european bioplastics

META STUDY

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THE BEHAVIOUR OF BIOPLASTIC FILMS IN MECHANICAL RECYCLING STREAMS

SUMMARY

Biobased (non-compostable) plastic films are chemically identical to conventional plastics and are no more difficult to manage in plastic recycling streams.

Compostable plastics are designed for organic recycling. They are clearly marked for this purpose with logos such as the Seedling logo.

FIGURE 1: EXAMPLE OF A COMPOSTABILITY LOGO: THE 'SEEDLING' LOGO OF EUROPEAN BIOPLASTICS, AWARDED BY INDEPENDENT CERTIFICATION INSTITUTES

In the event that compostable plastics do end up in regular plastic recycling streams, the prevalent sorting technologies are able to sort them with little residual waste.

When residual amounts remain, they are similarly or more easily handled than current residual wastes in the PE stream (e.g. PS, PP, PET). They should not then add significantly to the cost or complexity of recycling processes or the recovery of valuable, recycled PE.

This remains true up to a share of 10% compostable plastics in the waste stream. At this level or below, studies show negligible impact on the technical performance of recycled PE.

As the market share of compostable plastics increases it will be economically rewarding to sort them out positively. This is technically possible today and should create new and valuable markets for the waste management industry.

Aside from the social and environmental benefits of bioplastics, the best evidence clearly shows that these materials present an economic opportunity and not a threat to the waste management industry.

DEFINITIONS

Bioplastics are plastics that are biobased, biodegradable, or both. This large family of materials can be simplified into two groups:

1. Biobased non-biodegradable plastics (also: durable bioplastics)
Materials: Biobased polyethylene (PE), biobased polyethylene terephthalate (PET), biobased polyamides, and materials such as starch-polyolefin blends etc.
Uses: Packaging sector or durable applications, for example in vehicles, buildings, household appliances, interior design, lifestyle goods and electronics.

2. Biobased biodegradable and compostable plastics
Materials: Thermoplastic starch, polylactic acid (PLA) or polyhydroxyalkanoates etc.
Uses: Short-lived applications such as in agriculture, catering products, packaging, or thin bags. Suitable for organic recycling, especially industrial composting.

Standards: Within the EU compostable products are certified under EN 13432 and EN 14995.

Bioplastics in mixed waste streams
Modern waste recovery systems cope with intermingled materials, including a variety of different polymer types. Automated plants sort out the profitable parts of the waste stream (for example PE and PET). The promising polymers are separated. The remainder is sorted into another container, usually marked and resold as 'mixed plastics'.

To achieve this, advanced sorting systems use a variety of analytical methods including near infrared, ultraviolet, x-ray, laser, polarized light, fluorescent light, electrostatic, melting point and other techniques. These methods are effective in keeping contamination of the main recycling streams with unwanted material low.

Compostable plastics should be sorted into biowaste bins. If such bins are not available Compostable plastics can still be clearly identified from their labels and sorted out for delivery to a biowaste processer.

However, even in efficient systems, the mixing of waste streams cannot be completely avoided. Non-compostable plastics can enter the organic waste stream (e.g. misthrows) and biodegradable, compostable plastics might be found in mechanical recycling systems (e.g. misidentification[a]). It is already the case that conventional plastics find their way into the wrong stream in small volumes.

In well-run waste management facilities most residual bioplastic will be handled as 'mixed plastic' until such a time as recovery is profitable. Today, even when bioplastics are sorted incorrectly, they do not enter the waste stream in sufficient volume to cause concern more than any other type of plastic.

The case against bioplastics is not evidence-based

Voices in some parts of the waste management industry claim that bioplastics can cause a serious disturbance in the established recycling streams, for example of PE and PET.

The following research and evidence refutes these assertions. It suggests the influence on the collection and processing of profitable materials is negligible.

Biobased Polyethylene (PE, not biodegradable or compostable)

Biobased PE is obtained by polymerisation of ethylene monomers. Depending on the polymerisation process biobased LDPE or biobased HDPE can be produced. The only difference to fossil-based PE is the source, which is bioethanol, e.g. made from sugar cane, sugar beet, or wheat.

As a result fossil and biobased PE are chemically identical. They share exactly the same physical properties. Therefore, biobased PE can be recycled mechanically with fossil-based PE in the corresponding recycling streams.

PLA/PBAT blends (compostable according to EN 13432)

Studies by the University of Hannover [1], [2] examined the influence of different compostable plastics on low-density polyethylene (LDPE). The mixtures tested contained between 0.5% to 10% foreign material. The LDPE contaminants were a PLA/PBAT[b] blend, pure PBAT and a starch blend. They found:

- Mixtures of LDPE with PLA/PBAT showed the same viscosity behaviour, elasticity, and tensile strength as pure LDPE.
- No optical (i.e. transparency or appearance) changes could be observed.
- There was a slight decrease in the melt-flow rate at 10% foreign material.

The biodegradable polyester PBAT was also tested as a possible contaminant for LDPE. The blending of pure PBAT with LDPE had no effect on the viscosity behaviour compared with pure LDPE and was affirmed to have no effect on the processing properties. The melt flow rate values were close to those of pure LDPE and were found to cause no distinctive disturbances during processing of the material. Optical changes could also not be observed.

Contamination below 10% has no effect.

Starch blends (compostable according to EN 13432)

A study by BIOTEC [3] has evaluated tensile strength, elongation at break and specific impact resistance for mixtures of PE with possible contaminations with a starch/PBAT[c] blend as well as PP and PS. It was shown that the biodegradable starch blend contaminates PE no more than contamination with conventional plastics such as PS or PP.

In most cases the properties of the mixtures of PE with PS or PP contaminants performed worse than mixtures of PE with a starch blend contaminant.

However, the same study found that even extremely low PET shares (2%) in a PE recycling stream cause serious problems. Due to the comparatively high melting temperature of PET (approx. 250°C), it was impossible to run a PE-based blown-film.

These results suggest that the contaminating effect of a compostable plastic on PE is actually less than the contaminating effect of PET on PE.

A study by the University of Hannover [1] also examined a starch blend used in flexible packaging applications. It found that the influence on the viscosity and flow characteristics was only marginal up to the tested ratio of 10%.

The influence on the melt flow rate processing properties was described as low compared to the pure LDPE. A change of colour was observed with an increasing amount of starch blend.

[a] *Certified biodegradable plastics are marked with a corresponding label, e.g. the Seedling logo. This makes compostable plastics clearly identifiable and distinguishable from conventional and non-biodegradable plastics.*
[b] *Blend of polylactic acid and poly(butyleneadipate-co-terephthalate); Tradename: ecovio®*
[c] *Tradename: BIOPLAST®*
[d] *Blend of polylactic acid and poly(butyleneadipate-co-terephthalate); Tradename: ecovio®*

Tests carried out at the Plastics Testing Laboratory Foundation of the Polytechnic Institute of Milan and the Proplast Laboratories in Tortona/Italy (on behalf of CONAI, the National Packaging Consortium in Italy) [4] confirmed that it is possible to reprocess and recycle bags made of a starch-based material[d] and traditional plastic shopping bag waste up to a concentration of 10% of starch-blends as input material.

CONAI found that flexible, compostable packaging can be recycled with common plastics packaging materials up to a content of 10% without any problems [5].

CONAI concluded that even if biodegradable bags are not disposed off properly, they do not interfere with the recycling stream of conventional plastics.

LITERATURE

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[3] C. Heß, Influence of BIOPLAST-Material and conventional non-PE Plastics on the mechanical Properties of recycled PE-Film, BIOTEC, Presented at K Fair 2013
[4] Italian National Packaging Consortium CONAI, Findings of Biodegradable Packaging Recovery Project. Presented at the European Bioplastics Conference, Berlin, 2013.
[5] http://www.ecodallecitta.it/notizie.php?id=114824, retrieved on December 8th, 2013

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[d] *Tradename: Mater-Bi®*