Production

The basis of polylactic acid (abbreviated PLA) is the naturally occurring lactic acid (2-hydroxypropionic acid), which plays an important part in the metabolism of most organisms. The polymerization of PLA can take place by two routes:

• Direct production of a polymer from lactic acid by a polycondensation reaction

• Production by ring-opening polymerization and the detour via the cyclic dimer of lactic acid, dilactide.

It is ordinarily produced in a two-step process in which first polylactides are synthesized and then split into dilactides. This is followed by the ring-opening polymerization which is usually catalyzed by metal-organic compounds.

Starch, which is usually produced from corn, is used as the raw material for lactic acid. But agricultural wastes such as whey also come under consideration as a substrate for the production of PLA.

Fabrication and properties PLA can be fabricated both by extrusion, by melt spinning, injection molding or even by pressing, but the process conditions must be adapted in terms of time and temperature, since a typical reverse reaction for a polycondensate may occur.

The softening point of ordinary PLA is around 60 °C, which limits its use in many fields. However, examples of products are already on the market that use PLA materials with thermal shape stability. In this case, the higher temperature stability is achieved by copolymerization or by the addition of fillers or natural fibers.

Through the choice of suitable comonomers, with PLA or its blends, plastics can be produced with properties comparable to those of petroleum-based plastics such as polyethylene terephthalate (PET), polystyrene (PS) or even polyvinylchloride (PVC).

Economical aspects Biopolymers based on PLA have a great economic potential. For years, there has been extensive experience in the use of PLA products in the medical sector and corresponding commercial applications, such as its use as biocompatible and biodegradable implants for osteosynthesis, as drug delivery systems and as support systems for tissue engineering. However, because of the high price of PLA, its use has remained essentially limited to these high-priced special applications. Present ly PLA is probably the most promising candidate among the biologically degradable materials that could penetrate further into the market for packaging plastics. In the packaging sector, plastic packaging, especially for foods and beverages as well as for articles for home and office have been mentioned as potential applications soon to be ready for the market. The European market for PLAbased polymers was estimated in 1997 at 40,000 tons per year in the year 2000 and at 107,000 tons in the year 2005. At present, the world production is about 140,000 tons per year. For the year 2020, if development continues at the same pace, a production volume of 530,000-1,150,000 tons per year is estimated.

The current price of PLA is primarily determined by the price of the materials used. As in the case of all plastics based on renewable raw materials, it is higher than the price of plastics produced by petrochemistry. A cost reduction of about €2.00/kg can be realized by mass production.

(Picture source: Danone)