

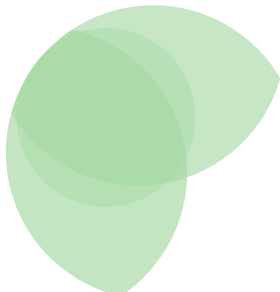
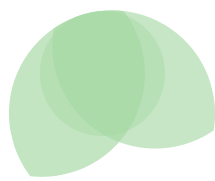


**BASF**  
We create chemistry

# ecovio®

Certified compostable biopolymer  
for injection molding





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# THIS IS ecovio®

**Certified compostable  
polymer based on  
renewable raw materials**

ecovio® IS A HIGH-QUALITY AND VERSATILE  
BIOPLASTIC FROM BASF. THE PRIMARY AD-  
VANTAGES: IT IS CERTIFIED COMPOSTABLE  
AND HAS BIO-BASED CONTENT.





### ecovio®:

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

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 bio-based content. The bio-based 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.

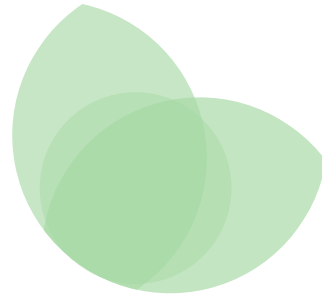


## One step ahead together

AS A LEADING PROVIDER OF HIGH-QUALITY AND HIGH-PERFORMING PLASTICS, BASF HAS BEEN RESEARCHING BIODEGRADABLE AND BIO-BASED 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 bio-based 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 bio-based. 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”: “bio-based” and “compostable” plastics.

**Bio-based** 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. Bio-based plastics can be biodegradable – but they are not always. Bio-based 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.

### Proven in practice

Practical tests at industrial composting plants show that organic waste bags made of ecovio® can be processed within three to four weeks.

### Suitable for food

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

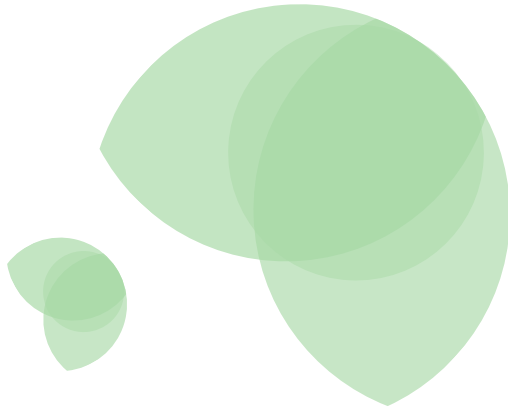
ecovio® offers various product grades that conform to the following international standards and norms for composting, among others:



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

<sup>2</sup> 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<sub>2</sub>
- 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.



# THE PROPERTIES OF ecovio®

## injection molding grades

FOR INJECTION MOLDING, BASF OFFERS THE GRADES ecovio® IS AND ecovio® IA. ecovio® IS IS A BLEND OF POLYLACTIC ACID (PLA) AND ecoflex®. IT CAN BE USED FOR A RANGE OF DIFFERENT PACKAGING APPLICATIONS. ecovio® IA IS A BLEND OF BIODEGRADABLE POLYESTERS AND PLA. IT CAN BE USED FOR APPLICATIONS REQUIRING GREATER DIMENSIONAL STABILITY AT HIGH TEMPERATURES.



Injection-molded products made from ecovio® IS and IA benefit from an optimum balance of rigidity and toughness. The flow behavior is fitting to most applications – from medium to thin-wall applications. The natural color of the ecovio® injection-molding grades ranges from light beige to light gray. These grades are a good choice particularly for plastic components in the field of packaging or for applications with a high level of mechanical loads.

- Mainly bio-based
- Certified compostable according to international standards
- Can be used on conventional injection-molding machines
- Usable for single- and multi-cavity tools
- Designed for cold and hot runner molds
- Suitable for contact with food
- Excellent performance in multi-cavity thin-wall applications





## Product range

**ecovio® INJECTION-MOLDING GRADES ARE MAINLY USED IN THE PACKAGING AND AGRICULTURAL INDUSTRIES.**

In general, it is a challenge for plastics processors to produce large, dimensionally stable components, for example for packaging applications. Our ecovio® injection-molding grades simplify processing. It is possible with some adjustment to achieve similar molding shrinkages longitudinally and transversely – the best prerequisites for the production of low-warp components that are subsequently fitted together.

### Reinforced grades

Depending on what is required, ecovio® grades are noted for their excellent balance between high rigidity and good impact resistance. Depending on the demand, they are

similar in terms of mechanics compared to polypropylene (PP), high-impact polystyrene (HiPS) or acrylonitrile butadiene styrene (ABS).

### Increased flowability

With our innovative ecovio® IS and IA grades, it is possible to fill thin-walled molds and also achieve cycle times comparable to standard materials in the packaging industry. Furthermore, they exhibit a noticeably increased flowability relative to comparable compostable injection-molding grades (see table 1).

Our technical experts are ready to assist in selecting the most suitable grade for your specific application.



# Mechanical properties

## Toughness

ecovio® injection-molding grades exhibit a balanced combination of rigidity and strength with good toughness as well as outstanding dimensional stability.

A criterion for toughness is the impact strength for unnotched test rods according to ISO 179/1eU. The impact strength of ecovio® IS1335 and ecovio® 60 IA 1552 is depicted over a temperature range in figure 1. When compared with pure PLA, ecovio® IS1335 has an almost identical softening point of 55 °C but also has higher impact strength, particularly at low temperatures. This is advantageous primarily for cold food packaging, which is packed, transported, and stored in the cold.

The main difference between ecovio® IS and IA grades is the heat resistance temperature (HDT B): for ecovio® IS 1335 it is 55 °C, for ecovio® 60 IA 1552 it is 93 °C.

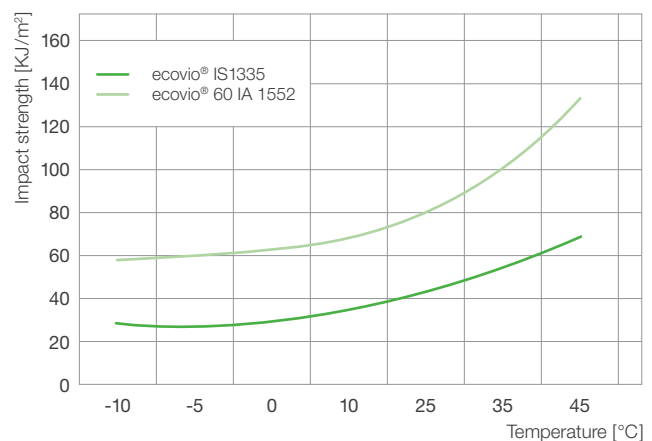


Fig. 1: Impact strength as a function of temperature

# Thermal properties

As semi-crystalline plastics, which solidify in an almost amorphous state, ecovio® IS1335 and ecovio® 60 IA 1552 have a narrow processing window between 180 °C and 210 °C depending on the molding and tool equipment.

ecovio® IS exhibits a low coefficient of linear expansion having in particular high dimensional stability with temperature changes.

## Behavior with short-term heat effect

Apart from the product-specific thermal properties, the behavior of ecovio® IS components when heated also depends on the duration and type of heat effect and the stress. The component design is also crucial. The heat dimensional stability of ecovio® IS parts therefore cannot necessarily be evaluated on the basis of temperature values from the different standard tests.

Our experts are ready to assist with developing your individual application, also regarding the layout and design.

In contrast to ecovio® IS, the injection-molding grades labeled IA can be used with temperatures of up to around 100 °C. It is therefore not necessary to adhere to a suitable geometry with the component design, as with ecovio® IS. This property makes the ecovio® IA grades a good choice for thin-walled packaging items with a hot filling or for use at elevated temperatures.

## Chemical resistance

In order to allow the use of the material in potentially aggressive chemicals, the chemical resistance should be checked prior to use. The test can be done on the basis of experience with similar parts molded from the same material in the same medium under similar conditions or by testing the part under realistic conditions.



# PROCESSING OF ecovio® in injection molding

ecovio® CAN BE PROCESSED BY ALL KNOWN METHODS FOR THERMOPLASTICS. HOWEVER, INJECTION MOLDING AND EXTRUSION ARE OF FOREMOST IMPORTANCE. PARTS MADE OF ecovio® IS AND IA CAN BE PRODUCED IN LARGE SCALE BY INJECTION MOLDING.



## General processing notes

### Moisture and drying

Poly(lactic acid) (PLA) as well as thermoplastic polyesters such as biodegradable polyesters as our *ecoflex*<sup>®</sup>, are materials that are sensitive to hydrolysis. The moisture content in the processing of *ecovio*<sup>®</sup> should generally be  $\leq 0.08\%$ . If the moisture content during melting in the processing is too high, damage can occur. Cracking of the molecular chains is caused and hence the molecular weight is reduced. In practice this manifests itself in a decrease in viscosity as well as a loss of toughness and elasticity. The loss in strength is normally smaller.

If *ecovio*<sup>®</sup> IS and *ecovio*<sup>®</sup> IA are not processed directly from their airtight original container, the granulate must be pre-dried. Special focus should be on the granulate pre-treatment and processing, so that a high quality of the finished parts and only small variations in quality can be ensured.

To guarantee reliable production, pre-drying should usually be carried out and charging of the machine should be done in a closed delivery system. Suitable equipment is commercially available.

Pre-drying is also recommended for the addition of batches, e.g. in the case of self-coloring. In order to avoid the formation of condensation, containers in unheated rooms should be stored at ambient room temperature for a minimum of two hours before processing. Among the different drying systems, dry air dryers are recommended. The drying time should be at least four hours for *ecovio*<sup>®</sup> IS at 55 °C and for *ecovio*<sup>®</sup> IA at 80 °C. In general, the instructions of the equipment manufacturer should be followed in order to achieve the desired drying performance.



### Production stop and material change

During short production stops the screw should be brought to the front position, and with longer stoppage times the cylinder temperature should also be reduced. Before restarting, even after a short stop, purging of the plasticizing unit is required.

A change of material requires cleaning of the screw and cylinder. For this case, high-molecular-weight as well as glass-fiber-reinforced polyethylene (PE) or polypropylene (PP) have been shown to have a good cleaning action.

### Reprocessing

Reprocessing of regrinded parts sprues and cold manners is generally possible. In reprocessing, a decline in characteristics material characteristics can occur to a greater or lesser degree. For this reason, this should be tested beforehand in a specific case. Clarity is provided by checking the melt viscosity.

In general, up to 25% of the regranulate can be mixed with virgin granulate, without any appreciable decline in material characteristics occurring.

When regenerated material is added, attention should be given to sufficient pre-drying (see the section “Moisture and drying”).

### 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.





# Injection-molding processing

## Injection unit

A normal-cut, three-zone standard screw is suitable for processing ecovio® injection-molding grades. Shallow-cut screws can sometimes be advantageous.

For processing ecovio® injection-molding grades, only wear-resistant steels should be used for the cylinder, screw, and non-return valve.

## Mold design

Hot runner systems are recommended to process ecovio® injection-molding grades.

With hot runner systems and heated nozzles, externally heated systems offer greater operating safety. Those systems provide a more homogeneous melt temperature and a reliable purging effect. The flow channels have to be designed to favor continuous melt. It is furthermore important to have good thermal isolation at the gate. This means that the heated and cooled regions can be better controlled and the total energy demand for heating and cooling is reduced. Cold runners are also possible, but not the preferred choice. This channel system has a high temperature loss along the flow path. The type of gate that is most suitable depends on the particular application and must therefore be tested in each individual case.

Mold temperatures of 10°C and 30°C are recommended. Processing with a mold temperature of 15-25°C is preferred as setting.

The mold temperature control should be effective enough that even over long production times the desired temperatures are reached in all molding areas. The quality of effective cooling also manifests itself when the temperature fluctuations during the cycle phase are as small as possible. Demolding angles of <1° per side showed the best performance. Undercuts and sections that are stretched while ejecting must be adapted by mold and part design to ecovio® properties.

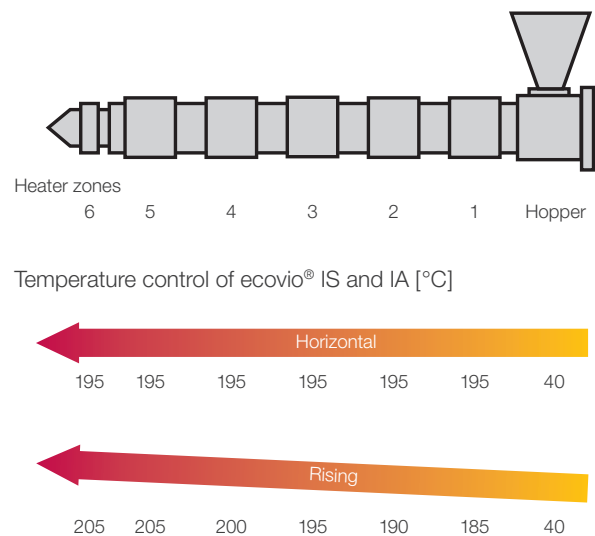


Fig. 2: Examples of temperature control in the barrel



### Processing temperature and residence time

The recommended material temperature ranges from 180 °C to 210 °C. Experience has shown that the optimum machine setting should start with a temperature of 195 °C. A level or slightly rising temperature profile is advisable. Hot runner temperature profile should be set between 210 °C and 230 °C depending on the flowability requirement of ecovio®.

The choice of material temperature depends on the length of the flow path and the wall thickness as well as the residence time of the melt in the cylinder. Long temperature exposure or excessively long residence times of the material in the barrel can cause decomposition of the material.

### Residence time in the barrel

The residence time of plastic in the plasticizing cylinder has quite a crucial effect on the quality of the molded part. Very short residence times can lead to thermal inhomogeneity in the melt. In comparison to that too long residence times (> 5 min) often result in thermal defects. This results in a loss in toughness, starting with a decline in viscosity visible in the purging of the plasticizing unit. Please read as well the “Production stop and material change” chapter.

### Mold surface temperature

Experience has shown that the mold surface temperatures should be in the range of 10 °C to 30 °C. Due to its heat dimensional stability of 55 °C, parts of ecovio® IS and IA are demoldable without deformations even after a short cooling time.

Compared to other plastics, the shrinkage, warping and hence the surface finish can only be slightly influenced through the mold temperature (see the section “Shrinkage”).



### Flow behavior and injection speed

In general, the plastic melt should be injected into the mold as quickly as possible. However, for a few individual geometries and types of sprues it may be necessary to reduce the injection speed.

The mold filling is always dependent on the flow behavior of the melt. The flow behavior at a specific temperature can be assessed with a spiral mold on a commercial injection-molding machine. In this mold, the path covered by the melt is indicating the flow behavior. The spiral lengths of the ecovio® IS and IA grades are shown in figure 3.

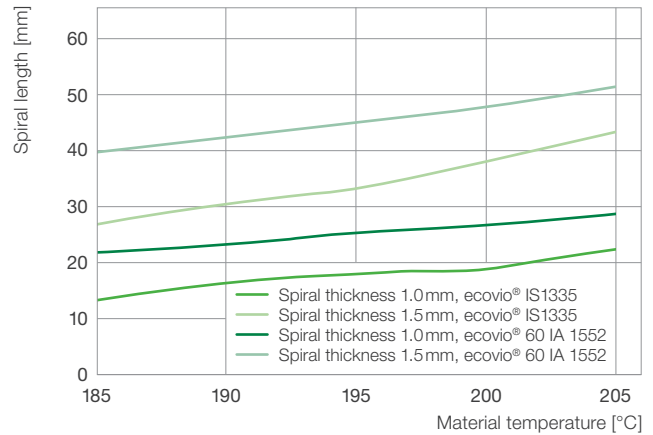
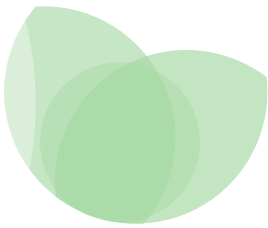


Fig. 3: Spiral length as a function of material temperature and spiral thickness (1.0 and 1.5 mm) for ecovio® 60 IA 1552.

	Spiral thickness 1.0 mm				Spiral thickness 1.5 mm			
	ecovio® 60 IA 1552		ecovio® IS1335		ecovio® 60 IA 1552		ecovio® IS1335	
	Spiral length	Flow path-wall thickness ratio	Spiral length	Flow path-wall thickness ratio	Spiral length	Flow path-wall thickness ratio	Spiral length	Flow path-wall thickness ratio
	mm	i	mm	i	mm	i	mm	i
185 °C	21.8	21.8	13.3	13.3	39.7	26.5	26.9	17.9
190 °C	23.1	23.1	16.4	16.4	42.3	28.2	30.5	20.3
195 °C	25.4	25.4	18.1	18.1	44.9	29.9	33.2	22.1
200 °C	26.5	26.5	18.7	18.7	47.7	31.8	37.8	25.2
205 °C	28.7	28.7	22.3	22.3	51.3	34.2	43.3	28.9

Table 1: Flow path-wall thickness ratio [i] for ecovio® IS1335 and ecovio® 60 IA 1552 .



### Flow behavior and injection speed

The injection pressure in this case was a steady max. 1000 bar and the mold surface temperature set to 30°C. In this test, the achievable spiral length as a function of spiral thickness serves to characterize the flow behavior of a thermoplastic. This yields the ratio of flow path to wall thickness. Thinner spirals yield smaller flow path-wall thickness ratios. These ratio values ( $i$ ) are presented for spirals of 1.0 and 1.5 mm thickness in table 1, but they only have limited application to molded parts.

Not only the flow properties of the plastic but also the processing conditions, the injecting capacity of the injection-molding machine and the wall thickness of the molded part have a considerable effect on the achievable ratio of flow path to wall thickness. Another method for assessing the flow behavior is to find the pressure (filling pressure) at which a mold is just filled when there are constant temperatures in the mold and in the melt.

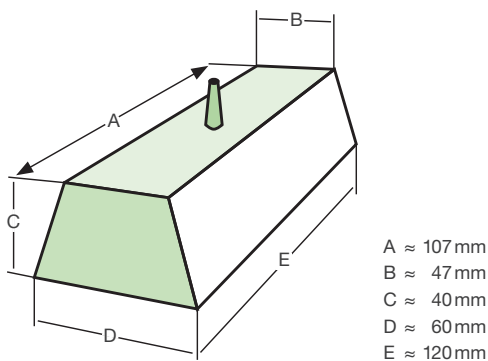


Fig. 4: Test box

### Filling pressure

The required filling pressure is strongly dependent on the flow behavior of the material, the type of sprue and the component geometry. Figure 4 depicts the test box on which example filling pressure tests were carried out. The filling pressure of two selected ecovio® injection-molding grades as a function of the material temperature can be seen in figure 5

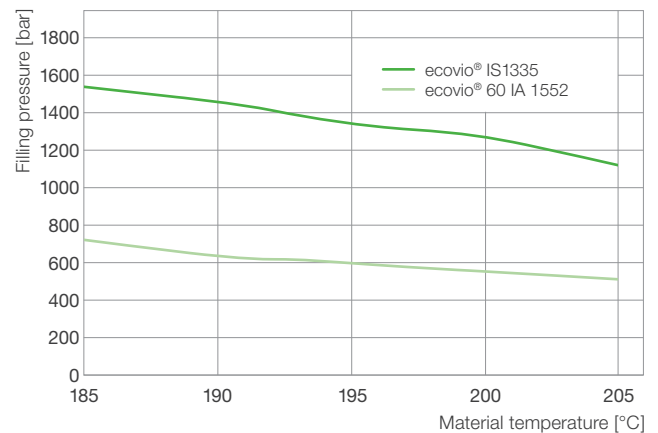


Fig. 5: Required filling pressure as a function of material temperature and spiral thickness ( $T = 30^\circ\text{C}$ ; test box thickness = 1.0 mm).



### Mold filling

Rapid injection promotes uniform solidification and the surface quality. With very thick-walled molded parts, a reduced injection speed may be appropriate in order to avoid a free jetting. When the material is injected, the air in the mold cavity must be able to escape. It must be ensured that suitable places are designed to allow the air to escape. This avoids compressed air, visible in the so-called diesel effect. In order to prevent sink marks and cavities in material accumulations, the holding pressure and holding pressure time must be selected to compensate volume contraction that occurs during cooling down the part. A prerequisite for this is a sufficiently gating to ensure that the material in a specific region does not solidify before the end of the holding pressure time.

### Demolding

Molded parts made of ecovio® IS and IA can be demolded effectively according to shape and geometry. In injection molding with hot molds (over 35 °C), ecovio® IS and IA grades can tend to stick in the cavity.

### Shrinkage

In general, shrinkage is defined as the difference between the dimensions of the mold and those of the molded part at room temperature. Shrinkage is primarily a material property, but it is also determined by the geometry of the molded part as well as its origin. The shrinkage for ecovio® injection molding grades is measured according DIN EN ISO 294-4.

Guideline values for the shrinkage of the ecovio® IS and IA grades are provided in the overview of the product range. These guideline values were determined on samples with 1mm thickness that could shrink freely. A test box like the one depicted in Figure 4 served as test component. The values of shrinkage given were measured longitudinally on the test box (see figure 6).

Post-shrinkage of the components can be disregarded.

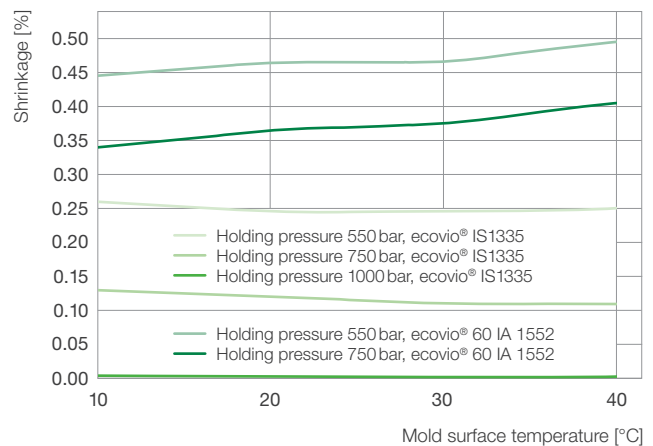
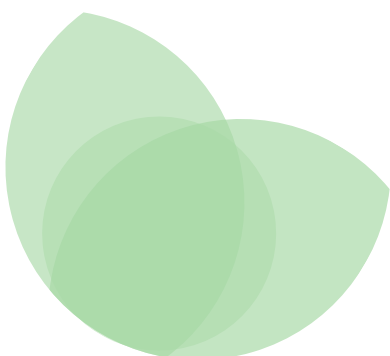


Fig. 6: Impeded shrinkage of ecovio® IS1335 and ecovio® 60 IA 1552 as a function of mold surface temperature; 40x40x1mm sheet with film gate, Material temperature = 195 °C).





### Warpage

Warpage of a molded part is mainly caused by differential shrinkage in the direction of flow and rectangular to it.

Products made of ecovio® IS show approximately the warpage in the direction of flow and rectangular. In general, the effect on component warpage through variation in mold temperature is very small for ecovio® injection-molding grades.

### Special injection molding process (IML)

IML is one of the surface decoration processes. This involves a film being inserted into the open mold for surface decoration. In the subsequent mold filling, the film is back-molded. This means, in the process it is melting onto the surface by the hot melt. This results in a combined part of the molded part and the film surface.

For the backmolding of films with ecovio® injection molding grades in IML, films based on PLA or PBAT are particularly suitable. Very good results could be achieved with ecovio® films as well as BO-PLA films with a thickness of 20 to 40 µm, cellophane or uncoated paper.

### Gas injection technology (GIT)

During the injection molding process of ecovio®, gas can be flushed into the process. This technology requires special equipment and tools with a corresponding periphery. The advantage of such hollow-molded components is that it enables to produce thick-walled components in such a way that they can compost faster.

Please contact our experts for further details and information.

### Foaming with chemical blowing agents

While processing ecovio® in injection-molding, the addition of a chemical blowing agent enables to produce microcellular component structures. Tests showed that a weight reduction of up to 20% was possible. But as well as the pure weight reduction, the speed of industrial composting can also be accelerated to a certain degree.



# Processing and after-treatment

## Machining

Semi-finished parts and molded parts made of ecovio® IS and IA can be effectively machined. This includes drilling, lathe turning, tap drilling and cutting, sawing, milling, filing, and grinding. Special tools are not required for this; rather, machining with standard tools suitable for machining steel on all conventional machine tools is possible.

A high cutting speed with a low feed rate and rapid removal of chips is applicable as a general guideline. The cutting tools must always be sharp. As ecovio® IS has a low softening point, cooling during machining is generally advisable.

## Joining methods

After the injection molding, parts made of ecovio® IS and IA can be joined economically by different methods with other molded and semi-finished parts, particularly with films made of ecovio®. The strength of ecovio® IS enables economical snap and press sites to be made for high-durability joints. The specific merits of ecovio® IS and IA should always be taken into account in the part design (see the section “Service”).

The bonding of ecovio® IS and IA with other components (consisting of ecovio® or another material) must be specifically tested. In particular the biodegradability should not be disregarded. The highest bonding strengths can be achieved when the adjoining surfaces of the parts are roughened and degreased. A previous check of surface polarity is recommended.

Heating-element and ultrasonic welding are very suitable methods for welding ecovio® IS and IA, particularly the heating-element welding which is widely used in packaging technology and also known as “hot sealing” or “sealing”. This type of welding is working very good with injection-molded ecovio® IS and IA molded parts. Very suitable joining partners in heating-element welding are films and sheets that are completely or predominantly based on PLA or PBAT (ecoflex®).

The ultrasonic joining technique in particular offers the possibility of integrating the joining of mass-produced injection-molded parts efficiently and synchronously into fully automated production sequences. A design of the joining surfaces, that is suitable for welding, as well as optimum processing parameters are prerequisites for the quality of the welded joints. During part design it has to be considered how parts are welded and then design the joining surfaces accordingly.

## Laser marking

Good results are achieved with laser marking on molded parts made of ecovio® IS and IA. Both grades can be laser marked white: the accuracy on the surface is excellent.

## Coating

The surface coating of ecovio® IS and IA grades is possible. When it comes to printing or surface coating, the regulations according to DIN EN 13432 and other international standards and norms on composting must be observed. Suitable pigments as well as their concentration in the molded material should be taken into consideration.

## Printing

In general, injection-molded ecovio® components as well as various films made of ecoflex® and ecovio® can be printed on standard machines used for LDPE. Alcohol-based or water-based inks can be applied. A corona pre-treatment needs to be investigated. The drying temperatures are to be kept lower for ecovio® IS grades than for LDPE.



# GENERAL INFORMATION







# Safety notes

## Safety precautions during processing

Pure ecovio® IS and IA melts are thermally stable up to 205 °C and present no hazards from molecular decomposition or formation of gases and vapors. However, like all thermoplastic polymers, ecovio® IS and IA also decompose as a result of excessive thermal stress, for example from overheating or from cleaning by burning off. Gaseous decomposition products are formed here. We recommend that attention is paid to ensure adequate ventilation during the processing of both grades. With appropriate processing of ecovio® injection-molding grades and the use of sufficient extraction by the nozzle, no damage to health is to be expected.

In the case of inappropriate processing conditions, for example high temperatures and/or a residence time in the processing machine that is too long, pungent-smelling vapors that pose a health hazard may be released. In such a hazardous situation, which can also be apparent by brownish burnt streaks on the molded parts, the cylinder of the processing machine is to be flushed by injecting out into the open air with a simultaneous reduction in the cylinder temperatures. Rapid cooling of the spoiled material, for example in a water bath, reduces the unpleasant smell.

Ventilation of the workplace should generally be ensured – ideally with an exhaust hood over the cylinder unit.

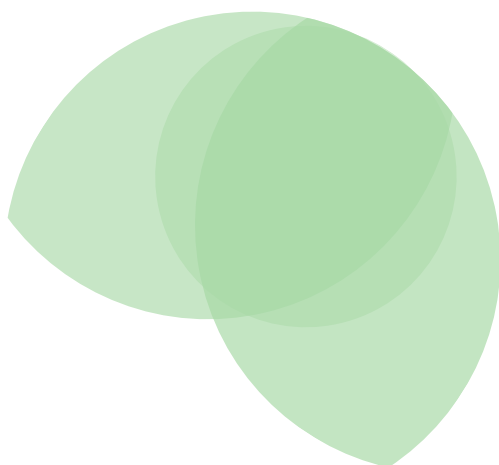
## Toxicology and food safety

The ecovio® IS and IA grades are not hazardous materials. With appropriate processing of the materials and good ventilation of the operating facilities, no health problems have been found among personnel involved with the processing of ecovio® IS and IA.

## Food contact

All grades of the ecovio® injection-molding products comply with the requirements of the Commission Regulation (EU) No 10/2011 of January 14, 2011 on plastic materials and articles intended to come into contact with food as well as with the requirements of the Federal Food, Drug and Cosmetic Act, 21 CFR for the use in single use polyester films, coatings, and molded articles. They are manufactured according to the requirements of Commission Regulation (EC) No 2023/2006 of December 22, 2006 on good manufacturing practice for materials and articles intended to come into contact with food.

Specific limitations and further details concerning the food contact compliance status of the ecovio® injection-molding products as well as their compliance status for other regions in the world can be obtained upon request via a local BASF representative or by contacting [plastics.safety@basf.com](mailto:plastics.safety@basf.com). The suitability of the article for the application concerned must be ensured in each case by the person who places any finished food contact article on the market.





## Quality assurance

ecovio® IS AND IA ARE PRODUCED AS A STANDARD MATERIAL IN A CONTINUOUS PRODUCTION PROCESS ACCORDING TO DIN EN ISO 9001: 2011.

The melt volume-flow rate (MVR) at 200 °C according to ISO 1133 was defined as a specific parameter for quality control.

A certificate of the MVR value with each batch number can be presented on request. Other data recorded in our documentation are typical values that are not part of the product specification for ecovio® IS and IA.



## Delivery, storage and aging

ecovio® IS and IA leave our production site as granular beads in 25 kg laminated aluminum bags or in 1000 kg big bags on request. The temperature during transport and storage should not be higher than 60 °C. The storage time in unopened packs at room temperature (23 °C) should not exceed a period of one year.

Biodegradable plastics should on the one hand, like traditional plastics, fulfill their function in their application and on the other hand be biodegradable after use under defined environmental conditions. Because of their specific molecular structure, certified biodegradable plastics like ecoflex® and ecovio® can meet these opposite requirements. Nevertheless, there is frequently doubt about the functionality of biodegradable plastics during usage.

For this reason, the effect of storage and aging on films made of ecovio® F2224 under room climatic conditions (23 °C, 50 % relative atmospheric humidity) was examined more closely. Tests are currently being carried out to determine whether this is applicable to ecovio® IS1335 and IA 60 1552.

ecovio® F2224 is a compound based on ecoflex® and PLA. This product is used predominantly as a blending component for a range of film applications.

The effect on storage and aging was studied on blown films made of ecovio® F2224 under standard room climatic conditions (23 °C, 50 % relative atmospheric humidity). Over the course of a storage period of two years, the properties of the films change as follows:

- Rigidity increases by 50 % longitudinally and by 25 % transversely.
- Tensile strength decreases by less than 10 % longitudinally and by about 20 % transversely.
- Elongation at break decreases by 25 % longitudinally and to more than 130 % transversely after 21 months.

However, the corresponding values for LDPE carrier bags in relation to rigidity, tensile strength and puncture resistance can be reached or even surpassed. The equivalent initial value of elongation at break can be achieved by reducing further, the proportion of PLA in blending formulations with ecoflex® F Blend C1200 or by using products from our ecovio® F product range with a lower PLA content.

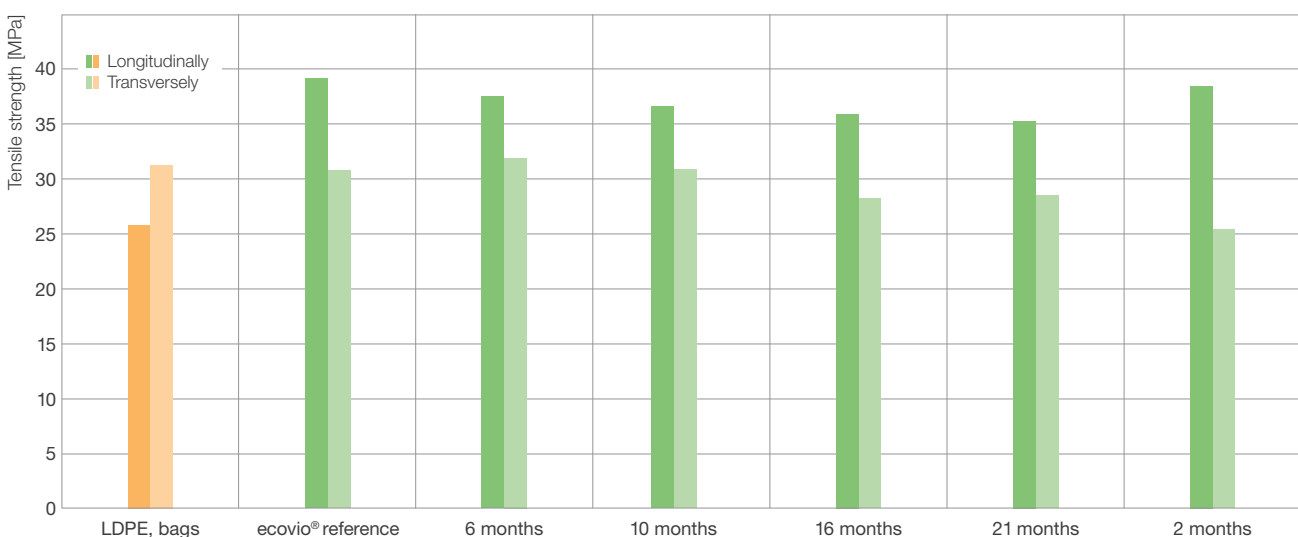


Fig. 7: Tensile strength of ecovio® F Blend F2224 after aging



## Services

### Component design

Our customers are constantly looking for possible ways to optimize their processes. As up to 80% of the production costs of a plastic part are attributable to the material and the processing machines, this provides a vital key to success. BASF helps to optimize the process parameters and the use of material and thus to keep the manufacturing costs as low as possible.

The main points of the service on offer are providing support with component design and mold construction. Furthermore, our many years of experience in the area of component testing using state-of-the-art test procedures make a significant contribution to finding a rapid solution to individual questions.



## Ultrasim®

Ultrasim® is the comprehensive and flexible CAE expertise of BASF with innovations from BASF plastics. The design of thermoplastic components places considerable demands on the developer. In balancing the production process, component design, material, and disposal after use with a view to composting, only an integrative approach can produce an optimized component. Modern optimization methods support component design and enable considerable improvements to be made at each stage of development as well as taking account into “end-of-life” scenarios.

BASF’s Integrative Simulation builds the production process of the plastic component into the calculation of its mechanical performance. This is based on a new, numerical material description which takes, in its mechanical analytics, into account the following typical plastic properties:

- Anisotropy
- Expansion rate dependence
- Tension-pressure asymmetry
- Failure behavior
- Temperature dependence

BASF is more than just a raw material producer that can supply innovative plastics. With Ultrasim®, components can be designed that are tailored to specific demands. This is done not just for highly stressed, efficient, lightweight components and thus for long-term market success, but now also to achieve a component design that is optimized for disposal and sustainability.



## 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 8 gives an overview over the most important test options:

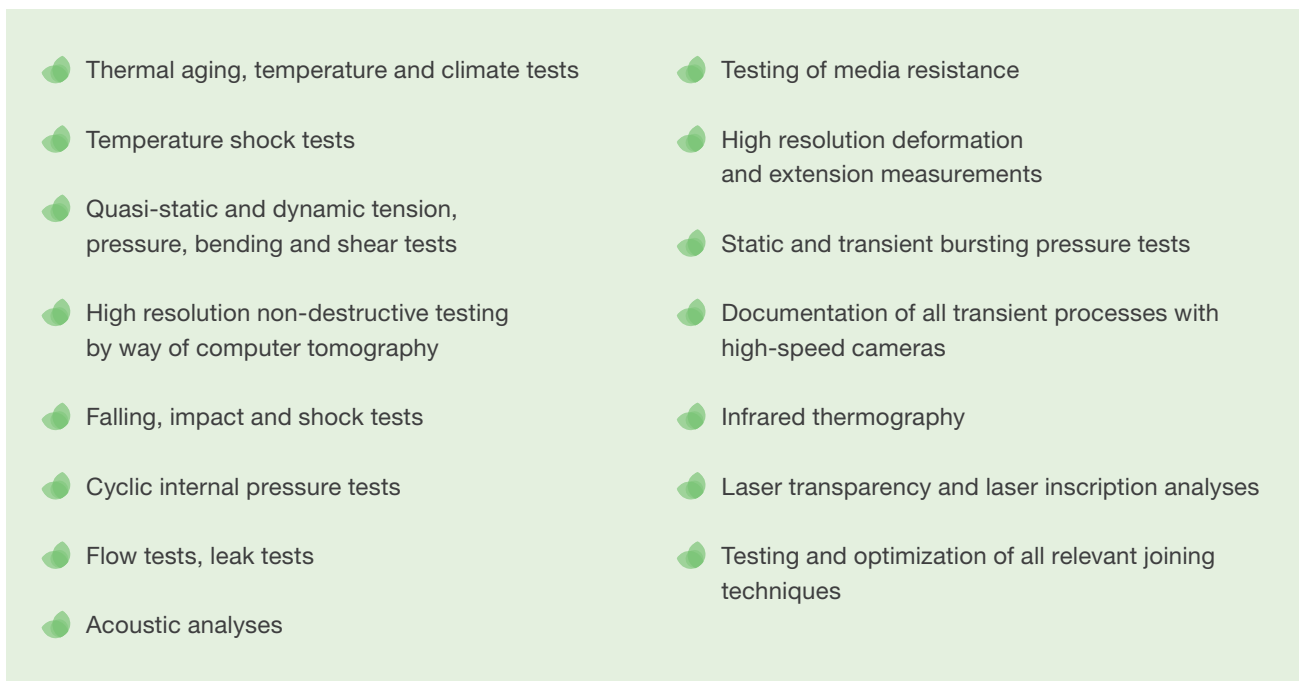


Figure 8: Testing possibilities for ecovio® at BASF's service laboratory

An experienced team of experts is ready to answer all questions about processing and processing methods, as well as special plastics processing techniques. A well-equipped processing technology center can be accessed for research, development, and project studies. This center can be used for e. g. the processing of thermoplastics, multicomponent injection molding, GIT/ WIT technology as well as back-molding of thermoplastic composites on state-of-the-art production cells. Please contact us for further information at [biopolymers@basf.com](mailto: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. (August 2022)

#### **More information on ecovio®:**

[www.ecovio.basf.com](http://www.ecovio.basf.com)

#### **Please visit our websites:**

[www.plastics.basf.com](http://www.plastics.basf.com)

#### **Request of brochures:**

[plas.com@basf.com](mailto:plas.com@basf.com)

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

[biopolymers@basf.com](mailto:biopolymers@basf.com)