european bioplastics

META STUDY

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THE BEHAVIOUR OF BIOPLASTIC FILMS IN MECHANICAL RECYCLING STREAMS

SUMMARY

Biobased, non-compostable plastics films (e.g. Bio-PE) are chemically identical to their conventional counterparts and are just as easily managed in the existing plastics recycling streams.

Compostable plastics, which are certified according to EN 13432, are specifically designed for organic recycling (i.e. industrial composting). They are clearly marked for this purpose with logos such as the Seedling.

FIG.: 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 conventional plastics recycling streams, the existing sorting technologies are perfectly able to sort them with little residual waste.

In a PE stream, any residual amounts that do remain can be treated in a very similar fashion to existing residual wastes (e.g. PS, PP, PET). This means that they do not increase the complexity of the recycling process - there is no detrimental effect on the recovery of recycled PE.

As the market share of compostable plastics increases, it will become economically rewarding to sort them out positively. Since the technical means already exist today, the sorting of compostable bioplastics should create new and valuable markets for the waste management industry.

Aside from the social and environmental benefits of bioplastics, the evidence clearly shows that these materials – rather than being a threat – are in fact an economic opportunity for the waste management industry.

DEFINITIONS

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

1. Biobased, non-biodegradable plastics

Materials: Biobased polyethylene (Bio-PE), biobased polyethylene terephthalate (Bio-PET), biobased polyamides (Bio-PA), some biobased polyesters (PTT, PEF), starch-polyolefin blends, and other materials.
Uses: In packaging as well as in durable applications such as vehicles, buildings, household appliances, interior design, lifestyle goods, and electronics.

2. Biobased, biodegradable and compostable plastics

Materials: Thermoplastic starch, polylactic acid (PLA), polyhydroxyalkanoates (PHA) and others.
Uses: Short-lived applications such as in agriculture, catering products, packaging, or thin bags. Suitable for organic recycling, especially industrial composting.
Standards: In the EU, compostable products are certified under EN 13432 and EN 14995.

Bioplastics in mixed waste streams

Bioplastics account for less than one percent of the entire market share. Considering that durable bioplastics films can be recycled in conventional recycling streams, the remaining amount of compostable plastics films is even less significant. Furthermore, plastics films and bags are only a small share for the recycling industry, the expected collection ratio in 2015 for plastics films being 15 percent and for bags 7.5 percent.[1]

Modern waste recovery systems cope with mixed materials, including a variety of different polymer types. Automated plants sort out the profitable parts in the waste stream (for example PE, PS or PET) by identifying and separating the most valuable polymers. Anything that remains is kept in separate containers and usually labelled and resold as 'mixed plastics'.

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

[1] *Assessment of impacts of options to reduce the use of single-use plastic carrier bags. Final report, 2011, p. 54. Available at: http://ec.europa.eu/environment/waste/packaging/pdf/report_options.pdf.*

Biodegradable and compostable plastics should end up in biowaste bins. Should such bins not be available, compostable plastics can still be clearly identified from their labels and sorted out for delivery to a biowaste processer.

However, even in well-working systems, a mixing of waste streams cannot be completely avoided. Non-compostable plastics can end up in the organic waste stream (e.g. misthrows) and biodegradable, compostable plastics may be found in mechanical recycling (e.g. misidentification[2]). The same holds for conventional plastics, which – in low volumes – occasionally find their way into the wrong recycling streams.

It is fair to say that, as long as recovery is not profitable, most waste management facilities will treat residual bioplastics as 'mixed plastics'. In any case, however, bioplastics today do not enter the waste stream in sufficient volumes to cause concern - at least no more concern than any other type of impurity.

The case against bioplastics is not evidence-based

It has been claimed by some representatives of the waste management industry that bioplastics are a serious disturbance to the established recycling streams of for example, PE or PET.

The following research findings and evidence gathered from looking at various representative 'mixed plastics scenarios' refute these assertions. Scientific research unequivocally suggests that the influence of bioplastics 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 plant-based (bioethanol made from sugar cane, sugar beet, wheat and others).

In other words, fossil and plant based PE are chemically identical. They share the exact same physical properties. Therefore, biobased PE can be mechanically recycled together with fossil-based PE in the same recycling stream. The same holds for biobased PET – no issues of added complexity of the recycling process arise.[3]

PLA/PBAT blends (compostable according to EN 13432)

Studies [1] and [2] by the University of Applied Sciences Hannover examined the influence of various compostable plastics on different low-density polyethylenes (LDPE). The tested mixtures contained between 0.5 percent to 10 percent impurities. The external materials introduced to the LDPE stream were a PLA/PBAT[4] blend, pure PBAT, and a starch blend. They found that:

- Nearly all 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 of LDPE could be observed in the contamination scenario with PLA/PBAT.
- There was a first slight decrease in the melt flow rate at 10 percent impurity material.

The biodegradable polyester PBAT was also tested as a possible impurity for LDPE. The blending of pure PBAT with LDPE had no influence on the viscosity behaviour compared with pure LDPE and was found to have no influence on the processing properties. The values for melt flow rate were close to the ones of pure LDPE and were confirmed to result in no distinctive disturbances during processing of the material. Optical changes were also not observed.

Starch blends (compostable according to EN 13432)

Study [1] by the University of Hannover further examined possible variations of LDPE when mixed with starch blends used in flexible packaging applications. It was found out that the influence on the viscosity of the LDPE and flow characteristics was only marginal up to the tested ratio of 10 percent. A change of colour and water uptake was observed with increasing ratios of starch blend.

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[5] blend as well as PP and PS. It was shown that the biodegradable starch blend contaminates PE no more than conventional plastics such as PS or PP.

In most cases, the properties of the mixtures of PE with PS or PP as contaminants showed worse performances than the contamination of PE with a starch blend.

[2] Certified biodegradable, compostable 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 ones.
[3] see also: Karin Molenveld et al.: Recycling of Bio-PE. Influence of bio-PE shopping bags on the quality of recycled film from SITA. December 2014.[c] Tradename: BIOPLAST®
[4] Blend of polylactic acid and poly(butyleneadipate-co-terephthalate); Tradename: ecovio®
[5] Tradename: BIOPLAST®

However, the same study found out that PET shares as low as 2 percent in a PE recycling stream results in 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 impurifying effect of a compostable plastic on PE is actually smaller than of PET on PE.

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], have confirmed that it is possible to reprocess and recycle bags of a starch based material[6] and traditional plastic shopping bag waste up to a concentration of 10 percent of starch-blends as input material.

CONAI found that flexible, compostable packaging can easily be recycled with common plastics packaging materials up to a content of 10 percent [5]. CONAI concluded that even if biodegradable bags are not disposed of properly they do not interfere with the recycling stream of conventional plastics.

LITERATURE

[1] A. Kitzler, Bioplastics in Waste Management Streams, Dissertation, University of Applied Sciences, Hannover, 2013
[2] H.-J. Endres, A.-A. de la Cruz, Influence of PLA/PBAT material (ecovio®) on the recycling of conventional LD PE, University of Applied Sciences, Hannover, 2013
[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, December 8th, 2013

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European Bioplastics e.V.
Marienstraße 19/20
10117 Berlin
Phone: +49 (0) 30 284 82 350
Fax: +49 (0) 30 284 84 359
info@european-bioplastics.org
www.european-bioplastics.org

[6] *Tradename: Mater-Bi®*