Biopackaging

Growing market share, refined offering

In this feature, biopackaging is defined as packaging made of renewable materials and/or which is compostable. The market share of bioplastics is presently about 1%. However, it is steadily growing because the offering is becoming larger and more varied. The recent trend has been for companies to rely on environmental gains at the source; degradability or compostability are not always a primary consideration. Yet functional requirements are becoming more numerous and packaging is becoming increasingly complex and ingenious. This feature provides an overview of the current situation.

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What is **biopackaging** ?

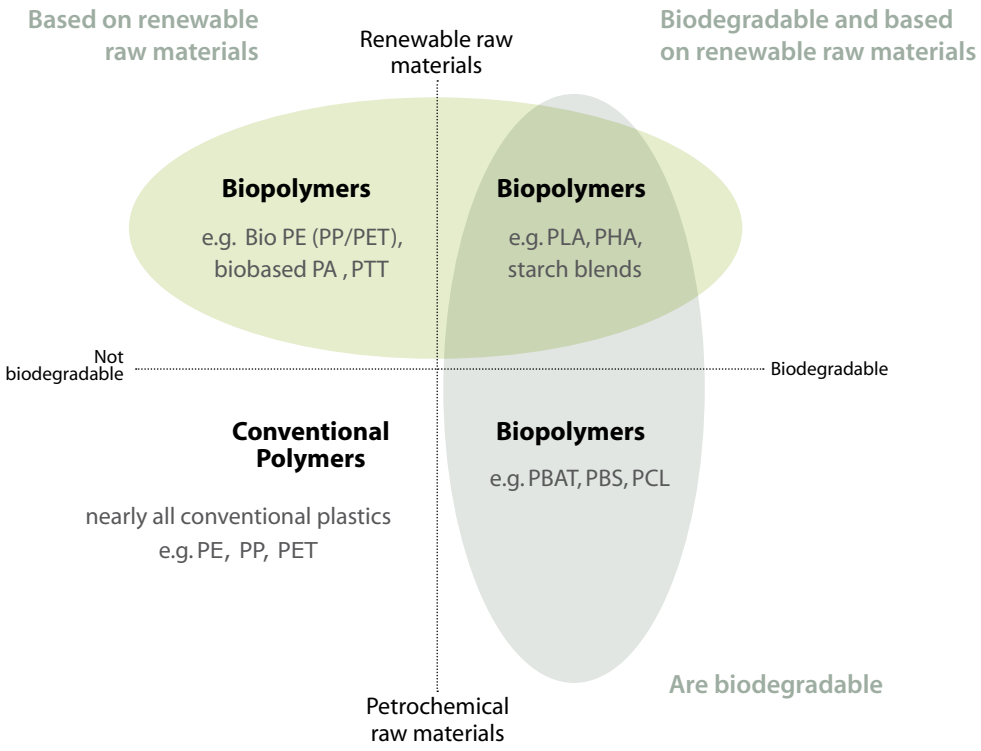
According to the man in the street, biopackaging is 'packaging that is good for the environment'. Joachim Quoden, Managing Director of Pro Europe, shares this opinion, but adds a precision: 'environmental gains can be achieved in a number of ways, for instance by making packaging lighter, by optimizing transport, by using less energy during manufacturing, by making packaging recyclable, or by using renewable materials. Professionals from this sector are sticking to only two aspects to define biopackaging: packaging that is made from renewable materials and/or that is compostable.'

In other words, for these professionals, biopackaging is a packaging that complies with at least one of the following conditions:

- **Its manufacturing** involves (virtually) no use of fossil materials or other raw materials in limited supply
- **After (final) use**, the packaging can be entirely composted

Quoden adds however that the environmental gain is not always obvious: 'Biopackaging is not automatically better for the environment; it depends on numerous factors.'

MATERIAL COORDINATE SYSTEM OF BIOPLASTICS



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Biopackaging

Classification based on raw material

Because paper and cardboard are made from wood fibre, which is a renewable material, cardboard packaging is considered the oldest and most important industrial biopackaging. There are also other types of packaging made from natural fibres. These include palm fibre or coconut fibre based packaging, as well as bagasse trays made from sugar cane fibres. Packaging made from bioplastics or biopolymers form an important group. Peter Ragaert of Pack4Food distinguishes three primary categories:

• Natural polymers based on cellulose or starch. Examples include the cellophane films of Innovia and the starch films and fillers of Novamont.

• Polymers obtained through the chemical synthesis of a natural monomer. These include the PLA (based on lactic acid) and the biological equivalents of fossil plastics such as bioPE, bioPP and bioPET.

• Polymers obtained through bacterial fermentation, such as PHAs (polyhydroxyalcanoates), including the well known PHB (polyhydroxybutyrate).

Bruno De Wilde, Lab Manager at Organic Waste Systems, adds a fourth category of bioplastics which are biodegradable: petrochemical polymers such as PBS, PBAT, PCL, and PVOH.

Growing attention to the flow of raw materials

The definition of biopackaging has not always been this broad. 'A decade or so ago, people focussed mainly on waste issues,' clarifies Ragaert. 'In order to be good for the environment, biopackaging had to be primarily compostable. That has gradually changed with the growing attention to the environmental footprint and greenhouse effect. It is now understood that there is at least as much environmental gain to be realized at the source. It is possible to reduce the burden on the environment by using natural, renewable raw materials.'

'OK biobased' illustrates the renewable source

The renewable source can easily be established in an objective manner. In addition, Ragaert notes that it is relatively simple to explain. 'In 2009, Vinçotte launched the internationally renowned 'OK biobased' logo. The label features four levels, each indicated by a star that represents 20% of renewable raw materials. Four stars therefore signify 80% biobased. That is crystal clear for consumers.'

However, Quoden remarks that 'it is also important to see that the manufacturing process is sustainable. Otherwise the potential environmental benefits of biopackaging are immediately counterbalanced.'

Competition with food products must be avoided

The flow of raw material for biopackaging is gradually becoming more diverse. This is necessary to avoid competition with food production. 'Some residual flows are already being looked into and actually used,' observes Ragaert. 'For instance, starch can be extracted from the juices obtained when cutting potato fries. That starch can then be used to produce bioplastics. For the production of PHA, we need a substrate on which the bacterial synthesis can take place. That substrate can also come from specific waste flows.'

However, many of these techniques are still in a research phase. At present, competition with food products therefore remains a threat.

good to remember

- Biopackaging is made of **renewable** and/or **biodegradable raw materials.**
- Pure waste streams are best **recycled** or **incinerated with energy recovery**. Composting is only useful if the packaging is contaminated with moisture or food.
- In order to meet market demand, biopackaging is becoming **increasingly innovative and complex**. Techniques and materialsare frequently being combined.
- The **development** of bioplastics is **gaining** momentum worldwide.

Biopackaging

End-of-life is more complex

The 'OK biobased' logo informs users about the raw materials that are used but does not say anything about the end-of-life of the packaging. Quoden says this depends upon numerous factors. 'Which materials are being used? Which processing infrastructure is present in a specific country? Some types of biopackaging are recycled, others composted or incinerated with energy recovery. Recycling also requires caution. Some polymers, such as PLA, are not compatible with the recycling of other types of plastics and can seriously contaminate the recycled material.'
'End-of-life is indeed more complex,' acknowledges De Wilde. 'A biobased packaging, for instance, does not automatically imply that it is compostable or degradable. Reciprocally, some petrochemical plastics are degradable. That complicates things for consumers: can the package be thrown on the compost heap or not, can it be put with the paper waste or in the blue PMD bag, or should it be thrown away with the residual waste?'

No erroneous claims

The use of claims such as 'compostable' or 'biodegradable' is strictly regulated. The Royal Decree of 9 September 2008 establishes the product norms for compostable and biodegradable materials. It refers to the European EN 13432 standard which defines the test programme and the evaluation criteria to which compostable products (including packaging) must comply. Meeting these requirements is essential to market reliable products and to rule out erroneous claims or 'green washing'.

Compostable but not on the compost heap

Not every biobased packaging complies with the compostability criteria outlined in EN 13432. Furthermore, even compostable types of packaging can not automatically be thrown on the compost heap. 'Bioplastics such as PLA only compost in a controlled environment and at a high temperature,' explains De Wilde. 'The degradation process is only initiated after heating to 60 °C for a week. This can not be done at home. A distinction is therefore made between packaging that is compostable in a controlled environment and packaging that is compostable at home. Various logos indicate this, such as those of Vinçotte and Din Certco.'

In addition, a packaging with a compostability logo may not be placed in the organic waste container. 'This is a precautionary measure,' says De Wilde. 'No packaging is allowed in the green waste container because this can easily lead to mistakes that are likely to contaminate the green waste flow; for instance with non compostable bioplastics. Some people within the sector are now requesting that green waste containers be opened for compostable packaging, on the condition that consumers are well informed.' '

At the moment, it is therefore of little use to put the 'OK Compost' logo on a packaging,' notes Quoden. 'That logo actually means that the package is only compostable industrially but it cannot be thrown with the green waste at home. It's very confusing for consumers.'

Abbreviations used

BioPE = Biopolyethylene
BioPP = Biopolypropylene
BioPET = Biopolyethylene terephtalate
MAP = Modified Atmosphere Packagingg
PBAT = Polybutylene adipateco terephtalate
PBS = Polybutylene succinate
PCL = Polycaprolactone
PET = Polyethylene terephtalate
PHA = Polyhydroxyalcanoates
PHB = Polyhydroxybutyrate
PLA = Polylactic acid
PVOH = Polyvinyl alcohol

Biopackaging

Looking for **suitable applications**

Compostability does not always entail added value. 'It is better if a non-contaminated flow of packaging waste is recycled, even if it bio-based,' says De Wilde (see also Coca-Cola testimonial). 'In some cases, incineration with energy recovery might even be the better option. We must judge this taking into account an overall lifecycle analysis.'

'Environmental studies indicate that incineration with energy recovery is better for the environment than composting,' endorses Quoden. 'Indeed, the latter leads to raw material losses, which goes against the European policy framework on Resource Efficiency.'

Bruno De Wilde notes that compostable packaging is interesting primarily when the waste flow is moist or inevitably mixed with food. Think of airline catering or fast food chains. Such packaging waste is too contaminated to be recycled well and too humid to be incinerated efficiently. In that case, composting the package and the food remains together is ideal. A distinct collection must then be organized. Other useful applications include body bags, starch-based garden, fruit and vegetable waste bags, and mulching films that are degradable on site for the agricultural sector.'

Creating clarity

It remains important to sensitize and inform. 'Biopackaging too must be managed in a responsible way,' says De Wilde. 'Logos and certificates should not be an excuse to just throw waste in the natural environment. That is why the Royal Decree of 9 September 2008 forbids the mention of the word 'biodegradable' on packaging. Whether degradable or not, packaging does not belong in the natural environment. And some claims require extra caution. This is the case with 'oxodegradable', for instance. This relates to films that degrade into microscopically small particles under the influence of light. These particles remain in the natural environment however and entail pollution, even though they cannot be seen with the naked eye.'

Functional requirements keep growing

In the mean time, packaging requirements—whether biobased or not—keep growing. 'Smart packaging, MAP, microwave resistant packaging, resealable packaging, et cetera, are in high demand today,' stresses Ragaert. 'Research is being carried out in each of these areas. As a result, biopackaging is also becoming more complex. Materials and techniques are increasingly being combined. In order to extend storage life, for instance, coatings and barrier materials are being added, whether biobased or not, compostable or not. Heat resistance is also a hot subject, for instance to enable pasteurization inside the packaging. In the case of PLA, research is examining what types of lactic acid are able to increase heat resistance. The impact on filling lines must also be considered. Everything is becoming technology intensive.'

1.7 million tons of bioplastics by 2015

The worldwide production of bioplastics is increasing rapidly. In 2009, a total of 318,000 tons were produced. One year later, this figure had already more than doubled to 724,000 tons. Expectations are that by 2015, approximately 1.7 million tons of bioplastics will be produced annually.

At the moment, however, their cost remains an obstacle. 'The manufacturing processes remain rather expensive,' explains Ragaert. 'This pushes the overall price upwards. As a comparison: PLA currently costs about 1.6 to 2 euros/kg, whereas petrochemical PE is 1.2 euros/kg. But of course, we know that petrol prices will rise in the future and that the production of bioplastics will in all likelihood become more efficient. In addition, virtually every industry supports bioplastics. Their use is certainly not limited to packaging. The automobile sector uses them, and gadgets and electronic devices are being designed using bioplastics. That is a big boost for further developments.'

For **additional information**

Pack4Food is a consortium of knowledge centres, network organizations, and companies concerned with the topics of 'innovating through the packaging of food products' and 'sustainable and functional packaging'. **www.pack4food.be**

Organic Waste Systems (OWS) is a spin-off of the University of Ghent that specializes in the biological treatment of organic waste flows. OWS is renowned worldwide as an independent lab that tests products on their biodegradability and compostability, among other things. **www.ows.be**

Pro Europe is the umbrella organization of producers responsible for the recycling of packaging. **www.pro-e.org**

500 ml bottles made of 22,5 % **plant materials**

Coca-Cola launched its PlantBottle® in the Benelux during the spring of 2011. The bottle is partly manufactured from plant-based plastic. Its design enables it to be recycled within the existing PMD circuit. In addition, its manufacture generates fewer CO_2 emissions than standard PET bottles

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100% recyclable bottles

Coca-Cola is active worldwide on the non alcoholic drinks market. Its main brands are Coca-Cola, Sprite, Fanta, Nestea, Chaudfontaine, Minute Maid, and Aquarius. The company developed its PlantBottle® in 2009. In Belgium, its launch took place during the spring of 2011 for 500 ml bottles of Coca-Cola, Coke light and Coke Zero.

'Our bottles already contained 25% recycled PET. Now, they are also made of 22.5% plant-based materials. In addition, they are 100% recyclable,' explains Jeroen Langerock, Corporate Identity, Public Affairs & Communications Director Belux at Coca-Cola. By the end of 2011, 80 million PlantBottles® had already been marketed in Belgium. This is the equivalent of 15% of all of the company's PET bottles.

Integration into the PMD circuit

The plant-based material chosen for the PlantBottle® is sugar cane. The latter is first converted into bio ethanol, which serves as the raw material for plant-based plastic. This plastic is identical to standard PET. To the naked eye, it is impossible to distinguish a PlantBottle® from a PET bottle.

'A major benefit of the PlantBottle® is that it integrates seamlessly into the PMD collection and recycling circuit,' observes Langerock. 'The PlantBottle® packaging material can thus be recycled and re-used. This feature fits perfectly into our vision of packaging materials that are recyclable and re-usable, and not merely waste.'

880 tons of CO_2 saved

The use of renewable materials enables Coca-Cola to use fewer fossil fuels and thus to reduce CO_2 emissions generated by the production of its bottles. As a result, the company emitted 880 tons of CO_2 less in 2011 during the manufacturing of bottles destined for Belgium and Luxembourg. On a worldwide scale, the PlantBottle® has already enabled the Group to save about 60,000 barrels of petroleum.

The company intends to replace all of its PET bottles with PlantBottles® by 2020.

good **to remember**

The PlantBottle® contains **22,5 % sugar cane-based materials**.

In addition, the bottle contains **25 % recycled PET** and is **100% recyclable**.

It **fully fits** existing PMD **collection and recycling circuit**.

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500 ml bottles made of 22,5 % **plant materials**

How Coca-Cola manufactures and markets the **PlantBottle®**

Step 1:
Select the renewable material
After analyzing various plant sources, Coca-Cola opted for Brazilian sugar cane because of its widespread availability and sustainable cultivation. In addition, considerable knowledge had already been accumulated regarding its use for packaging purposes. The company collaborated with a local NGO in order to identify the most responsible source; in other words, one that does not contribute to deforestation and that does not compete with food production.

Step 2:
Adapt the logistics chain
The PlantBottle® has required the company to implement a second logistical circuit. The supply, forming, and production of the PlantBottle® are indeed different than those of other bottles. After harvesting, the sugar cane is processed into bio ethanol in Brazil. The pre-forming of the bottles is then carried out in France. Finally, the bottles for the Belgium and Luxembourg markets are blown in the company's manufacturing site in Antwerp.

Step 3:
Communicate clearly to consumers
The PlantBottle® features a special sticker that informs consumers of its plant-based material content and of the fact that it is 100% recyclable. A folder was added to six-packs when the bottle was launched. In addition, Coca-Cola initiated a billboard campaign in the cities, as well as a media campaign.

Jeroen Langerock, Corporate Identity, Public Affairs & Communications Director Belux, Coca-Cola

« By 2020, Coca-Cola's goal is to use the PlantBottle® for all of the beverages that the company markets in PET bottles. »

Coca-Cola and the environment

- Each Coca-Cola package complies with its 4R strategy : **Reduce, Recycle, Re-use, and Renew.**
- The interactive www.traceyourcoke.be Website informs citizens of the **environmental efforts** deployed by Coca-Cola. It also encourages them to adopt responsible environmental behaviour.
- The company has introduced energy management systems for its cooling equipment. This measure enables a **35% energy saving per installation**.
- The speed of Coca-Cola Belgium's trucks is limited to **80 km/h** thereby reducing CO_2 emissions by up to 15%.
- The company adopts programmes for **responsible water management** and rinse water re-use (to cool machines, for instance). In addition, it protects source water capture areas in the region of Chaudfontaine.

www.cocacolabelgium.be

Environmental impact **of packaging**

Establishing the precise impact of packaging.

As part of their efforts to minimize the environmental impact of their products, companies also aim to reduce the impact of packaging. They increasingly rely upon lifecycle analyses (LCAs) to quantify this impact. These analyses cover the entire spectrum of environmental impact, from raw material extraction to waste processing, including manufacturing, transport, distribution, and use. In order to be relevant, an LCA must be carried out with precision and careful thought.

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From cradle to grave

Packaging can play a significant role in the environmental impact of a product/packaging combination. The material used, the packaging weight, and its manufacturing methods are all factors that can increase or decrease this environmental impact.

'The environmental impact of a packaging can be quantified in terms of air, water, and ground emissions, as well as in terms of a final waste product that must be eliminated,' explains Bernard De Caevel, Managing Director of Intertek-RDC. 'An LCA takes all of these aspects into account, as well as the raw material, water, and energy consumption that is required at each stage of the lifecycle.' In addition, an LCA enables the identification of the stages at which actions can be implemented to lower repercussions on the environment.

'Other methods exist to calculate the impact of a specific packaging, but they are not as all-inclusive,' adds De Caevel. 'Indeed, they seldom cover more than a single aspect of the packaging lifecycle. As a result, they do not enable the identification of certain types of impact.'

Clear definition of goals = qualitative results

The relevance of the results of an LCA depends upon the quality of its preparation stage. The more clearly the hypotheses, target, and range are defined, the more accurate the analysis will be. It is also important to specify the rules of analysis that will be used, and the processes that will be covered. 'What is the geographical scope of the analysis? Do we want to know the current impact or the one that will occur in five years time? These are just two of the questions that need to be considered and adequately answered before initiating the analysis itself,' pinpoints De Caevel. 'Similarly, the specific approach of the investigation will differ depending on whether the results will be used for information or comparison purposes, or whether they will be used to support decisions regarding technological choices.'

good to remember

A **lifecycle analysis** (LCA) is the most accurate method of **calculating the environmental impact** of packaging.

Clearly defining the target, hypotheses, methodology, and scope of an LCA before starting the analysis **improves the accuracy** of the results.

An LCA enables the **quantification of the impact** of a specific packaging and the accurate **comparison** of two different types of packaging.

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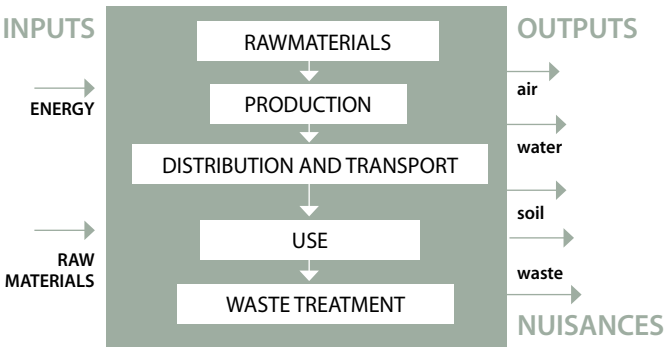
Environmental impact **of packaging**

Quantifying the impact of a specific packaging

In the case of a specific packaging, an LCA identifies the stages during which the lifecycle impact is at its greatest:
Is the resource used as packaging material available in unlimited quantities and can it renew itself rapidly enough? Knowing these parameters is essential for any packaging. When packaging is made from renewable resources, it is absolutely essential that the answer to this question is positive

Is the process of transforming the (renewable) source into a product efficient? And what about its transport? The latter aspect is one of the parameters taken into account during the analysis of the logistics chain. Indeed, the raw material of a particular packaging manufactured from a renewable resource may have to come from far away.

Is the final quality of the packaging sufficient to efficiently preserve the product and minimize product waste?



Life cycle of a product or a packaging

Moreover, the end-of-life processing is another key element taken into account by an LCA. Can the packaging be re-used or recycled within existing circuits, or does it require incineration?

Compare two types of packaging

Often, an LCA is also used to compare the respective impacts of two types of packaging. 'Such an analysis enables, for instance, the comparison of refill and non-refill packages, or biopackaging (see Feature) and conventional packaging,' observes De Caevel. 'The environmental gains related to the use of biopackaging can be quantified during the manufacturing, use, and end-of-life stages.'

For **all types** of companies

Many large companies already rely upon LCA to calculate the impact of their packaging. However, this is often not the case for smaller companies. That is why Fost Plus, together with Intertek-RDC, has developed a simplified LCA tool. The tool is available on www.pack4ecodesign.org.

Avoiding green washing

Using environmental impact analysis results can lead to false or erroneous assertions—whether intentional or not. This is called « **green washing** ». Based on its methodology, **an appropriate LCA can counter this type of abuse**. For instance, simply utilizing a renewable material is not enough to state that a packaging is green. Other factors must also be taken into account, in particular the sustainability of the resource and the speed at which it is renewed. Similarly, the results of a small scale LCA should not be used to extrapolate to a larger scale. Avoiding « **green washing** » therefore implies that the result always relates to an environmental impact analysis (whether an LCA or a partial analysis) with appropriate methodology, targets, and scope.

Bernard De Caevel, Managing Director, Intertek-RDC

« The renewable and renewed aspect of a material source is a key parameter in analyzing the environmental impact of biopackaging. »

For **additional information**

www.intertek.com/consumer/sustainability
www.pack4ecodesign.org