Transforming visions into realities.
Compostable polymers with biobased content

ecovio® in the web: www.ecovio.com
This is ecovio®

Compostable polymer with biobased content

ecovio® IS A HIGH-QUALITY AND VERSATILE BIOPLASTIC OF BASF. THE PRIMARY ADVANTAGES IT’S CERTIFIED COMPOSTABLE AND CONTAINS BIOBASED CONTENT.
ecovio®:

- is a finished compound
- has a variable biobased content
- certified compostable worldwide
- is printable and weldable

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

ecovio® is highly transformable, meaning a wide range of end use applications are possible. This makes organic waste diversion easier for stadiums and large venues, where a variety of compostable food service packaging is required.

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 BASF polymer ecoflex® and polylactic acid (PLA), which is derived from corn. 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 by the customer as a drop-in solution with standard plastic production procedures. 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. An ecovio® bag can take the same load as its polyethylene counterpart. The product properties were designed such 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 BIOBASED POLYMERS FOR MORE THAN A DECADE.

The continual development of innovative plastic solutions and the improved functionality of the products occurs in close cooperation with internal BASF units as well as with external partners.

There are no general advantages or disadvantages to fossil or renewable resources. For each individual application, environmental safety, cost efficiency and the social consequences for a product’s entire life cycle must be examined, for example as part of an eco-efficiency analysis. Compostable or biobased polymers are generally not more environmentally friendly than others. They are, however, the optimal solution for particular applications – organic waste bags, compostable packaging for food or sub-arable agricultural films to name a few.
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. Numbering among the biobased but not biodegradable plastics are biopolyethylene, natural fiber plastics, and composites of wood and plastic.

**Compostable** plastics can be completely biodegraded by microorganisms. Special bacteria give off enzymes which break down the material’s flexible polymer chains into small parts. These are then digested by the bacteria together with other organic material such as, for example, organic waste. Water, carbon dioxide and biomass remain. 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.

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**What is meant by bioplastics?**

<table>
<thead>
<tr>
<th>based on renewable raw materials</th>
<th>compostable</th>
</tr>
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<tbody>
<tr>
<td>Bio-PE, Bio-PA, Bio-PUR, Bio-PP, Bio-PVC</td>
<td>PLA, PHA</td>
</tr>
<tr>
<td>not compostable</td>
<td>compostable</td>
</tr>
<tr>
<td>PE, PP, PVC</td>
<td>PBS</td>
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Completely compostable

THANKS TO A SPECIAL CHEMICAL STRUCTURE, ecovio® CAN BE DEGRADED BY MICROORGANISMS AND THEIR ENZYMES.

In the conditions of an industrial composting plant – high temperature, high moisture, defined oxygen content – biodegradation only takes a few weeks.
Advantages of the separate collection of organic waste:
Incinerating organic kitchen waste is not an effective option, because its high water content yields virtually no energy value whatsoever. It is worse when organic waste is disposed to landfills. There they produce methane, which has a 20 times more effective greenhouse gas potential than carbon dioxide.

Composting organic waste can therefore reduce the production of greenhouse gases. According to calculations resulting from an eco-efficiency analysis, the composting of ecovio®-coated paper tableware, even with small amounts of food remains, brings along environmental benefits compared to disposal to landfill. Furthermore, compost can prevent soil erosion and be used to improve soil fertility. It contains the valuable and very limited phosphate, which is used for fertilization.

ecovio® bags – proved thousands of times across the planet
BASF has tested the use and composting of ecovio® bags in various conditions in composting projects all over the world. The results show that the bag material biodegrades without any problems in different industrial composting sites, without adversely affecting the quality of the compost. When asked, residents of the respective regions also report positively on the clean and hygienic collection of organic waste.

You can find additional information on www.ecovio.com/projects
Certified by test institutes
Independent institutes test bioplastics in special certification procedures with respect to complete 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 ecovio® bags can be processed within three to four weeks.

Suitable for food
ecovio® offers product grades that comply with the requirements of the European food contact regulation¹ as well as the US Food Contact Substance Notification ² and are suited for food packaging among other things.

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

- European standard EN 13432
- Australian standard AS 4736
- American standard ASTM 6400
- Japanese standard GreenPla
- European standard EN 13432
- Home composting

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
<table>
<thead>
<tr>
<th>ecovio® bag filled with organic waste</th>
<th>Complete biodegradation to:</th>
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<tbody>
<tr>
<td></td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td>CO₂</td>
</tr>
<tr>
<td></td>
<td>Biomass</td>
</tr>
</tbody>
</table>

| “Oxo-degradable” bag filled with organic waste | No complete 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 (PE) bags filled with organic waste | Biodegradation impossible |
|                                                    | 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” PE films 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 (PE) 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. |
More than just a biopolymer

ADDED VALUE FOR OUR CUSTOMERS AND PARTNERS.

Closed-Loop System: Compostable food service packaging for stadiums and large venues
Due to its wide variety of end use applications, ecovio® can be used to develop comprehensive system solutions. The Closed-Loop System approach is a good example. In stadiums, for example, only certified compostable food service packaging made with ecovio® or ecovio® coated paper tableware is used. These can either be cups, plates, or straws. After use, the compostable tableware and remaining food are collected in compostable ecovio® waste bags, then converted into valuable compost at a composting plant.

Advantages of the Closed-Loop System: Thanks to a stadium’s enclosed nature, it is possible both to prevent foreign materials from entering the loop, and also to ensure the proper disposal of the compostable, single-use items.

ecovio® in compostable multilayer films
In combination with other BASF technologies, certified compostable multilayer films can be produced with ecovio®. Due to its good barrier properties, these films are suited to a wide range of food packaging, and at the same time offer an alternative end-of-life option. Together with the Major League baseball team Seattle Mariners, BASF introduced a completely compostable peanut bag into the Safeco Field’s existing closed loop system.

You can find additional information on our projects all over the world at www.ecovio.com/projects
Multiple options: Even after use
With ecovio®, BASF is not only a raw material supplier, but also supports partners right across the value chain and over the entire product life cycle – from production to consumption and onto disposal. According to the application, ecovio® products make different end-of-life options possible, such as composting or recycling (e.g. with ecovio® PS for paper coating).

Eco-efficiency: Consulting and service
For which applications is the use of compostable polymers sensible and truly sustainable? More and more, industry, consumers and politicians are confronted with this question. BASF has a vast pool of competence and expertise in eco-efficiency and life cycle analyses. By comparing the ecological foot print of various product alternatives, it can be examined which product offers what environmental advantages.
One biopolymer – many applications

ecovio® CAN BE USED FOR SEVERAL PURPOSES.

<table>
<thead>
<tr>
<th>Application</th>
<th>Description</th>
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<tbody>
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<td>Organic waste bags and shopping</td>
<td>Biodegradable bags for waste disposal</td>
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<tr>
<td>bags and shopping bags</td>
<td></td>
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<tr>
<td>Mulch films</td>
<td>Mulching and soil conditioning</td>
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<tr>
<td>Paper-coating</td>
<td>Coating for paper products</td>
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<tr>
<td>Shrink film applications</td>
<td>Shrinkable films for various applications</td>
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<tr>
<td>Foam packaging</td>
<td>Packaging for food products</td>
</tr>
<tr>
<td>Thermoformed packaging</td>
<td>Thermoformed packaging for food products</td>
</tr>
<tr>
<td>Injection molding applications</td>
<td>Injection molding applications for food products</td>
</tr>
</tbody>
</table>


Compostable shopping bags offer the customer an additional advantage. They are not only strong enough to be used many times as a shopping bag: In their final phase, the bags can be used for collection of organic waste.

Whether shopping bag or organic waste bag - kitchen and food waste can be collected hygienically in ecovio® bags, then turned, together with the bag, into compost. Undesirable odor and pest infestation are prevented. Thanks to its good wet strength, liquid from teabags or the remains of fruit do not leak through, so there is no more laborious scrubbing of the organic waste bin.

The compostable product grade ecovio® FS is a new development from BASF: The material mainly consists of renewable raw materials and can be composted even faster. In Germany, bags made from this material can be used for the collection of organic waste in accordance with the German Biowaste Ordinance at the end of 2011.

- Mostly biobased
- Usable on blown film equipment for LDPE
- Elastic
- Moisture and tear resistant
ecovio® for mulch films

‘ecovio® M’ WAS SPECIALLY DEVELOPED FOR FILM APPLICATIONS IN FARMING AND GARDENING.

The advantage: The farmer does not have to laboriously collect the mulch films after harvest, but can plow it in directly. This saves time and money. Because of its excellent mechanical properties, ecovio® M offers a high downgauging potential and is optimally suited to different film applications, such as mulch, covering and silage films.

The ready for use compound already contains anti-blocking agents and enables simple processing as a drop-in solution on conventional PE equipment.

ecovio® M is suitable for the production of black, transparent and colored mulch films. Films made of ecovio® M can also be specifically produced for different harvest cycles and climate conditions (2 component system).

- Drop-in solution: Simple processing on conventional PE equipment
- High down-gauging potential
- Can be directly plowed in
- Offers protection against weeds
ecovio® for paper coatings

‘ecovio® PS’ WAS SPECIALLY DEVELOPED FOR COATING PAPER AND PAPERBOARD.

The certified compostable and mostly biobased polymer has multiple advantageous properties. In extrusion coating, ecovio® PS offers a low coating thickness at high coating rates and process stability. The good adhesion of ecovio® PS to many types of paper and paperboard, its temperature stability up to 100°C and sealing capacity comparable to PE make it ideal for the production of paper- and paperboard-based packaging and disposable tableware, e. g., cups, paper plates, or wrapping paper.

In addition to the option of composting packaging which is contaminated with the remains of food after use, ecovio® PS also offers the option of paper recycling.

- Mostly biobased
- Good barrier properties against liquids, fat and mineral oil
- Suitable for food contact
ecovio® for shrink films

WITH ‘ecovio® FS’ FOR SHRINK FILMS, BASF HAS DEVELOPED A COMPOUND SPECIALLY FOR THE MANUFACTURE OF CERTIFIED COMPOSTABLE, FLEXIBLE SHRINK FILMS.

The mostly biobased ecovio® FS for shrink films gives the film an especially balanced relationship between shrink and durability. Depending on the application area, the film’s excellent mechanical properties can reduce coating thickness considerably, compared to conventional polyethylene film. For example, the packaging thickness of 0.5 l drink six-packs can be reduced by up to 50%. The shrinking temperature can also be lowered by about 30°C, which saves energy.

- Mostly biobased
- Lower coating thickness compared to PE
- Saves energy through lower shrinking temperature
- Simplified certification without additional composting test
ecovio® for foam packaging

WHETHER FOR FAST-FOOD BOXES, FOOD PACKAGING OR CONTAINERS ‘ecovio® X’ IS THE SOLUTION FOR COMPOSTABLE FOAM PACKAGING.

The certified compostable polymer ecovio® X can be processed on existing conventional foam extrusion equipment and produces foams of low density that are comparable in their properties with polystyrene foam.

- Mostly biobased
- Suitable for food
- Usable on conventional foam extrusion equipment

In addition, ecovio® X meets the requirements of the US Food Contact Substance Notification.
ecovio® for thermoformed packaging

‘ecovio® T’ IS OPTIMALLY SUITED FOR SHEETING WHICH IS SUBSEQUENTLY THERMOFORMED. THE COMPOSTABILITY OF ‘ecovio® T’ DOES NOT PRECLUDE CONVENTIONAL PROCESSING.

With ecovio® T, processing on conventional sheeting equipment is possible with and without calenders. The result: A stiff yet very tough sheet which wraps extremely well – ideal prerequisites for the thermo-forming of demanding components. Whether inline or offline – the sheet, produced in a processing window of 105-140°C, can be thermoformed through a die with or without pre-stretching. This results in thermo-formed components of high design freedom which are compostable after use.

- Mostly biobased
- Usable on conventional flat-film equipment
- Very wide processing window
- Suitable for single- and multi-layered sheeting
- Suitable for food
ecovio® for injection molding applications

‘ecovio® IS’ CAN BE USED FOR A WIDE RANGE OF PACKAGING APPLICATIONS. IT ALLOWS CUSTOMERS TO PRODUCE COMPOSTABLE PLASTIC PARTS ON STANDARD INJECTION MOLDING MACHINES.

Products made of ecovio® IS benefit from an optimal balance of stiffness and toughness. Depending on the application, the flow behavior is flexibly tunable: from a medium to a high flow capacity. The surface look ranges from beige to light gray, depending on the amount of mineral fillers. Especially for plastic components in packaging or for applications with high mechanical loads, these products are a good choice.

- Mostly biobased
- Usable on conventional injection molding machines
- Runs on single- and multi-purpose tools
- Suitable for food
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