

Guidance Pack on Used Beverage Cartons

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Executive Summary

A beverage carton, also known as a paper bottle, is a multilayered packaging made up of paper, plastic and aluminium layers. It is used for perishable liquid food such as dairy products, juices, sauce and baby food. Food products packaged with beverage cartons have a longer shelf-life and do not need to be refrigerated, thus reducing food waste and energy during transportation.

With the recent increase in awareness of pollution arising from plastic use, consumers have been demanding companies to replace plastic water bottles. While plastics with recycled content would have a lower environmental footprint than beverage cartons, businesses and consumers struggle with how similar these alternatives look like plastic. This, alongside

other factors such as price, leads to an increasing trend to replace plastic water bottles with paper water bottles.

Although beverage cartons are theoretically recyclable, their actual recyclability is debatable. This is because:

- Firstly, a beverage carton cannot be 100% recycled back to a new beverage carton.
- Secondly, the recovered materials from recycling are either downcycled or made into products that are unrecyclable.
- Although advances in recycling technology can improve the recyclability of beverage cartons, there are very few facilities with such advanced technology, raising the question of the term 'recyclable' from a country's waste management context.

For Singapore, the nearest recycling facility for used beverage cartons is in Selangor, Malaysia (KPT Recycle SDN BHD). The recycling facility is only able to recover paper, while the remaining plastic and aluminium are downcycled into a composite material (a material that is made from at least two very different materials).

PACT's recommendation: It is acknowledged that the design of the beverage carton has helped minimise food wastage and reduce energy consumption during transportation and storage. However, due to its debatable recyclability, **such packaging should be restricted to highly perishable food products, and not for drinking water**. There is also a need to clear the misconception that a beverage carton is a sustainable paper bottle, since it is made of [other materials besides paper](#), and it may not be a material with the least environmental impact. To truly reduce environmental footprint, we urge businesses to opt for 100% reusable packaging. If seeking single-use alternatives, businesses should consult the [Alternative Materials Tool](#) to find the material with the least environmental impact.

Background

A beverage carton is a commercial packaging commonly used for food products like milk and other dairy products, juices, sauce and baby food products. Beverage cartons are lightweight and can be stored flat until used. Due to these factors, transportation costs for beverage cartons are lower than that of glass or steel bottles, which led to a rise in beverage cartons in packaging.

Due to increasing awareness of pollution arising from single-use plastics, consumers are demanding companies to replace plastic with alternative packaging materials, especially for drinking water and other beverages. It is forecasted that [583.3 billion of PET bottles](#) will be produced in 2021, and the [world wide recycling rate is estimated at only 9%](#).



There is a growing trend among companies to switch from [PET to beverage cartons](#) for drinking water and other non-carbonated drinks. This has been observed for the F&B and Hospitality industry, and especially for in-house branded bottled water. This trend is due to several reasons:

- Consumers do not want to buy or use plastic bottles, due to its negative image as a marine pollutant. This places a strong pressure on companies to seek replacement for the plastic bottles, without giving regards to whether the waste management system supports the appropriate disposal of the alternative material.
- Businesses that switched to recycled-PET and PLA (a biodegradable plant-based plastic) are rejected by the consumers who do not know that these materials are environmentally better than virgin, fossil-based PET.

- Manufacturers are promoting beverage cartons as the more 'sustainable' choice, which is debatable.

This paper will look at the material specification of a beverage carton, explore its functionalities and point out appropriate applications. The recyclability of the beverage carton in the local context will also be discussed.

The Structure of a Beverage Carton

This section explains the multi-layered structure of beverage cartons, and how this design serves to meet the stringent requirements of the aseptic packaging for food products.

Aseptic packaging is a sophisticated packaging approach in ensuring the safety and preservation of the food product contained by the packaging. Due to the multiple steps involved in the aseptic process - mainly involving thermal sterilisation of the food product before filling into a sterile packaging material, followed by sealing in equally sterile condition - food that is packed in this process has a long shelf life at ambient condition. Food packed in aseptic packaging often does not require refrigeration or preservatives for up to 6 months, as long as the pack remains unopened.

Indirectly, this saves energy during transportation and storage as food products do not need to be kept cold. Furthermore, food waste is reduced since the shelf life is prolonged through the sterilisation process mentioned earlier. Therefore, the packaging material has to be designed to firstly withstand the sterilisation process and secondly, ensure that the bacteria does not penetrate the packaging by being able to hermetically seal (i.e. airtight seal) the packaging. While glass containers were originally used in aseptic packaging, their heavy weight and brittle properties meant that beverage cartons, a multi-layered aseptic packaging, became more popular.

Beverage cartons are able to fulfill this stringent aseptic standard as the different materials with the required properties have been identified. By unifying them in layers, a composite material is formed in a cost effective manner. The main materials consist of the following (percentage found in a beverage carton is given here as an approximate as there are different models of beverage carton available in the market):

- Paper (75%) gives the packaging its firm shape and strength to withstand stacking while providing flexibility for packaging to be folded flat;
- Polyethylene (20%) is the material that will come into direct contact with the food products. Due to its chemical resistance property, it is inert to the food product while also responsible for retaining flavours and nutrients;
- Aluminium (5%) acts as a barrier to air, light and moisture and most importantly, external bacteria migration.

In general, aseptic packaging has to be low in moisture and gas transmission rates to ensure the longevity of the food product, food safety and ideally be non-brittle. Perishable food that greatly benefit from this storage method include milk and other dairy products, fruit juices, and sauces.

Recyclability of a Beverage Carton

The multi-layer property of a beverage carton contributes to its functionality, but also results in difficulty in recycling. Materials have to be segregated into distinct categories (e.g. paper, metal and plastic) before actual recycling can take place.



According to Tetrapak, one of the major manufacturers of beverage cartons and the main supplier of beverage packaging for local brands, beverage cartons are fully recyclable. The step-by-step process is summarised here based on [Tetrapak's website](#):

1. The used beverage cartons (UBCs) are separated from other recyclables.
2. The UBCs are mixed with water in a large pulper and agitated for 30-40 min. This step will separate the outer paper layer in the form of fibre from the aluminium and plastic layers.

3. A filter is applied so that the paper fibre passes through while the aluminium and plastics are retained. The paper is sold into a ready market as cartons or kraft paper. The aluminium and plastics are **not further separated**.
4. Using high heat and pressure, the remaining aluminium and plastic layer, also known as polyAl, is transformed to tough, light weight and composite boards. These boards can be made into panel boards or roof sheets. In some cases, polyAl is co-incinerated by the cement industry (e.g. in Germany) where the aluminum is used to substitute bauxite in cement production.

Why is the recyclability of beverage cartons debatable?

Both Plastics Recycling Europe and The Association of Plastic Recyclers, have come up with a [definition](#) that plastic products must meet in order to be considered as recyclable:

1. The product must be made with a plastic that is collected for recycling, has market value and/or is supported by a legislatively mandated program.
2. The product must be sorted and aggregated into defined streams for recycling processes.
3. The product can be processed and reclaimed/recycled with commercial recycling processes.
4. The recycled plastic becomes a raw material that is used in the production of new products.

Although the above conditions are targeted at plastic recycling, the same conditions can be applied to other packaging materials. This is important because while the packaging material may be technically recyclable, the technology must be available in the country or within the region to handle it. Having a recycling market value also indicates that the recycling technology is established and the process is economically viable. Lastly, the recycled secondary material must have an application either as a similar type of product as it originally came from or converted to another value-added product. Otherwise, the packaging material should not be considered as recyclable.

This raises the question on the recyclability of beverage carton, in correspondence to the four conditions mentioned earlier:

1. Market value and/or is supported by a legislatively mandated program

[A study in 2019](#) found that the informal sector in India did not collect UBCs separately. UBCs were usually mixed with paper waste due to its low market value as an individual product. The low value could be attributed to the following reasons:

- Not all paper mills are able to handle the multi-layered packaging.
- When the UBCs were contaminated (e.g. with leftover liquid content in the UBCs), the market price would fall further.
- The uncleaned UBCs attracted pests and developed foul smell. Hence, UBCs were not eagerly collected by the informal sector.

However, the study also showed that with active interventions from Tetra pak, by working with local recyclers and developing technologies, the recycling rate of UBCs in India has increased from 29% in 2011 to 54% in 2019.

2. Easily sorted and aggregated into defined streams for recycling processes

UBCs can be easily recognised and picked out and segregated from other recyclables. However, this can only be done manually, even for material recovery facilities with sophisticated sorting technology since UBCs are not monomaterial.

3. Reclaimed/recycled with commercial recycling processes

Most commercial recycling processes, including traditional paper mills, are unable to recycle UBCs. This is because the [pulping process in a traditional paper mill](#) soaks paper-based packaging for only a few minutes, which is sufficient to remove stickers and tapes from cardboard boxes but not laminated paper found in UBCs. While it is technically possible for traditional paper mills to process UBCs, this would require more time and more wastewater generated in the process of separation. Therefore, most paper mills would regard UBCs as contaminant and manually pick them out to discard.

The recycling of polyAl requires even more specialised equipment. Tetra pak has collaborated with several companies to explore different technologies to further separate the plastic from aluminium:

- [Alcoa Aluminio](#) (Brazil) - convert plastic to paraffin oil using plasma technology heating and recover Al
- [Alucha](#) (Spain) - recover plastic as gas through pyrolysis and 95% pure Al recovered

- [Veolia](#) (start in Europe) - still under research to upcycle PolyAl
- Delamination/Solvent Separation (under research) - using chemicals like [chloroform](#) to dissolve the plastic layer first, before recovering the rest

While it is technically possible to separate polyAl, it is a matter of economic viability. In fact, there are only 41 integrated recycling facilities across the world that are able to handle UBCs with both paper fibre and polyAl recycling (Figure 1).



Figure 1. Recycling facilities world wide that are able to recover fibre, polyAl or both from the UBCs. (Source: [Tetra pak](#))

4. The recycled plastic material can be used in the production of new products

It has been argued that the beverage carton is recyclable since 75% of the paper layer in the original packaging can be recovered and made into new paper products. However, the same cannot be said for the polyAl. To convert polyAl into a composite material is to downcycle since these composite products cannot be further recycled at the end of life.

Singapore's Waste Management Context

What about Singapore's waste management context, can beverage cartons be considered as recyclable?

In Singapore, there is a recycling collection system in place. There are currently 3 public waste collectors that are appointed by NEA to provide general waste and recyclables collection services for an assigned area. Within every few blocks of a residential area, there is a blue recycling bin for residents to place their commingled recyclables. These will be collected by the public waste collectors and brought to a centralised Materials Recovery Facility for sorting. Beverage cartons are one of the accepted recyclables that can be placed in the recycling bin. Private entities such as commercial and industrial premises can choose to collect and segregate UBCs or other recyclables and engage their own general waste collectors.

Whether public or private waste collection is utilised, there is currently no dedicated recycling facility in Singapore that can recycle a single component of a beverage carton. The nearest dedicated recycling facility is in Selangor, Malaysia (KPT Recycle SDN BHD). This facility is only able to recycle the paper portion of the UBC into kraft paper, and downcycle the polyAl into a composite material.

Not having a local recycling plant also means that the collected UBCs have to be cleaned and baled before they can be exported to Malaysia. There is currently no recycling facility in Singapore that undertakes the cleaning and it is up to the public to empty out the content and wash the UBCs before putting them in the recycling bin.

In the context that a company is willing to take up this responsibility of segregated collection and also the cleaning, they are also limited to KPT Recycle SDN BHD as a recycler.

PACT's Recommendation

Consumers are getting more aware of the crisis related to plastic usage and the pollution it causes. However, a [survey](#) showed that businesses are not meeting consumers' demand for more sustainable products in Singapore and businesses are urged to respond to that. Recycling is a complex topic with a lot of misconception and it is important to educate the

consumers with the right information, otherwise, this may lead to a shift of environmental impact to another system.

It is acknowledged that the design of the beverage carton provides a high level of sterile condition to ensure the longevity of food products that would otherwise have a very short shelf life. If the food waste avoidance is taken into consideration with the packaging material, there is no doubt that the beverage carton has a significant role to play in the food packaging industry and in lowering the carbon footprint from food waste and transportation. Thus, despite its debatable recyclability, PACT suggests that the beverage carton should be reserved for **highly perishable liquid foods that require the preservation of flavour and nutrient value, and benefits from a lengthened shelf-life.**

The intended design of the beverage carton would not contribute significantly to the shelf life of drinking water. Neither does drinking water require the preservation of flavours or nutrients. Beverage cartons should not be used as a replacement for drinking water plastic



bottles, simply to accommodate consumers' demand for plastic removal. The disposal of the beverage carton will also be a problem, especially in Singapore's waste management context. A clear understanding of the LCA of the material is utmost important and so is communicating the right message to the public.

The advancement of technology could result in an economically viable large-scale recycling system for UBCs in the future. Until then, PACT suggests businesses to:

- Firstly consider 100% reusable packaging
- Consider procuring recycled-PET which has a higher recycling potential, and provides a market for recycled plastics