Open-Bio

Opening bio-based markets via standards, labelling and procurement

Work package 6
Managed end-of-life options

Deliverable N° 6.10:

Assessment of chemical/feedstock recycling and test methods

Public summary

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1 Public summary

The application of standards, certification schemes and labels has positive long-term effects on the overall development of the European bio-based product market. Adequate product information that presents correct claims to industry and public procurers is vital for the usage of these new products. Ensuring the sustainable sourcing of raw materials and the effective measurement of bio-based content are important additional steps towards public confidence.

The Open-Bio project (www.open-bio.eu) aims at increasing the uptake speed of standards, labels and harmonised product information lists for bio-based products. It covers research on direct and indirect bio-based content methods, biodegradability, and social acceptance. Working with European standardisation committee CEN/TC 411 *Bio-based products* (http://www.biobasedeconomy.eu/standardisation/cen-tc411) the goal is to translate results from the Open-Bio project into European standards and product information lists. These will also form the basis of an online database cataloguing bio-based products. Recommendations towards updates to the EU Ecolabel will be formally presented in order to clearly distinguish bio-based products on the basis of the functionality as defined in standards. Public acceptance comes with clear and harmonised labels on products and packages.

Led by Organic Waste Systems (OWS), work package 6 of the Open-Bio project addresses “managed end-of-life options”, including centralised industrial composting, decentralised composting, anaerobic digestion, mechanical recyclability and chemical/feedstock recyclability. This report addresses the latter. Chemical recycling is the process of transforming a waste material, by means of a chemical reaction, back to the original chemical intermediate. This will usually be the monomer that is polymerised to make the plastic in question. Sometimes a different chemical product is formed, which may be achieved with thermal rather than chemical processes. This may be referred specifically as feedstock recycling, although chemical recycling can be used as a blanket term for all processes of this kind.

Chemical recycling is a particularly interesting end-of-life option for certain products, such as materials that cannot be successfully mechanically recycled or that are not biodegradable (either inherently or in certain circumstances). Plastics are the most suitable materials to be chemically recycled, offering a different approach to the existing, well-established waste management options.

The purpose of this report is to evaluate the technical suitability of chemical recycling for bio-based plastics, also defining acceptance criteria for recyclates and recycled products, and explaining the role of chemical recycling alongside more established waste management practices. Contained in this work is an extensive desk study describing the state-of-the-art, experimental results, and recommendations on the future application of chemical recycling. Furthermore, the basics of chemical recycling are explained, and different processes classified as chemical recycling introduced and discussed in terms of feasibility. The characterisa-

tion of plastic waste relevant to chemical recycling is briefly presented, considering classification (type of polymer, origin, sector, recycling shape) and composition. This is important to identify suitable targets for chemical recycling. Different examples of chemical recycling of bio-based (PLA, PHA, cellulose acetate esters, PET, PE) and petroleum-based (PC, PA, PU, PS, ABS, PVC) plastics have been collated from published academic studies and patents.

Experimental results, primarily on the chemical recycling of PLA products, features hydrolysis and solvolysis procedures. The hydrolysis of PLA to lactic acid was particularly successful. Real commercial products have been chemically recycled, including mixed wastes, blended materials of different polymers, and plastic retrieved from anaerobic digestors. This represents a clear advance over previously reported chemical recycling practices that only address model systems or pure product streams. It was also confirmed that PLA can be selectively hydrolysed in the presence of PET or PP.

The application of chemical recycling is severely limited by the availability of suitable wastes of PLA and other appropriate polymers. Given the low amounts of chemically recyclable plastics currently in circulation, alternative applications for chemical recycling have been proposed in this work, such as the processing of contamination removed from anaerobic digestors (reclaimed PLA), and the removal of contamination in mechanical recycling streams (PLA in a mixture with PET). These integrated approaches to waste management indicate a certain amount of flexibility regarding the implementation of the waste hierarchy might actually present an overall environmental benefit.

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