ecovio®

Biologically degradable solutions for extrusion applications

- Blown film applications
- Cast / flat film applications (e. g. thermoforming)
- Extrusion coating of paper and cardboard

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ecovio® – certified biodegradable and bio-based

ecovio® – A HIGH QUALITY, VERSATILE BIOPLASTIC FROM BASF THAT IS CERTIFIED BIO-BASED AND BIODEGRADABLE

	Not biodegradable	Biodegradable
Based on renewable resources	Bio-PE, Bio-PA, Bio-PUR, Bio-PP	PLA, PHA
Fossil-based	PE, PP, PVC	PBS

Source: Hans-Josef Endres, Technical Bio-polymers, 2009.

What are bioplastics?

The term “bioplastics” comprises two different groups of products: “bio-based” and “biodegradable” plastics.

Bio-based plastics are wholly or partially derived from renewable raw materials. For example, this material group includes polylactic acid (PLA), polyhydroxyalkanoate (PHA) as well as the partially bio-based plastic ecoflex® FS from BASF. Bio-based materials can also be simultaneously biodegradable. This is the case in the examples mentioned above. In contrast, bio-polyethylene (bio-PE) is an example of a bio-based, yet non-biodegradable plastic.

Biodegradable plastics can be broken down by microorganisms. In the process, the microorganisms emit enzymes which break down the polymer chains of the plastic into smaller molecular components. These are subsequently absorbed by bacteria and fungi, metabolized and, in the process, converted into carbon dioxide, water and biomass. Biodegradable plastics can, but do not have to be, produced based on renewable resources.

The biodegradability does not depend on the raw material, but solely on the chemical structure and the physical properties of the plastic. There are biodegradable plastics developed especially for decomposition under conditions of industrial composting. In addition, these can be degraded in a backyard compost or soil. Depending on the application, this differentiation is important (e. g. bio garbage bags vs. mulch film). Respective certificates help with the orientation (see the following paragraph).

Certification according to international standards

Confirmed by third-party test institutes
The biodegradability of ecovio® was confirmed by approved, independent institutes based on clear test criteria. For example, a certified, industrially degradable plastic has to be tested with respect to biodegradability, disintegration (physiological decomposition), ecotoxicology (impact on flora and fauna) and chemical composition. Only a material that fulfills all requirements is certified and may be labeled industrially degradable. Similar certification processes exist for materials which can be degraded in the backyard compost or soil.

Practical tests
Practical tests in industrial composting systems show that thin-walled extrudates made of ecovio®, such as bags or thermoformed cups, can be degraded in as early as four to eight weeks.

Suitable for direct contact with food
All ecovio® types comply with the requirements of the European Ordinance on Foodstuffs as well as the US-American Food Stuffs Regulations. Therefore, they may be suitable for food packaging. Please see our respective certificates for the precise status of the Food Stuffs Regulations, which can be requested from your local BASF representative or at Plastic Safety (plastics.safety@basf.com).

ecovio® offers various product qualities, as well as, comply with the following international standards:

Industrial composting

European Standard EN

American Standard ASTM 6400

Italian Certification CIC

Biodegradation in soil

Japanese Standard

European Standard EN 13432
Australian Standard AS 4736

Backyard composting

ecovio® …

- a ready-made plastic compound
- certified compostable and biodegradable
- partially bio-based
- suitable for the contact with food
- printable and has excellent sealing properties
- can be utilized on conventional processing machines

The extrusion of blown and flat film as well as extrusion coating of paper and cardboard are the main fields of application for ecovio®. Therefore, the possibility of products to be manufactured from ecovio® are very versatile.

An innovative mix of tried and proven ingredients

With ecovio®, BASF offers a certified compostable plastic with bio-based components which can be adapted according to the customer's requirements. ecovio® consists of the biodegradable BASF plastic ecoflex® and polylactic acid (PLA).

High performance and biodegradable

Products made of ecovio® are as efficient and resilient during their service life as conventional plastics. Thus, a thermoformed yogurt cup made from ecovio® has the same material properties as its polyethylene equivalent. The product characteristics are designed in a way that the products biodegrade only after their use, e. g. under industrial composting conditions.

All types of ecovio® in many forms of application were registered according to the US American Standard ASTM D 6400 and the European Standard DIN EN 13432 for compostable and biodegradable polymers. Paper articles coated with ecovio® PS1606 may also be certified for composting.

ecovio® for a variety of extrusion applications

ecovio® provides versatile application options as a thin, flexible blown film, thermoformable flat film, extrusion coated substrate on paper and cardboard or as plastic film. Such applications can be found in packaging production, disposable crockery sector, agriculture, horticulture and many more. One particular advantage is the fact that ecovio® can be processed on conventional machines for the production of biodegradable films and coated paper and cardboard products.

Bags

Thermoformed products

Extrusion coated products

Mulching films

The characteristics of ecovio®

ecovio® – A COMPOUND MADE OF ecoflex® AND PLA FOR A VARIETY OF FILM AND EXTRUSION COATING APPLICATIONS

Product portfolio

Films or extrusion coated applications made of ecovio® benefit from an optimal balance of stiffness and toughness. Depending on the extrusion process, the viscosity can be flexibly adjusted – from medium to high melt strength. ecovio® types are offered as ready-to-use compounds.

The most important fields of application of ecovio® include films for bags, packaging and agricultural, as well as thermoformed and extrusion coated articles for the consumer and catering segment.

BASF provides a broad product portfolio of various ecovio® types with different bio-based components, as well as mechanical and thermal properties. All types are distinguished by excellent sealing and certified biodegradable/compostable properties.

ecovio® F/FS/FT

ecovio® F, FS and FT were specifically developed for blown film extrusion. ecovio® FS/FT is characterized by its greater bio-based component.

ecovio® T/TA

ecovio® T and TA were especially developed for cast/flat film extrusion and subsequent thermoforming. ecovio® TA is characterized by greater thermal stability.

ecovio® PS

ecovio® PS was especially developed for the extrusion coating of paper, cardboard and other substrates. Our technical experts are happy to support you in the selection of suitable types for your particular application.

General characteristics

Blown film extrusion

The advantages of ecovio® F/FS/FT

- Flexibility
- Elasticity
- Good sealing properties
- Good printability perforation
- Tear resistance
- Tensile strength

Blown film applications

- Bio waste bags
- Shopping bags
- Fruit and vegetable bags
- Mulching films
- Packaging films

Cast-/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 & lids
- Capsules

Extrusion coating

The advantages of ecovio® PS

- Good sealing properties
- Good printability
- Good barrier properties (moderate for steam, oxygen) for mineral oils and aromas

Extrusion coated applications

Predominately coated paper and cardboard applications such as

- Drinking cups for hot and cold beverages, paper plates
- Wrapping paper, e. g. for fresh food (cheese, meat, fish) or snacks
- Sugar and salt sachets
- Grass and foliage bags
- Catchment trays for fats and spreads
- Deep freeze containers

Overview ecovio® types for blown film applications

Types / Solutions	Sector	ecovio® F2332	ecovio® FS2312	ecovio® F2223	ecovio® FS22C3	ecovio® F2224	ecovio® F23B1	ecovio® FT2341	ecovio® M2351
Thickness		30	30	30	30	30	25	25	12
Bio component*	%	16	46	28	55	40	9	34	9
EN 13432 certification		✓	✓	✓	✓	✓	✓	✓	✓
Backyard composting		-	-	-	-	-	✓ (24 µm)	✓ (53 µm)	✓ (24 µm)
Properties**									
Young's modulus MD/TD	MPa	330/180	430/190	760/350	780/260	1100/600	260/130	270/160	260/130
Tensile strength MD/TD	MPa	37/39	31/35	47/43	39/28	47/40	25/25	24/21	25/20
Elongation at break MD/TD	%	540/600	380/670	450/600	400/560	440/350	480/570	340/610	180/380
Tear resistance MD/TD	Nm	800/550	1900/700	500/450	700/500	280/230	1600/1300	4900/3000	730/520
Perforation resistance	g	650	530	450	250	320	250	150	200
Decomposition speed			✓		✓			✓	
Wet strength		✓	✓	✓	✓	✓	✓	✓	✓
Slip/anti-block additive		✓/✓	-/✓	✓/-	✓/✓	✓/-	✓/✓	-/✓[1)]	✓/✓
Main applications		BAB, TT	TT	TT	BAB, TT	CP	TST, BAB	TST, BAB	MF

BAB: Bio waste bag, TT: Carrying bag, TST: T-Shirt bag, CP: Compounds & Blends, MF: mulching film

Slip additive master Batches: ecoflex® Batch SL05, ecoflex® Batch SL10B, ecoflex® Batch SL10C | Anti-block (AB) Master Batches: ecoflex® Batch AB1

[1)] Usage of sl master Batch is mandatory

Overview ecovio® types for cast / flat film extrusion coating

Types / Range of solutions	ecovio® T2308	ecovio® TA1241
Bio-based component* [%]	~80	~60
Cert. DIN CERTCO EN13432	✓ (max. 1.1 mm)	✓ (max 0.45 mm)
Cert. Vincotte OK Compost	✓	✓
Recyclability (pure)	✓	✓
Food contact***	EU/NA	EU/NA
Properties**		
Young's modulus; MPa [ISO527]	2700	2700
Impact strength Charpy [kJ/m²]	60	85
Heat resistance HDT B [ISO 75-1/-2]	55 °C	94 °C
Density [g/cm³]	1.25	1.49
MVR 190 °C/2.16 kg [cm³/10 min]	9.0	2.0

Overview ecovio® types for extrusion coating applications

Types / Range of solutions	ecovio® PS1606
Bio-based component* [%]	min. 70
Cert. DIN CERTCO EN13432	✓
Cert. ASTM D6400	✓
Food contact***	EU/NA
Can be used on paper extrusion coating systems	✓
Barrier properties against fat and grease	✓
Barrier properties against liquids	✓
Properties**	
Density [g/cm³]	1.25
MVR 190 °C/2.16 kg [cm³/10 min]	approx. 18

* Bio component measured according to 14C method according to ASTM D6866-12

** Typical values, not to be interpreted as specifications

*** For details, please see page 6

General information on processing

Humidity and drying

Thermoplastic polyester such as ecovio® (from ecoflex® and PLA) is sensitive to humidity. The moisture content during the processing of ecovio® should be ≤ 0.1 % (0.06 % at PS1606). If the moisture content is too high, it can affect the degradation 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. The drying times amount to six hours at 70° C. Generally, the regulations of the equipment manufacturer should be observed to achieve the desired drying effect.

Colored straws

Self-coloration

Beyond the colors in our product range, it is possible to set other hues with color master batches by way of self-coloration. 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 on an ecoflex® basis, such as Sicoversal® B by BASF Color Solutions GmbH. For further information, please see www.basf.com/masterbatch.

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 20.

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 ecoflex® or ecovio®.

A change of material requires the cleaning of the screw and the cylinder. In this case, PE-LD or pure ecoflex® as well as suitable cleaning batches have been proven to have a good cleaning effect.

Recycling

The recycling of production waste is generally possible with the exception of products made of coated paper. During recycling, the material parameters may decline more or less.

These should be checked prior to the specific application. The verification of the melt viscosity provides clarity. Edge trimmings and stamping waste can be re-granulated during the blown film processing and re-entered into the process. Generally, approx. 5 % (up to 10 %) of the re-granulate can be added to the new granulate without experiencing any noteworthy decline in the material parameters of the film products.

Waste components and stamping grid residues can also be ground and re-entered into the process in case of cast and flat films as well as thermoform applications.

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.

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

Paper coated with ecovio® PS can be re-pulped in the same manner as PE-LD in the paper recycling process.

Extrusion processes (general)

ecovio® is a plastic, which was optimized for deployment in all conventional extrusion processes for thermoplastics. Single-start three-zone screws with an L/D ratio of up to 30 are suitable for ecovio® processing. However, specific recommendations exist for the optimum processing of ecovio®.

Extruder unit

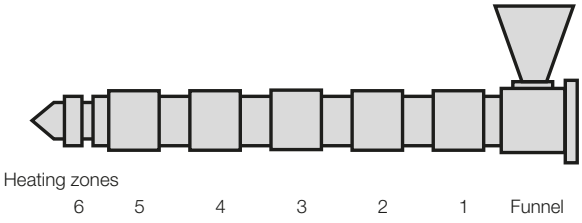
It is recommended to use a single-screw extruder not exceeding an L/D ratio of 30. A single-start, standard sectioned three-zone screw is suitable for the processing of ecovio®.

Barrier screws combined with grooved intake zones as well as mixing and shear elements can also be used.

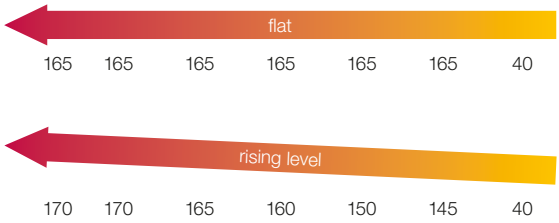
The processing temperatures here are lower than with polyolefin or styrol plastics.

Compared to shear-sensitive starch compounds, ecovio® exhibits a broader 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 (see diagram).

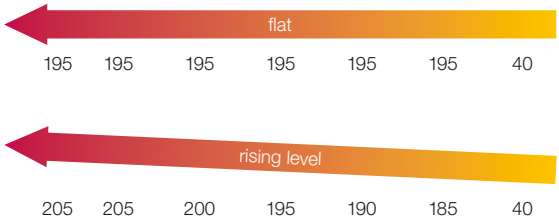
Only wear-proof steel should be used for cylinder and screw when processing ecovio® extrusion types.



Temperature control for **ecovio® F/FS/FT Blown film types** [°C]



Temperature control for **ecovio® T/TA Flat film types** [°C]



Temperature control for **ecovio® PS Extrusion coating types** [°C]

Examples for temperature controls at cylinder

Blown film extrusion

ecovio® F-/FS and FT types were developed for the processing of extrusion blown films on conventional blown film extrusion systems in thickness between 8 and 250 µm (depending on the product type). All common subsequent units (wrapping, print, cutting and welding/sealing, bag manufacturing machines etc.) can also be used.

Bags (bio-waste bags, shopping bags), mulching films and other thin, flexible film products are typical applications.

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

Conventional, latest generation spiral distribution tools can be used to process ecovio® F/FS and FT. The effective width of nozzle gaps is very large. Existing nozzles with a gap width of 0.8 – 2.0 mm can be used.

Customarily, ecovio® is processed in normal or standard mode analogue with PE-LD. With limitations, also existing PE-HD systems with long-neck mode can be used to process ecovio®. The length of the neck is hereby often significantly shorter than for PE-HD.

The typical blow-up ratios of ecovio® are between 1:2.5 and 1:4 (e. g. in case of mulching films).

Most of ecovio® F-/FS and FT types are equipped with an optimized amount (1- 2 %) of slip/anti-block master batches in order to adapt the gliding properties, prevent the formation of wrinkles and reduce blocking of the film. Compatible master batches to further optimize the properties are available from BASF upon request.

Processing

ecovio® generally exhibits greater surface tension than polyolefin. This usually permits printing without pre-treatment. In some cases, pre-treatment (e. g. corona) is required in case of the additional use of lubricants. Printing colors should be selected in such a manner that they do not affect the biodegradable characteristics.

Following the printing, blown films can be processed further. Loops or singlet bags can be produced on existing systems without major adjustments. Machine manufacturers also offer special welding and carrying bag machines or supplementation kits for an optimized bag production to process biodegradable film products.

Even though ecovio® exhibits excellent sealing properties, parameters such as sealing pressure, time and temperature have to be adapted. Generally, the sealing temperature for ecovio® has to be reduced.

Blown films manufactured from ecovio® can be combined with other materials with multi-layered structures, such as packaging applications. Thus, multi-layered packaging films can be produced by lamination with paper, aluminum foil, films on a cellulose base and many more. While other components in functional, multi-layered structures exhibit strength, barrier, printing or brightness characteristics, ecovio® exhibits good sealing properties in most cases. Special biodegradable glues are required in the coating process. Epotal® Eco by BASF is one such certified glue.

Extrusion coating – Paper coating

ecovio® PS1606 was developed for the extrusion coating of a variety of substrates such as paper and cardboard or other plastic films.

For example, typical applications for ecovio® PS1606 include wrapping paper for fresh food, (cheese, meat, fish) or snacks, sachets for sugar and salt, grass and leaf bags as well as coated cardboard e. g. for coffee cups, plates, catchment trays for fats and spreads, packaging for vegetables, fruit, etc.

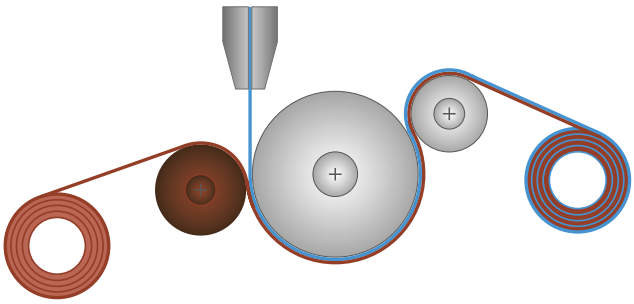
ecovio® PS permits minimum coating thickness at a simultaneous high coating speed and process stability. It can be processed on conventional systems for polyethylene.

However, the entire process happens at significantly lower temperatures. Melting temperature at the exit of the flat film extruding nozzle should be between 200 - 230 °C. In order to achieve good adhesion, the distance between nozzle lips (or the air gap) and the substrate should be as low as possible. If this distance is too great, the premature cooling down of the melted material leads to increased viscosity, which can result in poor adhesion of the paper substrate. As ecovio® is a polar material, there is no necessity – contrary to polyethylene – for oxidation of the melting surface due to a greater distance to the substrate.

A smaller distance is also convenient as ecovio® exhibits greater constriction properties (neck-in) than polyethylene.

Further measures to improve the adhesion of ecovio® and paper/cardboard are the corona or flame pre-treatment, a primary application of the paper/cardboard and/or co-extrusion with suitable polymers. This can be required for waterproof paper qualities (e. g. beverage cartons). The drums of the lamination unit should always be evenly cooled. In order to prevent adhesion to the surfaces of drums, the temperature should ideally be between 25 °C and 30 °C.

During post processing, e. g. the production of cups or packaging, ecovio® exhibits sealing qualities comparable with that of polyethylene. Even though ecovio® exhibits excellent sealing properties, parameters such as sealing pressure, time and temperature have to be adapted. Generally, the sealing temperature for ecovio® has to be reduced.



ecovio® generally exhibits greater surface tension than polyolefin. This usually permits printing without pre-treatment.

Cast and flat film 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 250 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 cooling drums of the calender should always be evenly cooled. In order to prevent adhesion to the drums, the temperature should be less than 40 °C. It was determined that 20 °C is a good starting temperature.

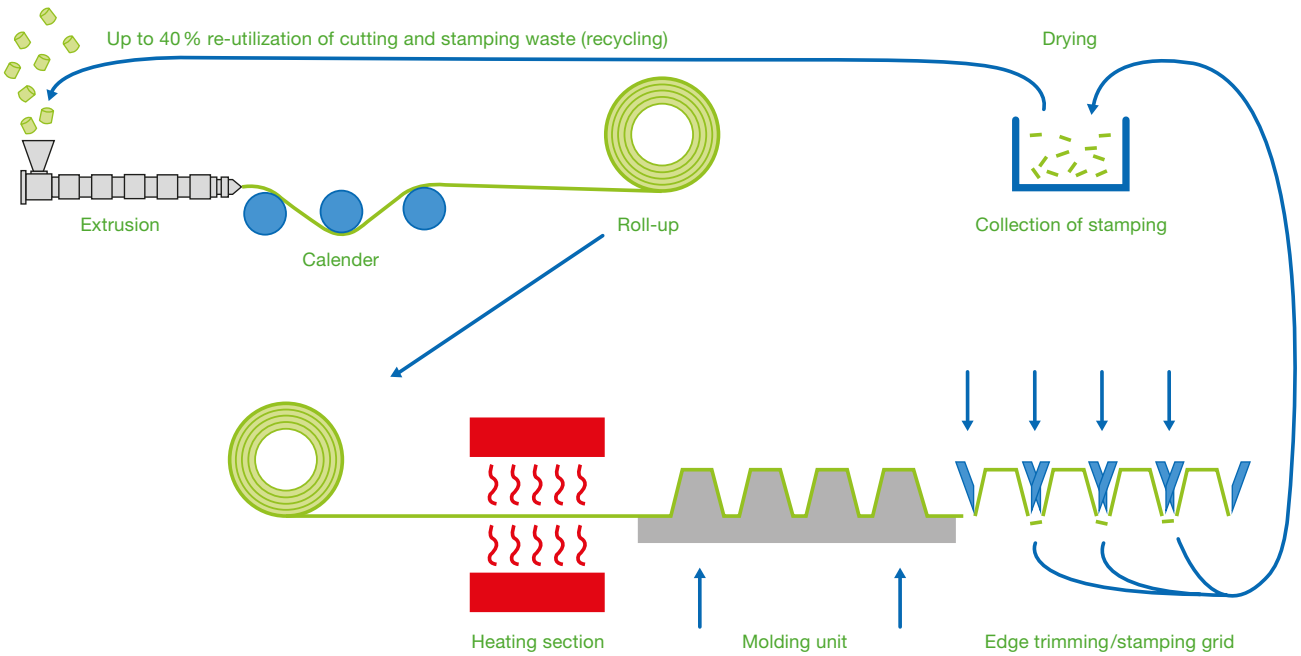
Up to 40 % of clean production waste can be mixed in with new material or in a separate old material coat for multi-layer extrusion.

ecovio® T and TA can be combined with other ecovio® types as well as PLA and ecoflex®. Layers with re-granulate or barrier material and bonding agents 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.

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.



Pre-heating to 40 °C is recommended. A brief 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 pure 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). However, it can also be processed similar to Hi-PS or pure PS. 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 process

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.

Geo-textiles made of fabric tape are a special application of ecovio® flat films. The flat films with a thickness of 60 - 70 µm are slit, stretched and woven into biodegradable textiles.

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.

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.

Gluing ecovio® to other components (made of ecovio® or another material has to be specifically tested. In the process, the biodegradability should not be ignored. Highest degrees of adhesiveness can be achieved if the connecting surfaces of the parts are roughened and greased.

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. Films and panels based entirely or predominately on PLA or ecoflex® are competent adhesion partners in hot plate welding. Due to its range of variations, 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.

Welded spouts with stand-up pouches made of multi-layered composite film

The sealing of bags or other film products as well as thermoformed applications and extrusion-coated paper products can be performed on standard sealing machines.

Coating

When selecting the coating materials, compliance with the regulations according to international standards regarding composting has to be observed.

Printing/coloration

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.

Suitable and pre-approved colors and pigments as well as their concentration in the molding component also need to be observed. Other colors and pigments may only be used in minimal quantities in accordance with the applicable standards.

Safety precautions

Safety instructions for processing

Pure ecoviomelts 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. 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, acrid 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 ecoflex®, 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.

Regulations pertaining to 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®.

Delivery, storage and aging

ecovio® leaves or production as a bead granulate in Big Bags (1 t) or 726 kg folding box. Sample quantities are available in 25 kg bags. 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.

On one hand, 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 ecoflex® and ecovio® can fulfill these opposing requirements. Notwithstanding, frequent doubt occurs regarding the functionality of biodegradable plastic in the service life.

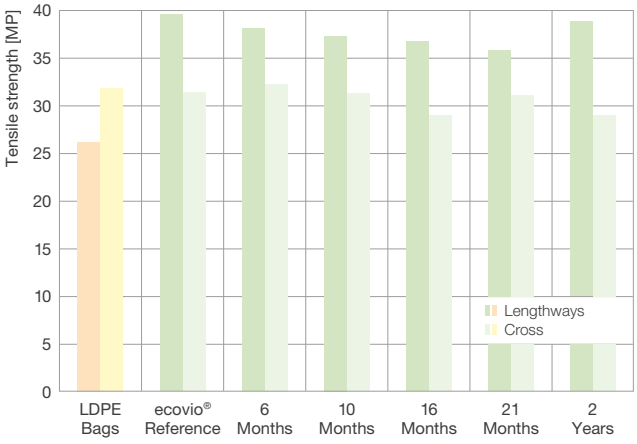


Fig. 7: Tensile strength of ecovio® F2224 after aging

ecovio® F2224 is a compound based on ecoflex® and PLA. This product is predominately utilized as a blending component for various film applications. The impact on storage and aging was examined at blown films made of ecovio® F2224 at a standard ambient climate (23 °C, 50 % relative air humidity). During a storage period of 2 years, the film properties changed as follows:

- Stiffness increases by 50 % lengthways and 25 % in the cross direction.
- Tensile strength is reduced by less than 10 % lengthways and approx. 20 % in the cross direction.
- After 21 month, ultimate elongation reduced by 25 % lengthways and to more than 130 % in the cross direction.

However: The respective values of LDPE bags with respect to stiffness, tensile strength and perforation resistance can be achieved or even exceeded. The equivalent base value of ultimate elongation in case of breakage can be achieved by further reducing the PLA component in blend formulas with ecoflex® F Blend C1200 or by employing products from our ecovio® F product family with a lower PLA component.

Services

Material testing, component testing and processing service

Our accredited laboratory for molding compounds or material testing 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).

The spectrum hereby comprises the entire sector of mechanical, thermal and electrical properties. Our laboratory provides further important service for component tests and joining techniques which assists the customer's project work. Among other, the extensive test options include:

- 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

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. Access to a well-equipped processing technical facility is available for research, development and project work. Among other, it allows the processing of thermoplastics, multi-component injection molding, GIT/WIT technology as well as the back-injection of thermoplastic composite materials on state of the art production cells. Please contact us for further information.

Glossary

Bio-based
Refers to the origin of the raw material. Only useful with the specification of the carbon component from annually renewable raw materials.

Fossil (not renewable)
Refers to raw materials which are not considered renewable, such as crude oil, petroleum and coal.

Biodegradable
Microorganisms such as bacteria or fungi metabolize such materials emitting CO_2, water and biomass.

Compostable
Entirely compostable material (certified according to European Standard EN 13432, Japanese Standard GreenPla and American Standard ASTM 6400), is processed into compost by industrial composting factories.

Literature references

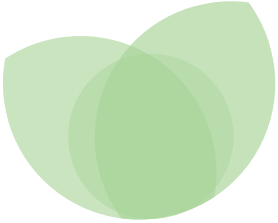
Product datasheets
(Further datasheets available upon request)

ecovio®: www.ecovio.com

- ecovio® F2224 – product information
- ecovio® T2308 – product information
- ecovio® TA1241 – product information
- ecovio® PS1606 – product information
- ecovio® F2332 – product information
- ecovio® FS2312 – product information
- ecovio® F2223 – product information
- ecovio® FS22C3 – product information
- ecovio® FS2224 – product information
- ecovio® F23B1 – product information
- ecovio® FT2341 – product information

ecoflex®: www.ecoflex.de

- ecoflex® F Blend C1200 – product information
- ecoflex® Batch AB – product information
- ecoflex® Batch C Black – product information
- ecoflex® Batch C White – product information
- ecoflex® Batch SL – product information



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. (August 2017)

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:
biopolymers@basf.com

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