ecovio®

Certified compostable resin for sheet-line extrusion and thermoforming

Table of contents

THIS IS ecovio®

Certified compostable polymer based on renewable raw materials

ecovio® IS A HIGH-QUALITY AND VERSATILE BIOPLASTIC FROM BASF. THE PRIMARY ADVANTAGES: IT IS CERTIFIED COMPOSTABLE AND HAS BIOBASED CONTENT.

01

Characteristics

ecovio®:

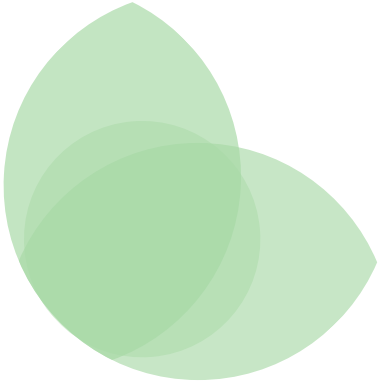
- is a finished compound
- is certified compostable and biodegradable
- has a variable biobased content
- is certified worldwide
- is printable and has excellent heat sealing properties

The main application areas for ecovio® are plastic films such as organic waste bags, fruit and vegetable bags, cling film, dual-use bags (first for shopping, then for organic waste) and agricultural films. Furthermore, compostable packaging solutions such as paper-coating and injection molding products can be produced with ecovio®.

As a wide range of applications is possible with ecovio®, solutions for Closed-Loop Systems can be implemented, e.g. for food catering in sports venues.

An innovative mix of proven ingredients

With ecovio®, BASF offers a certified compostable polymer which at the same time has a variable biobased content. The biobased portion can be adjusted to suit client requirements.



ecovio® consists of the compostable and biodegradable BASF polymer ecoflex® and polylactic acid (PLA), which is derived from corn or other sugar generating plants like manioc. In contrast to simple starch-based bioplastics, ecovio® is more resistant to mechanical stress and moisture.

Ready for use

ecovio® is a finished product that can be used as a drop-in solution with standard plastic production technologies. Additional blending is therefore not required.

High performing and certified compostable

ecovio® products are just as high-performing and strong in use as conventional plastics. A bag made of ecovio® can take the same load as its polyethylene counterpart. The product properties were designed in such a way that the products only fully biodegrade in compost after use.

01

Characteristics

One step ahead together

AS A LEADING PROVIDER OF HIGH-QUALITY AND HIGH-PERFORMING PLASTICS, BASF HAS BEEN RESEARCHING BIODEGRADABLE AND BIOBASED POLYMERS FOR MORE THAN A QUARTER CENTURY.

The continuous development of innovative plastic solutions and the functionality improvement of the products happen in close cooperation with internal BASF units as well as with external partners.

Certified biodegradable and biobased plastics can be the optimal solution for specific applications, e.g. certified compostable organic waste bags or soil-biodegradable mulch films. The biodegradability does not depend on the origin of the plastic – it can be fossil-based or biobased. For each application a detailed consideration of ecological compatibility, economic viability and social consequences over the entire life cycle is necessary, for example with an eco-efficiency analysis.

What is meant by bioplastics?

	not compostable	compostable
based on renewable raw materials	Bio-PE, Bio-PA, Bio-PUR, Bio-PP	PLA, PHA
on a fossil basis	PE, PP, PVC, PA, PBT	PBS

Two different groups of products fall under the term “bioplastics”: “biobased” and “compostable” plastics.

Biobased materials are partly or entirely made of renewable raw materials. Polylactic acid, polyhydroxyalkanoate (PHA), starches, cellulose, chitin and gelatin for example, belong to this group. Biobased plastics can be biodegradable – but they are not always. Biobased but not biodegradable plastics are e.g. biopolyethylene, natural fiber plastics, and composites of wood and plastic.

Compostable plastics can be biodegraded by microorganisms. Special micro-organisms give off enzymes which break down the material’s flexible polymer chains into small parts. These are then digested by the organisms together with other organic material such as, for example, organic waste. Water, carbon dioxide and biomass remain. This has been verified in several independent scientific studies. Compostable polymers can, but need not be produced from renewable raw materials. They can also be based on crude oil. The biodegradability does not depend on the raw material, rather, it depends entirely on the chemical structure of the polymer.

Tested and certified

THE COMPOSTABILITY OF ecovio® HAS BEEN CERTIFIED BY RECOGNIZED AND INDEPENDENT TEST INSTITUTES.

Certified by test institutes

Independent institutes test bioplastics in special certification procedures with respect to biodegradability, compostability, compost quality and plant compatibility.

Only when a material meets the clearly defined test criteria may it be identified as compostable.

Suitable for food

ecovio® grades comply with the requirements of the European food contact regulation[1] as well as the US Food Contact Substance Notification[2]. Therefore they are suited for food packaging.

ecovio® offers various product grades that conform to the following international standards and norms for composting, among others:

European standard EN 13432

Home composting

Soil biodegradability

American standard ASTM 6400

European standard EN 13432
Australian standard AS 4736

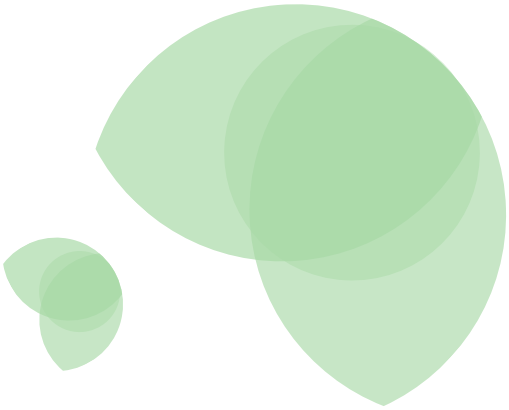
Italian certification CIC

Japanese standard GreenPla

Canadian standard CAN/BNQ 0017-088

[1] Commission Regulation (EU) No. 10/2011 of January 14, 2011 on materials and objects of plastic, designed to be in contact with food.

[2] According to Food Contact Substance Notification No. 178, 475 and 907 of FDA



Bag made of ecovio® filled with organic waste

Biodegradation into:

- Water
- CO_2
- Biomass

“Oxo-degradable” bag filled with organic waste

- **No biodegradation** (does not comply with international composting standards)
- **Disintegration to plastic fragments (PE)**
- Premature loss of mechanical properties upon **exposure to strong light**

Bio-polyethylene bags filled with organic waste

- **Biodegradation impossible** (only extremely slow disintegration into plastic fragments)
- **Disposal to landfill** (prohibited in some European countries)
- **Incineration** (not appropriate due to the high content of water in organic waste)

“Oxo-degradable” plastics and bio-polyethylene plastics are not compostable

“Oxo-degradable” polyethylene films (PE) are conventional plastics which only decompose with the addition of special additives. Triggered by exposure to UV or heat, they oxidize the polymer chains and break them up into smaller fragments. To date it has not been possible to scientifically prove any biodegradability of these PE fragments after decomposition that meets the composting standards, whether or not the materials were pretreated with UV radiation or heat.

Bio-polyethylene plastics are made with renewable resources. But they too are not biodegradable. Compostability does not depend on the origin of the raw materials, but on the chemical structure of the polymer.

02

PRODUCT PORTFOLIO

for sheet-line extrusion and thermoforming

THE MOST IMPORTANT FIELDS OF APPLICATION OF ecovio® INCLUDE FILMS FOR BAGS, PACKAGING AND AGRICULTURAL, AS WELL AS THERMOFORMED, INJECTION MOLDED AND EXTRUSION COATED ARTICLES FOR CONSUMER AND CATERING ARTICLES.

BASF provides a broad product portfolio of various ecovio® types with different bio-based components, as well as mechanical and thermal properties. ecovio® types are offered as ready-to-use compounds. All types benefit from an optimal balance of stiffness and toughness combined with excellent sealing and certified compostable properties.

ecovio® T and TA were especially developed for cast/flat film extrusion and subsequent thermoforming. ecovio® T is a stiff and less heat resistant grade. Compared to that ecovio® TA has a higher heat resistance and PP-like mechanical behavior (figure 1).

	Thermoforming	
	ecovio® T	ecovio® TA
Mechanical properties	comparable to HiPS / ABS	comparable to PP
Heat resistance (HDT B)	55 °C	95 °C
Certified compostable	✓	✓
Processable on standard machinery	✓	✓
Food contact compliant	✓	✓

Figure 1: ecovio® grades for thermoforming

ecovio® for thermoformed packaging

ecovio® T AND TA ARE OPTIMALLY SUITED FOR SHEETING WHICH CAN BE THERMOFORMED. THE COMPOSTABILITY OF ecovio® T AND TA DOES NOT PRECLUDE PROCESSING ON CONVENTIONAL MACHINES.

With ecovio® T and TA, processing on conventional sheeting equipment is possible with and without calenders. The result: A stiff yet very tough sheet which wraps extremely well – ideal prerequisite for the thermoforming of demanding components.

Whether inline or offline – the sheet, produced in a processing window of 105 to 140 °C, can be thermoformed through a die with or without pre-stretching. This results in thermoformed components of the usual high design freedom which are compostable after use.

- Mostly biobased
- Processable on conventional flat-film equipment
- Very wide processing window
- Suitable for single- and multi-layered sheeting
- Suitable for food contact

Sheet-line / flat film extrusion

The advantages of ecovio® T / TA

- Excellent strength and stiffness
- High impact strength
- Good heat resistance up to 94 °C (TA types)
- Good processing properties on conventional flat film extrusion systems
- Good sealing properties
- Good printability

Cast / flat film applications

Predominately thermoformed products such as

- Drinking cups
- Bowls and lids
- Capsules

03

PROCESSING

General information

Humidity and drying

Thermoplastic polyester such as ecovio® is sensitive to humidity. The moisture content during the processing of ecovio® should be ≤ 0.1 %. If the moisture content is too high, it can lead to decomposition of the polymer.

Decomposition causes the decline of viscosity and the loss of toughness and elasticity. If ecovio® is not processed immediately from the airtight original container, we recommend measuring the residual humidity and, if required, pre-dry the granulate. The pre-treatment of the granulate and the processing require particular attention in order to ensure high quality finished parts and a minimum of quality fluctuations.

To prevent condensation, containers which are not stored in heated rooms may only be opened once they have acquired the temperature in the processing room. Among the various drying systems, the dry-air dryer has been found to be technically and economically superior. Generally, the regulations of the equipment manufacturer should be observed to achieve the desired drying effect.

Coloring

Good compatibility with ecovio® should be ensured when selecting the color master batches in order to prevent any impact on its property profile. We recommend using certified compostable color master batches such as Sicoversal® B by BASF Color Solutions, part of Sun Chemical Corporation.

Interruption of production and material change

No special measures such as purging are required for short-term interruptions of production. Reduced viscosity in the emerging melted mass following an interruption indicates thermal decomposition. Brownish discoloration and escaping gases indicate that the melted mass is already pyrolyzed. In this case, please observe the safety instructions on page 24.

Prior to lengthy downtimes, e.g. overnight or over the weekend, the cylinder should be purged thoroughly with lightly flowing PE-LD (MVR ~ 4), as polyethylene is significantly less susceptible to thermal loads upon reheating. At the restart, the polyethylene should be rinsed out of the system with pure ecovio®.

Recycling of production waste

The recycling of production waste consisting of only ecovio® is generally possible.

Up to 40 % of the re-granulate can be added to the new granulate without experiencing any noteworthy decline in the material parameters of the film products. Please note to test the re-granulate percentage, if the regranulate is derived from a multi-layer sheet.

Sufficient pre-drying has to be ensured when adding re-granulated material (see section “Humidity and drying” on page 15).

Extrusion processes

ecovio® is a plastic, which was optimized for all conventional extrusion processes known for thermoplastics. Single-screw extruders with an L/D ratio of less than 30 are suitable for ecovio® processing. However, specific recommendations exist for the optimum processing of ecovio®.

Extruder unit

It is recommended to use a single-screw extruder not exceeding an L/D ratio of 30. A single-start, standard sectioned three-zone screw is ideal for the processing of ecovio®.

In general, barrier screws combined with grooved intake zones as well as mixing and shear elements can also be used.

The processing temperatures here are lower compared to with polyolefin or styrol plastics.

Compared to shear-sensitive compounds, ecovio® exhibits a broad processing window between 160 and 235 °C.

A flatter temperature profile or slightly increasing temperatures can be selected in contrast to other thermoplastics. These differ in various extrusion processes (figure 2). Only wear-proof steel should be used for cylinder and screw when processing ecovio® extrusion types.

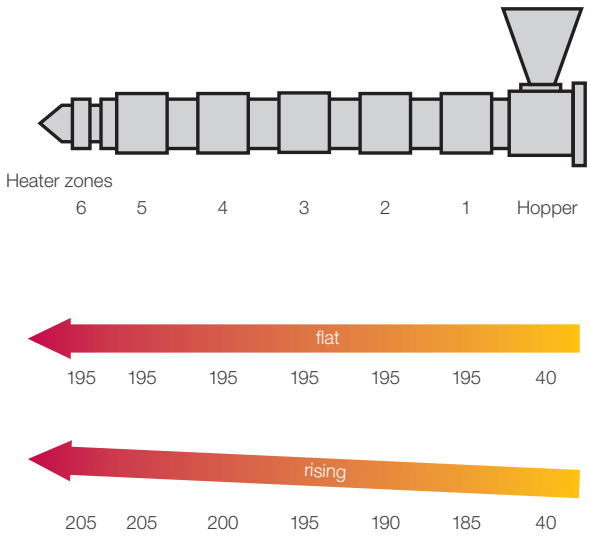


Figure. 2: Examples of temperature control of ecovio® T/TA flat film types in the cylinder [°C]

Sheet-line extrusion

ecovio® T and TA types were developed for the processing of extruded flat and cast films on conventional cast film systems in thicknesses between 200 µm and 1.5 mm, applying the film extrusion process for, e.g., subsequent thermoforming. All existing subsequent units (chill, roll, wind, cut and stacking systems etc.) can be used.

Due to different flow behavior – at the exchange of other polymers – both ecovio® types require precise new calibration of the extrusion tools at the respective operational spots.

Conventional slot nozzles, as used in the processing of PP or PS, are also suitable for ecovio® T and TA. It is recommended to heat the nozzle to the same temperature (or 5 - 10 °C higher) than the last zone of the extruder.

The polishing stacks should always be evenly cooled. In order to prevent adhesion to the polishing stacks, the temperature should be less than 40 °C. It was determined that 20 °C is a good starting temperature.

ecovio® T and TA can be also combined with other ecovio® types as well as e.g. barrier materials can be combined in more sophisticated multi-layer systems.

The cut films can subsequently be rolled up. Depending on the thickness of the film, a suitable core diameter should be selected. The film or flat film material can also be cut and stacked. Further processes, such as stamping, folding, welding or thermoforming are possible.

03

Processing

Processing by thermoforming

Flat films made of ecovio® possess excellent properties for thermoforming. This can be accomplished in a separate processing step or in line. The advantages of the thermoforming of ecovio® include (depending on machine and geometry):

fast cycle times, precise surface molding, high stretching properties and an extremely wide processing window as well as good stamping and stacking characteristics.

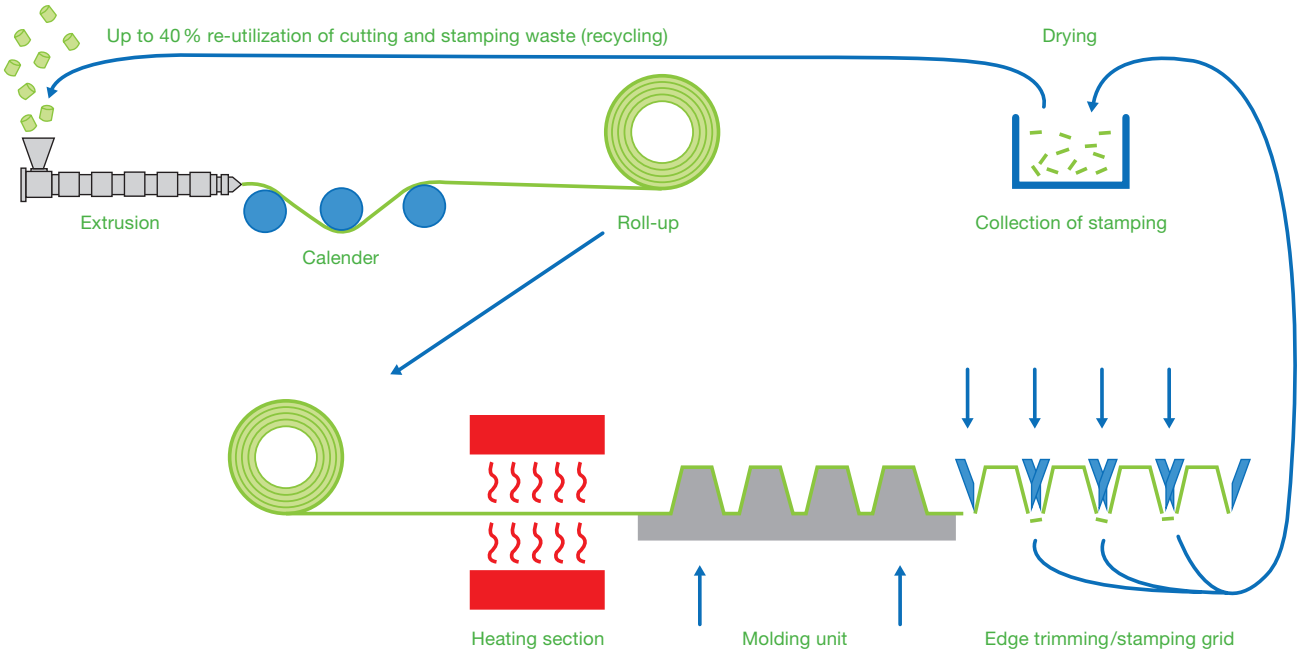


Figure 3: Schematic description of thermoforming process

Pre-heating to 40 °C can be applied if necessary. A short preheating zone, as is used for amorphous thermoplastics such as PS, is sufficient.

The ideal processing window for thermoforming of the ecovio® types T and TA is at a surface temperature of 100 -140 °C. Depending on the design of the machine and parts geometry, also lesser temperatures up to 80 °C can be achieved. This can have a positive effect on sustainability analyses.

Both process variations – positive and negative thermoforming – are possible. All existing parts of conventional systems (pre-stretching, cutting, stamping and stacking device) can be used; this means, the cycle times equate to those of conventional thermoplastics. Compared to PLA, the cutting edges of thermoformed ecovio® parts are much cleaner and exhibit a low breaking tendency.

Thermoformed parts of ecovio® T are generally characterized by surfaces with high image precision. In addition, the surfaces of building components made of ecovio® T have an interesting, mother-of-pearl surface sheen with the respective finish. The mechanical properties of ecovio® TA can be compared with stiff polypropylene (PP). The main advantage of ecovio® TA compared to ecovio® T is its distinctly higher service temperature of more than 90 °C.

Thermoformed parts

During processing to thermoformed parts, ecovio® T and TA types are characterized by their good balance between great stiffness and good expansion, excellent capacity for sealing and printing, high molding precision and easy de-stacking.

Special processes

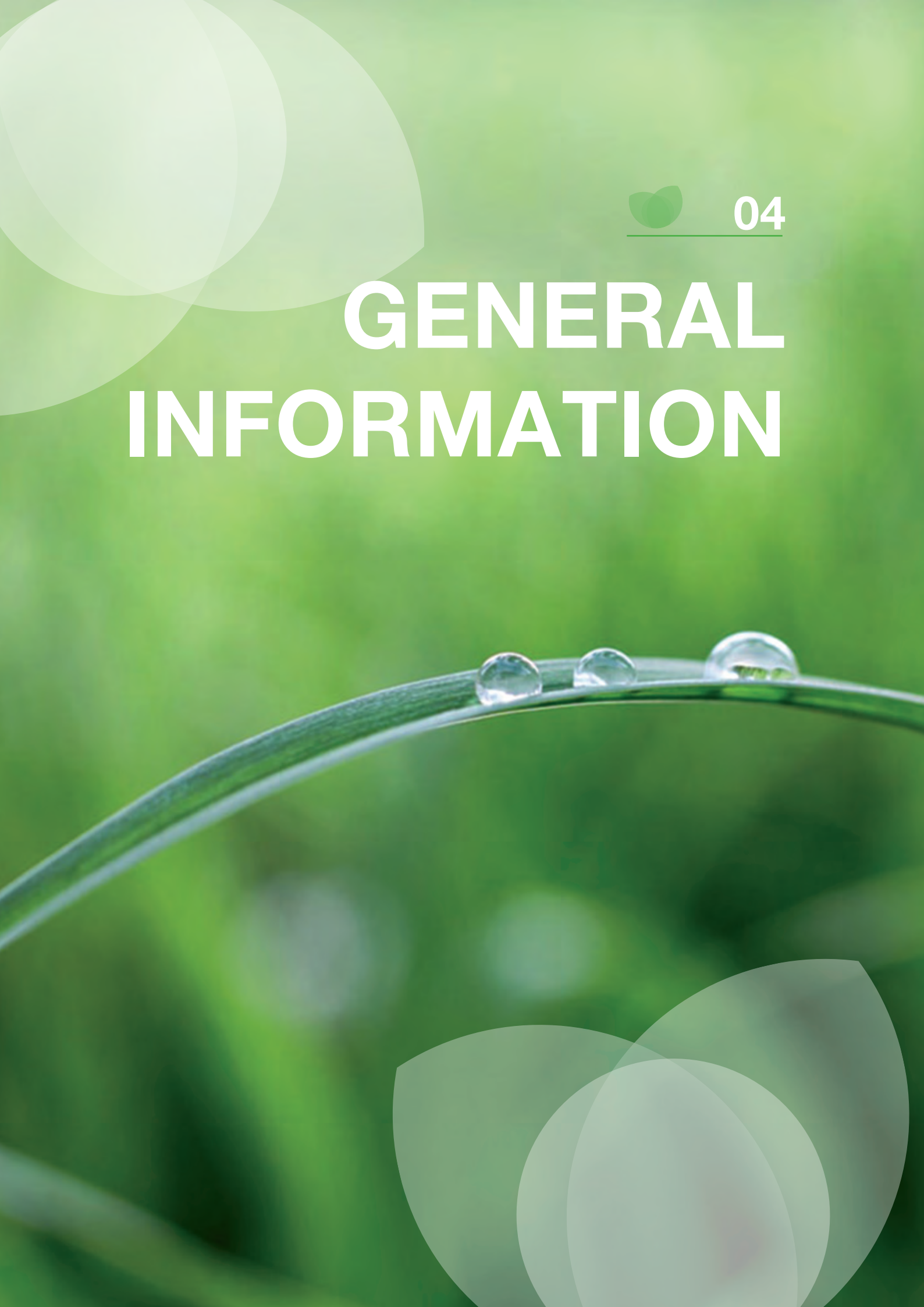
By adding a chemical blowing agent during the processing of ecovio® T and TA, it is possible to produce microcellular foam. Tests showed that a weight reduction of up to 25 % can be achieved.

ecovio® is also nicely compatible with in mold labeling (IML). IML's can comprise the features of oxygen barrier, innovative decoration and/or compostability. This combination can be a nice add on depending on the needs.

Other extrusion processes, such as profile extrusion, extrusion of straws etc., which are not described in this brochure, are also possible. Please contact our technical service for further details and information.

04

GENERAL INFORMATION



Processing and post-treatment

Joining methods

Parts or semi-finished parts made of ecovio® can be combined with other thermoformed or molded parts and particularly those made of ecovio®.

The strength of ecovio® allows the fabrication of highly durable snap and press connections. The thermoformed snap lids or other packaging applications with snap connections are some examples.

Hot plate and ultrasonic welding are well suited methods to weld or seal ecovio®. Particularly hot plate welding, also known as “heat sealing” or “sealing”, used in the packaging technology is perfectly suited for ecovio® components.

Specifically the ultrasonic joining technique provides the opportunity to rationally and synchronously integrate the connection of molded serial components in fully automated production processes. The welding-compatible design of the joining surfaces as well as optimum processing parameters are prerequisites for the quality of the welding connections. It is therefore recommended to consider as early as in the conception phase how the parts are to be welded together.

Thus, the sealing of other film products as well as thermoformed applications can be performed on standard sealing machines.

04

General information

Printing/coloring

As a general rule, ecovio® as well as various ecoflex® based films and ecovio® can be printed on standard machines for PE-LD.

Following a print test, alcohol or water-based colors can be used. The pre-treatment of the corona has to be examined. Drying temperatures have to be kept lower than those for PE-LD.

Delivery, storage and aging

ecovio® T and TA are supplied in Big Bags (1,000 kg) dry and ready to use in moisture-proof tight package in the form of cylindrical or flat pellets.Transport and storage temperatures should not exceed 60 °C. Unopened packaging should be stored at room temperature (23 °C) for a period not exceeding one year.

Biodegradable plastics should fulfill their function in the application as traditional plastics, and should be biodegradable under defined environmental conditions on the other. Due to their specific molecular structure, certified biodegradable plastics such as ecovio® can fulfill these opposing requirements. Notwithstanding, frequent doubt occurs regarding the functionality of biodegradable plastic in the service life.

Safety precautions

Safety instructions for processing

Pure ecovio® melts are thermally stable up to 240 °C (depending on individual types) and do not harbor any risks due to the molecular deterioration or the development of gases and vapors. However, as is the case with all thermoplastic polymers, ecovio® disintegrates under excessive thermal load, e.g. during overheating or cleaning with pyrolysis. If the machine is shut down for a longer period of time, it is recommended to decrease the temperature to prohibit a thermal degradation. Gaseous decomposition products are generated in this case. When processing ecovio®, we recommend to ensure sufficient ventilation. With the appropriate processing of ecovio® and the use of sufficient suction at the nozzle, health impairments are not anticipated.

Harmful vapors may occur in case of improper processing conditions, e.g. high temperature and /or excessive holding times.

In case of such a failure, which can also become evident due to incineration streaks on the extrudates, the extruder has to be purged clear e.g. with ecovio®, suitable cleaning batches or a slightly flowing PE-LD (MVR ~ 4).

Quick cooling of the damaged material, e.g. in a water bath, reduces the unpleasant odor.

Information regarding toxicology, regulations

ecovio® types are not considered dangerous substance. With proper processing methods and good ventilation of the premises, no health impediments have emerged in persons employed with the processing of ecovio®.

Chemical resistance

The chemical suitability should be reliably verified for the approval to utilize the material in possibly aggressive chemicals, be it with experiences with similar components made of the same material in the same medium under similar conditions or testing the part under practical conditions.

Food production and distribution

All brands of the ecovio® product range comply in their composition with the currently valid law for plastics with direct food contact in Europe and the USA. The conformity of these products is furthermore ensured by the production according to GMP (Good Manufacturing Practices). If detailed information regarding the legal status of a certain ecovio® type is required, please contact BASF (plastics.safety@basf.com) directly, specifying the specific application together with temperatures. BASF gladly issues a current conformity confirmation relating to the currently applicable regulations.

Quality assurance

ecovio® is manufactured as standard material in a continued production process according to DIN EN ISO 9001: 2008. The volume flow index (MVR) at 190 °C according to ISO 1133 was defined as specific parameter for quality control.

Upon request, a certification of the MVR value with each batch number can be supplied. Other data provided in our documentation are typical values, which are not a component of the product specifications of ecovio®.

Material testing, component testing and processing service

Our accredited laboratory can advise and support customers in all material science issues and plastic specific tests (Accreditation certificate D-PL-14121-04-00 according to DIN EN ISO/IEC 17025: 2005).

Our laboratory provides further important service for component tests and joining techniques which assists the customer's project work. Figure 4 gives an overview over the most important test options:

- Thermal aging, temperature and climate tests
- Temperature shock tests
- Quasi-static and dynamic tension, pressure, bending and shear tests
- High resolution non-destructive testing by way of computer tomography
- Falling, impact and shock tests
- Cyclic internal pressure tests
- Flow tests, leak tests
- Acoustic analyses
- Testing of media resistance
- High resolution deformation and extension measurements
- Static and transient bursting pressure tests
- Documentation of all transient processes with high-speed cameras
- Infrared thermography
- Laser transparency and laser inscription analyses
- Testing and optimization of all relevant joining techniques

Figure 4: Testing possibilities for ecovio® at BASF's service laboratory

Our experienced team of experts is available to you in case of questions regarding processing, processing chains as well as special procedures in plastic processing. Please contact us for further information at biopolymers@basf.com.

Note

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purposes. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. (October 2020)

More information on ecovio®:
www.ecovio.basf.com

Please visit our websites:
www.plastics.basf.com

Request of brochures:
plas.com@basf.com

If you have technical questions on the products, please contact:
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