

IMPROVING THE SUSTAINABILITY OF LAMINATE STRUCTURES USING RENEWABLE AND COMPOSTABLE FILMS

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ABSTRACT

The use of conventional flexible plastics allows companies to provide cost-effective packaging solutions coupled with excellent product protection characteristics. However they are difficult to recycle leaving incineration as the only practical solution for creating value from waste when they're used in laminates. Compostable bioplastics are also suitable for incineration but in addition they can generate value via composting (industrially or at home) and anaerobic digestion at the end of their end life. The development of new high barrier bioplastics (mineral oil barrier included) together with the combination of two or more different compostable films (like the conventional packaging industry is doing) opened the doors for them to be used in very demanding packaging applications with long-shelf life requirements. Many examples of bioplastic structures can be currently found in the market place.

Flexible plastic films have a long history of high performance in packaging applications and are well established at the forefront of waste reduction. Conventional plastics naturally tend

Given that conventional flexible plastics use small amounts of material to provide excellent shelf-life and therefore lead to a significant reduction in overall waste, one might be tempted to think that biomaterials are not able to offer much potential in this arena. Far from it, for it is at the end-of-life stage when biomaterials potentially come into their own, in a flexible packaging context. Flexible packaging is indeed great for minimising resource use and weight, and brings further benefits in terms of transportation and point-of-sale presentation. However flexible packaging materials are intrinsically very difficult to recycle (mixed and incompatible materials,

lightweight and impractical to collect). As a result, incineration, where available and where desired, is the only practical solution for dealing with conventional flexible packaging waste.



Figure 1

Whilst bioplastics too are perfectly suited to incineration, they also open up new opportunities such as composting (industrially or at home) and Anaerobic Digestion (AD).

AD in particular is starting to excite Government and waste management industries in a number of countries. There are three key benefits to disposing of packaging (including biowaste bags) via AD:

- It can help direct food and horticultural waste away from landfill (where this can create fugitive greenhouse gas emissions).
- It can contribute towards renewable gas generation techniques for energy supply and
- The residual digestate can also replace fossil and mineral-based fertilisers for soil improvement.



Figure 2

The key to developing bioplastic solutions for mainstream flexible packaging applications is coming from a combination of innovative bioplastic research and from 'copying' (or rather mimicking) the approaches already used by the conventional packaging industry. What consumers do not realise is that a huge proportion of the 'bit of plastic' they find around their packaged foods is actually much more technical than they would ever

imagine; laminates of different materials, surface coatings, adhesive systems, etc.

Let us take one example – coffee. Why? The demands on the coffee packaging are very high because coffee typically:

- Needs a long shelf life. Usually 12-18 months, but can be as much as 24 months
- Is highly aromatic. Maintaining the distinctive 'coffee aroma' is essential.
- Is a dry, powdered produce that is very sensitive to moisture.
- Is oxygen sensitive. Oxygen can reduce or taint flavours and taste.
- Contains highly flavoured oils.

When a consumer buys a bag of 'fresh ground coffee' it will actually have been roasted, ground and packed days or even weeks before into a highly developed laminate structure that typically comprises:

- A transparent Polyester (PET) film, which is reverse-printed (i.e. printed on the inside, for protection and actually viewed through the film.) PET is used because high temperatures are needed to seal through the pack and PET offers excellent heat-resistance.
- A thin layer of adhesive.
- A thin aluminium foil layer (or Metallised PET), to provide exceptional barrier.
- Another thin layer of adhesive.
- A thick Polyethylene (PE) film which is used to provide strong and leak-resistant heat-seal properties and also adds further body and resistance to the pack.

In addition, whilst this type of technical construction is also used in a range of other packaged food applications, in the case of coffee bags, there is also generally a very small valve device incorporated (often almost invisibly) into the structure, to vent-off gases generated by the coffee after roasting. This offers minimum resources, but maximum difficulty when it comes to dealing with the wrappers after use.

However, if we could mimic these constructions, but replace the conventional polymers with biopolymers, we could develop solutions that would run on the same conversion and packaging machinery, but which also open up the wider range of end-of-life scenarios we mentioned earlier.

So let us imagine our coffee pack 'turning Bio'....

- The outside PET film can be replaced by a transparent NatureFlex™, printed in exactly the same way but with biocompatible inks, providing barrier and heat-resistance properties.
- Adhesive manufacturers have been working on bio-adhesives and the first certified examples are hitting the market now.
- The aluminium foil can be replaced by a metallised NatureFlex™, providing excellent barrier to moisture and gases.
- Another bio-adhesive.
- Then finally the PE film on the inside can be replaced by a film manufactured by one of the high seal strength and high renacity materials such as starch based or co-polyester based materials (e.g. Mater-Bi, Ecoflex etc).

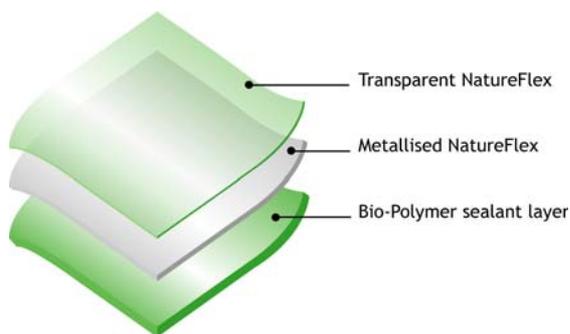


Figure 3: Coffee and Dried Foods Lamination Structure using NatureFlex™.

A New Zealand company, a coffee roaster, has already changed their packaging to enable them to meet their commitment to being socially and environmentally responsible.

Caffe Prima, based in Christchurch, switched to 'Econic'® coffee bags. The bags were specifically developed by New Zealand converter, Convex Plastics. The laminate construction was produced using three flexible films that are certified compostable and renewable – A reverse printed clear NatureFlex™ / High-Barrier Metallised NatureFlex™ / Starch based biopolymer.



Figure 4

Coffee is a very demanding product to package because maintaining freshness and taste is absolutely paramount. Packs have to be puncture and impact resistant and offer high barrier and good seal integrity to keep oxygen out and aroma in. Coupled with this, Caffe Prima, was looking for a solution that was kind to the environment. NatureFlex™ ticked all the boxes as far as we were concerned," said Andrew Sheerin, Technical Manager, Convex Plastics.

This type of laminate construction can be used in a range of other dried food applications such as confectionery, crisps, pasta, cereals, pulses and tea.

In fact, Ganong Bros Limited, Canada's oldest candy company founded in 1873 chose to pack its range of Easter confectionery in stand up pouches. The pack, converted by Canadian based Genpak -uses compostable NatureFlex™ NKR laminated to a biopolymer sealant layer.

"NatureFlex™ provides excellent barriers to oxygen and moisture, which ensures the product maintains its quality. The film also printed and performed well on our machines," said Bill Reilly, Development Manager, Genpak.



Figure 5: The stand up pouches for Ganong's Easter confectionery range are made using Innovia Films' compostable NatureFlex™ material.

Bruce Rafuse, Vice President of Marketing at Ganong explained *"We considered several alternatives, but based upon feedback from consumers and retailers decided upon NatureFlex™ due to it being compostable and the distinct competitive advantage this gives us. Our ultimate goal is to move all our products into compostable pouches."*

Another example is Boulder Canyon™ Natural Foods, a leading North American snack food manufacturer, who introduced a renewable, fully compostable pack for its line of *All Natural Kettle Cooked Potato Chips*.

They claim that the innovative packaging is gaining attention because it looks, feels and sounds the same as traditional, non-compostable bags. The bag is the first of its kind on the market to be made from a structure that incorporates metallised NatureFlex™ NKM from Innovia Films.



Figure 6: Boulder Canyon™'s potato chip package incorporates metallized NatureFlex™ NKM from Innovia Films.

Again Genpak's development manager, Bill Reilly commented: *"We recommended NatureFlex™ to Boulder Canyon™ for a number of reasons. First and foremost, the film performs well technically and has excellent moisture, gas and light barrier properties that enhance shelf life and protect the product. Secondly, NatureFlex™ is very well aligned with Boulder Canyon™'s sustainability goals, so we knew it was an excellent fit for their company values as well as the application."*

Additional technologies such as extrusion coating (directly applying molten polymer to heat resistant films or papers) and alternative polymers (PBS, PHAs, PHB, PLA) can also provide building blocks to help the industry further develop such technical solutions.

To prove such potential, Innovia Films and Sappi Fine Paper Europe joined forces to demonstrate potential laminate structures, using their respective products, suitable for end users in the food, confectionery and pharmaceutical industries.

Innovia Films with its NatureFlex™ product range, brings its unique expertise in manufacturing renewable and compostable cellulose-based films with tailored moisture and barrier properties.

Sappi brings its expertise in manufacturing flexible packaging papers and now offers coated and uncoated compostable paper options; Algro® Nature is a unique compostable one side coated paper; Leine® Nature is an uncoated equivalent, which is also compostable.

The Sappi and Innovia products have been independently tested and have received the "OK Compost Home" certification by Vinçotte, and also the compostability DIN E13432 certification by DIN CERTCO.



Figure 7: Innovia Films and Sappi have joined forces to produce a laminate pack structure (used here for packaging dried soup).

John Fell, Global Marketing Director for Innovia Films commented *“Both companies are committed to evolving this joint partnership and will announce future developments of sustainable packaging solution, based on renewable and recyclable forest products, as and when they become available.”*

Barrier is essential in many applications of food packaging to prevent product deterioration and contamination. A recent scientific study at the Zurich Food Safety Authority in Switzerland, using the same series of tests to prove the efficacy of compostable NatureFlex™ films, detected alarming levels of mineral oil residues transferring from recycled cardboard packaging into food.

Traces of mineral oil residues in food are thought to arise due to their migration from the printing inks present both on the packaging surface and in recycled newspapers, used in the production of cardboard packaging. Even at room temperature these residues can migrate and be deposited on dried foods packaged in the box, such as pasta, rice, and breakfast cereals.

Dr Koni Grob, who led the Swiss research team, has said that toxicologists have linked mineral oils to inflammation of internal organs and even cancer, though he stressed that individual meals would contain only a tiny dose of the chemicals.

“The tests conducted on our NatureFlex™ films showed that when used either as the inner bag or as a pouch they provide a very good barrier against mineral oil migration for circa 5.9 years (validated by Food Safety Authority, Zurich),” Clare McKeown, Market Manager Europe – NatureFlex™ films.

In conclusion, we believe to be truly innovative, the level of communication between co-suppliers of biopolymers has had to increase, not only for each other to appreciate the technical benefits of each polymer, but also to fully understand the end-of-life options that are possible for hybrid materials and how they should be positioned in the market. This role has been partly facilitated by organisations such as European Bioplastics and other similar associations worldwide.

Co-operation continues between producers in the bioplastics supply chain and partnerships are constantly emerging to take industry developments to the next level by offering new innovations in packaging. Innovia Films will be announcing several such innovative packaging solutions in the near future, which will ensure that sustainable packaging options, using bioplastics, can offer similar functionality as conventional plastics.

REFERENCES

www.NatureFlex.com