# Laminates: recycling the unrecyclable

While laminate packaging is generally viewed as 'green', we need to address what happens to it after disposal, say **Carlos Ludlow**, **Catherine White** and **Howard Chase**

**LAMINATES are used for packing a myriad of products from coffee to cocktails, from pet food to baby food, in forms such as stand-up pouches, sachets, and beverage cartons. With millions of tons of laminates used in packaging every year and the global market forecast to grow 15% each year until at least 2020, they crop up in all areas of our lives.**

But are laminates truly the eco-friendly, sustainable solution to reducing packaging waste they are made out to be? Or are they simply a quick and easy way for fast-moving consumer goods (FMCG) businesses and the local supermarkets to reduce food wastage and improve public perception of their green credentials?

## layer by layer

Laminate packaging, as the name implies, is made up of thin layers, each with a specific function, and combining to give optimum packaging properties. For example, aluminium foil is an exceptional gas and moisture barrier but, on its own, even the thicker gauges have a low tensile and tear strength. But when laminated to a polymer film, aluminium provides the barrier properties, while the polymer provides support, printability and flexibility. The combination results in a container with long shelf-life, puncture resistance and highly customisable appearance.

A common application of aluminium barrier laminates in particular is their use in hermetically-sealed retort pouches. Retort pouches can be heated to high temperatures to sterilise or cook their contents, and their high thermal conductivity allows for shorter overall heating times and hence less chance of overcooking or nutrient loss.

## consumer power

Packaging is an essential and very visible part of the FMCG products that we take for granted in daily life.

Consumers' purchasing decisions are increasingly influenced by sustainability concerns so a producer that can show a quantified decrease in packaging weight, diversion of waste from landfill or improved carbon footprint may have an immediate advantage.

Most communities around the world deal with their waste problems through several routes in a generally-accepted order of priority, or waste hierarchy. The most common are the three 'R's: reduce, re-use and recycle, where reduction is generally the first initiative implemented. In packaging terms, we call this 'lightweighting'.

## lightweighting

Laminates have been a key feature in the recent lightweighting trend, driven by both cost and sustainability concerns, and focusing on minimising the quantity of packaging while maintaining its protective function.

Aiming for lighter packaging isn't just a modern fad. Take the aluminium drinks can; when the first prototype was made in 1935 it weighed 85 g. Improvements in technology decreased that value, so that in 1973 a typical 330 ml beverage container was 21 g and now it is as little as 13 g.

However, lightweighting materials whilst retaining the same packaging format can only be taken so far; nowadays beverage can manufacturers must consider the trade-off between the savings experienced by using a thinner material gauge and the increase in deformations, leaks and customer complaints,

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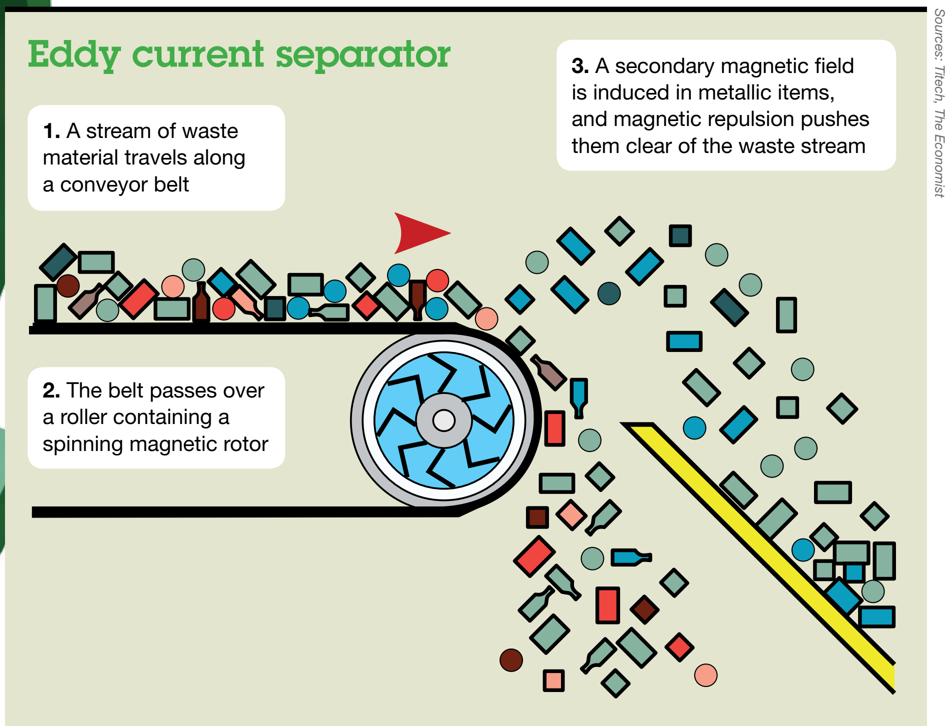


*Figure 1: Eddy current separation*

arising from loss of structural integrity.

Substitution of a flexible laminate-style package would appear to be the ideal solution, allowing for substantially decreased material costs, transport costs and even the overall quantity of waste going to landfill.

## perception versus reality

Retailers extol the virtues of laminates in terms of the overall decrease in waste packaging. This is such a good marketing ploy that consumers may not think about the full lifecycle of the product.

For example, a study by the Waste & Resources Action Programme (WRAP) in November 2009 compared pet food packaging formats. The packaging for the lightest can of wet pet food recorded made up 9.5% of the total product weight, but when packaged in a laminate carton or pouch, the numbers were 4.8% and 3.1% respectively.

WRAP's results support laminate adoption, but a lifecycle analysis (LCA) on a consumer goods product found that varying the disposal method can double the packaging's carbon footprint.

So does using laminates actually improve a product's sustainability credentials or simply provide a temporary salve and a quick and easy improvement in metrics?

## can we recycle laminates?

Worldwide, lightweighting is the most preferred waste hierarchy level to implement but most laminates are still landfilled after use ('disposal' – the least preferred level). Not only are laminates normally mixed with other wastes, but as laminate layers are stuck together, it's tricky to separate and recycle the individual components.

A few specific packaging formats, such as drinks cartons or pouches, have been successfully separated at source, ie by the consumer, using 'bring bank' schemes, although participation is low as it requires more input from the consumer. Commingled collection, where designated recyclables are all collected in one container, increases participation, so is growing in popularity, but typical laminated packaging isn't currently included.

However, increasing automation in material recovery facilities (MRFs) permits inclusion of new technologies for recycling or recovery of the separated fractions. Examples are eddy current separators (see Figure 1), which induce eddy currents in conducting materials to separate them magnetically, or those combining sensors with directed air jets to separate plastics of different types, textures, shapes or colours.

Another study by WRAP, conducted at an MRF, investigated the potential for using a novel process to recycle laminate packaging. It found that it was possible to identify and separate plastic-aluminium laminated drinks pouches using a conventional eddy current separator.

Once the laminate has been separated, it can then be sent for recycling or recovery, where recycling includes processing the waste material into new packaging products and also 'downcycling', where the waste material is converted into new but lower-quality

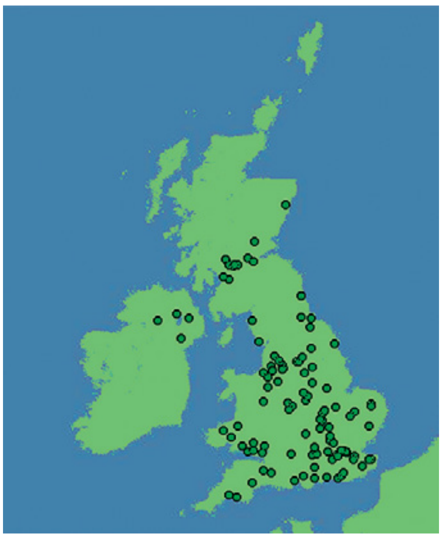

*Figure 2: Material recovery facilities in the UK*

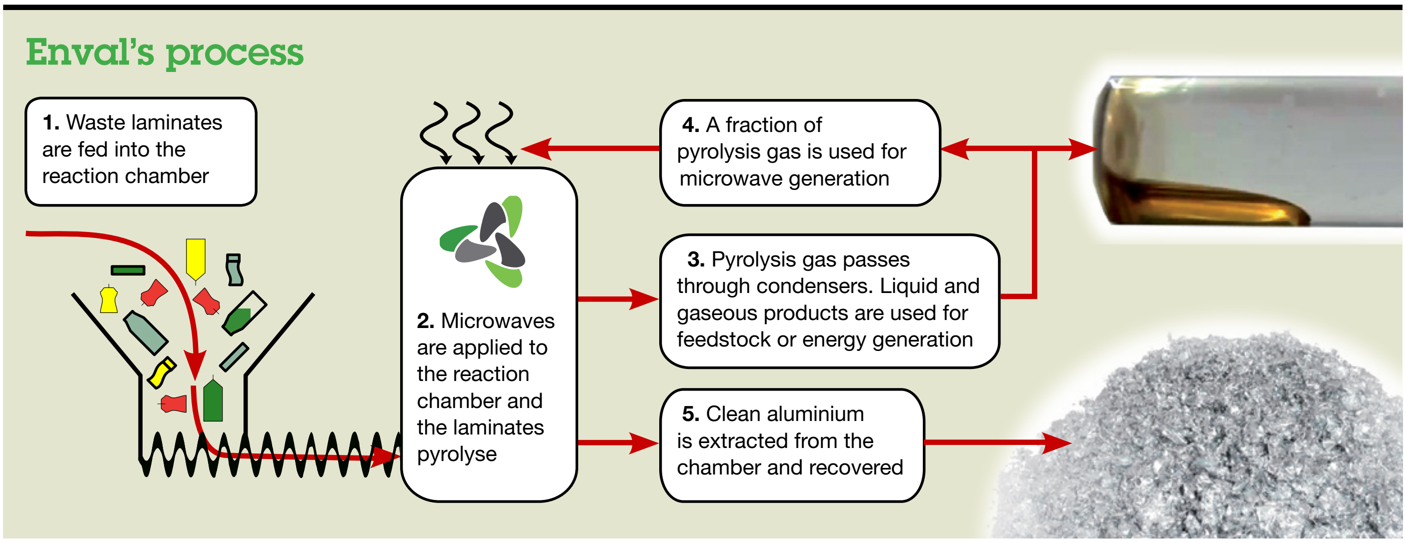


*Figure 3: The Enval process*

products. Laminates can be converted into roof tiles, park benches and pencil-cases. Where the laminate contains paper as well as polymer and aluminium, as is often the case in drinks cartons, it can be sent to a paper mill, where depulping can recover the paper fraction. However, if the residual aluminium and polymer aren't separated from each other, the value the aluminium would have as metal is lost.

## pyrolysis

Pyrolysis is a viable method for treating aluminium-containing laminate waste, resulting in recovering aluminium for recycling and collection of the polymer-derived hydrocarbons. However, pyrolysis plants haven't yet been incorporated into the laminate product lifecycle because, to date, implementation has been difficult. Where the infrastructure is already in place, such as at depulping mills for drinks cartons, there is potential to use pyrolysis to process the residue and, in Barcelona, there is already a large-scale pyrolysis plant to do exactly that.

Conventional pyrolysis plants often consist of large fluidised beds requiring a high throughput of waste to be viable. However, the current waste collection infrastructure, in the UK and other countries, consists of many distributed recycling facilities (see Figure 2). Hence collecting and transporting laminates from all these locations for processing at a single conventional plant isn't ideal and a distributed solution is needed.

## pyrolysing to recover aluminium

Enval has developed a novel compact continuous pyrolysis process to separate out the valuable aluminium layer present in many laminate packages and recycle it into the secondary aluminium stream. Appropriately-sized units can be installed at existing waste management sites to target post-consumer waste, or at production sites to target production waste, without the need to construct entirely new facilities or additional aggregation and transport of waste.

The process (see Figure 3) directs microwaves into an oxygen-free reaction chamber. Laminates coming into the chamber heat up, and any non-aluminium layers are pyrolysed, liberating clean aluminium and hydrocarbons of varying chain length, some of which can be condensed.

Recycling aluminium from laminates avoids energy- and resource-intensive primary production and, via this process, decreases the carbon footprint of the aluminium content by more than 70%. Furthermore, in addition to revenue derived from the products, costs associated with transport of wastes, gate fees and landfill charges can be avoided.

## going green?

Laminates are undeniably beneficial to producers and consumers, despite being perceived as unrecyclable. So the introduction of new technologies and processes for recovering the high value components of laminates is welcome. Closing the loop and providing an economically and environmentally viable recycling route for these materials will undoubtedly offer a major boost to the green credentials of laminate packaging. tce

**Closing the loop and providing an economically and environmentally viable recycling route for these materials will undoubtedly offer a major boost to the green credentials of laminate packaging.**

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