european bioplastics

FACT SHEET

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FEEDSTOCK RECOVERY OF POST INDUSTRIAL AND POST CONSUMER POLYLACTIDE BIOPLASTICS

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1. DESCRIPTION OF TECHNOLOGY

Polymers can be synthesized by means of polycondensation of the original monomers. Monomers are linked together with the release of water to form the polymeric chain. Polyesters, polyamides and polyesterpolyols used in polyurethanes are typically produced via polycondensation. The opposite reaction of polycondensation is hydrolysis, where the chemical bonds between monomers are broken through the addition of water so that the polymer is broken down to its original monomers. This reverse reaction can be exploited to recover the valuable monomers from post consumer plastics. This type of process is referred to as chemical recycling or feedstock recovery. In the bioplastics sector feedstock recovery is currently applied to polylactic acid (polylactide) polymers (PLA). PLA can be hydrolysed back into its monomer lactic acid. The process can be summarised as given in Figure 1.

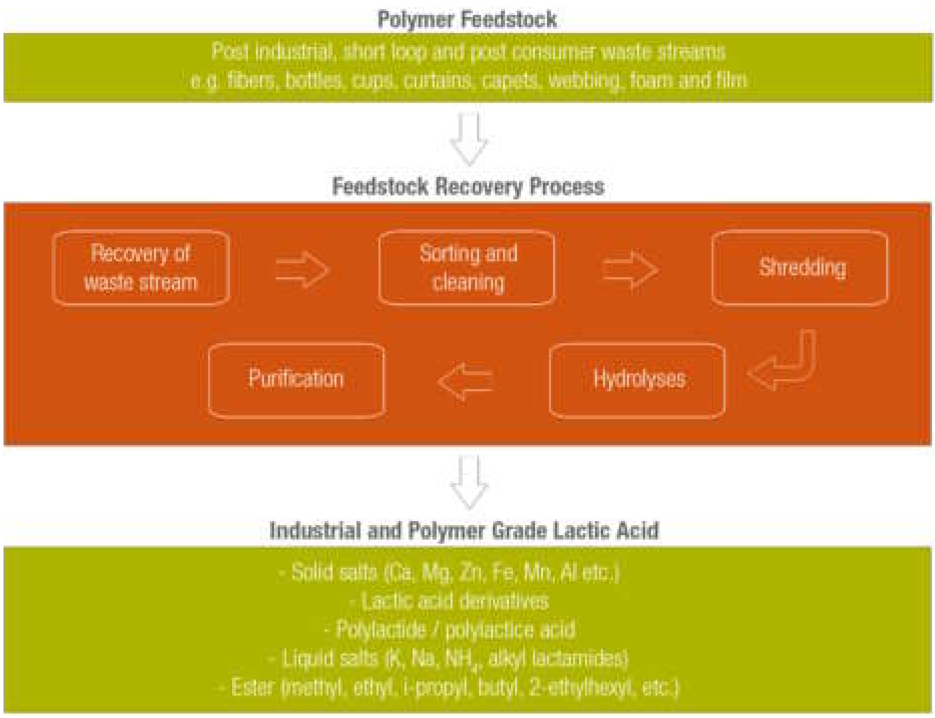

FIGURE 1. FEEDSTOCK RECOVERY OF POLYLACTIDE POLYMERS

The post industrial, short loop and post consumer PLA waste streams are collected and separated from the other materials. The collection and sorting technologies applied depend on the targeted waste stream. The hydrolysis technology is efficient for streams consisting mainly of PLA but can also be used for blends and compounds containing PLA. In case of post industrial and short loop waste stream the collection is a relatively easy task. The collection of post consumer waste streams is more complicated, but can be done when certain threshold volumes are available in the market. The sorted PLA waste stream will be cleaned, shredded and hydrolysed back into lactic acid with a rate of over 99%. The lactic acid is separated from the water fraction and further purified. The purification steps can be modified to accommodate the PLA waste stream composition and the lactic acid grade required. The overall recovery rate depends on the efficiency of the up and downstream processes. Typical contaminants such as sand, other plastics and additives are removed by the pretreatment, stay behind in the bottom fraction of the hydrolysis process or are finally removed by standard techniques such as ion exchange and activated carbon.

2. CURRENT DISTRIBUTION AND PROSPECTS

The current distribution of the technology is still limited, mainly because of the limited availability of PLA waste streams on the market.

In Belgium a 2000 metric tonnes per year plant to hydrolyze post industrial, short loop and post consumer PLA waste streams has been built for the European market. This unit has been designed to process PLA waste streams in different forms such as flakes, granulates and pellets but also cups, bottles, rolls, carpets, etc. The recovered lactic acid can be used for detergents, solvents, electroplating and tanning applications. As soon as PLA polymer production facilities are available in Europe, PLA polymer can be produced from the recovered lactic acid stream as well.[1]

In Wisconsin, USA, a 4000 metric tonnes per year plant has been built to hydrolyse post industrial and post consumer PLA waste.

A second facility is expected to be built in the USA with a capacity of 2200 metric tonnes in the course of 2010.

The hydrolysis process could be incorporated into existing lactic acid plants world wide. With a line-up of purification, concentration and packaging of virgin lactic acid being already in place in these plants, it would be possible to add the upstream processes like sorting, cleaning, shredding and the hydrolysis process itself.

3. REGULATORY FRAMEWORK

3.1 __ Waste Framework Directive[2]

To move Europe forward towards a recycling society the Waste Framework Directive sets binding targets for all EU member states to reuse or recycle at least 50% of plastics waste from household collection. The definition of recycling given in the directive covers both traditional mechanical and feedstock recycling technologies.

3.2 __ Packaging and Packaging Waste Directive[3] 1994/62/EC (PPWD)

The Packaging and Packaging Waste Directive requires all EU member states to recycle at least 22.5 % of all plastics packaging waste, counting exclusively material that is recycled back into plastics.

4. STANDARDS, CERTIFICATION AND LABELLING

Currently there is no standard or certification scheme for feedstock recovery of PLA. There is no separate plastic recycling code for PLA.

[1] E.g. collection from confined areas such as food, festival, stadiums and universities
[2] 2008/98/EC (WFD)
[3] 1994/62/EC (PPWD)

5. INTERACTION BETWEEN BIOPLASTICS AND TECHNOLOGY

A precondition for starting up more economically viable PLA feedstock recovery plants is the availability of sufficient volumes of post industrial and post consumer PLA waste streams. The recovered lactic acid can be re-polymerised into PLA or used in other industrial applications. This technology is available for PLA and blends of PLA with other polymers.

6. BENEFITS AND CHALLENGES

6.1 __ Benefits

- The hydrolysis process of PLA polymers is relatively simple, robust and efficient. It can be controlled to deliver lactic acid which can be re-polymerised to produce different 'custom-made' quality grades of PLA, the best one being identical to virgin PLA.
- Feedstock recovery is a flexible process considering the waste streams that can be processed and the multiple outlets for the recovered lactic acid.
- Post industrial and short loop waste streams are already collected today, and could be used as relatively pure feedstock in the hydrolysis technology.

6.2 __ Challenges

- As a result of the relatively low volumes on the market there are as yet no dedicated collection systems in place yet for post consumer waste streams.
- Specific labeling of PLA for recycling and feedstock recovery is not available.
- With only a few feedstock recovery plants installed today, collected post-industrial and post-consumer waste-streams will have to be transported over large distances.

7. SUCCESSFUL CASES

- Since 2002 polymer producers have successfully been recovering the lactic acid from industrial waste streams.
- Private companies are setting up feedstock recovery plants in the EU and the US.

8. REFERENCES

J. Willocq, A new cradle-to-cradle approach for PLA, Bioplastics Magazine, issue 05/2009

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