customized lines to handle thermoform-only bales.

02 IF USING
standard PET line:

a. **Do not use more than 15% to 30% of thermoforms (as prescribed by manufacturers)**
When increasing the level of PET TF on a non-dedicated recycling line, the maximum percentage recommended by the equipment manufacturer, which ranges from 15% to 30%, should not be exceeded. Above that threshold, yield and quality can be significantly affected, which can also impact economic viability.

b. **Adjust washing parameters**
When processing thermoform-only bales, the quantity of glue can increase by a factor of 10 to 20 compared to bottle bales. This is due to the presence of pressure sensitive labels, which use hot-melt adhesives that are difficult to remove. It is therefore recommended to keep the washing temperature at around 85°C (185°F) and to extend the residence time. Furthermore, the chemistry of the wash basin should be adjusted, as increasing the caustic concentration can facilitate glue removal.

c. **Reduce agitation and centrifuging**
Thermoforms are more brittle than bottles. Therefore, agitation should be reduced to a minimum, as it can accelerate the breaking down of the material, increasing the production of fines and reducing yield. Similarly, the usage of centrifuges for dewatering and drying should be minimized. If centrifuges are used, some manufacturers suggest having smaller holes on the screens as low as 1mm (0.04in), or ensuring that the process can recover and rewash the lost fines.

03 SELECT
flake sorting equipment adapted to thermoforms

Efficiency and capacity of flake sorting equipment are different when processing bottle and thermoform flakes, as the latter are flatter, smaller in size and can contain more contaminants such as PVC, PLA and PS. It is therefore important to test different flake sorting technologies to optimize both the capture rate of the PET TF flakes and the removal of contaminants. It should also be considered that available technologies have different specifications with regards to the minimum flake size that can be efficiently detected.

Best practices in PET TF DESIGN

01 USE
clear or transparent light coloration (blue or green) and mono-material PET

The use of colors or direct printing (unless with APR Design® for Recyclability Recognition) has a detrimental impact on recycling, as colored material can be more difficult to sort and current end-markets demand clear and transparent materials. Moreover, multi-material products (e.g. PET/PE lamination trays) should be avoided, as they will alter both the coloration and intrinsic velocity (IV) of the output.

02 MINIMIZE
label coverage and ensure complete removability

It is recommended to minimize label coverage, as high coverage can limit the ability of an optical sorter to properly identify the material of the main body, resulting in missorting. Furthermore, during processing, the containers and packaging will be shredded, and then go through wash basins where contaminants are removed. It is therefore recommended to use water soluble adhesives (so that they easily separate from the PET flakes) and label materials with a density lower than 1g/cm^3 (62.4 lb/ft^3), so that they will float, while PET sinks due to its higher density.

03 FAVOR
the use of other components (e.g. lid, pad, blister pack paperboard) that can be completely removed or that are compatible with PET recycling

Materials not made of PET are not easily separable during the washing process. Therefore, the following materials should be avoided: paper, welded plastic (regardless of resin), RFID and PS. If another plastic resin is to be used (e.g. lid film or label), it should have a density lower 1 g/cm^3 (62.4 lb/ft^3).

04 AVOID
any amount of PVC and degradable plastic

PVC and degradable plastics should never be used in PET TF, as they affect the processing yield and the output quality, impacting both economic viability and end markets.

05 USE
a size that will ease sortation

Packaging under 5cm (2in) are more difficult to sort in a standard MRF, as they often will end up in the glass stream or rejects. When possible, packaging should be designed to be more than 5cm (2in) on at least two sides.

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