

LETZero Product Book



PCR



Biodegradable



Bio Materials



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For printing this LETZero product book, we refrained from spot color printing and coating processes at the design stage to minimize environmental pollution and waste of resources during the printing process. It is made from FSC-certified eco-friendly pulp and uses eco-friendly soybean oil ink during the printing process to minimize harmful ingredients.





LG Chem’s Eco-Friendly Materials Brand - LETZero

LG Chem launched its first eco-friendly materials brand “LETZero” as part of its ESG management and sustainability strategy.

LETZero means helping zero environmental footprints and reaching net-zero carbon emissions by combining 'Let + Zero'.

LETZero is a master brand that integrates eco-friendly materials such as PCR made of reprocessed waste plastics, bio materials made of Bio-based renewable materials, and biodegradable materials made of glucose and waste glycerol extracted from corns.

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LETZero Brand



LET and Zero (0)

Brand Name

LETZero, LG Chem’s premium Eco-Friendly materials brand, is a compound word of “Let” and “Zero” that reflects our determination to “turn substances that are harmful to the environment and the net increase in carbon emissions into zero.”

Brand Design

The “O” represents our heartfelt promise for a sustainable environment and future, visualizing how LG Chem creates a healthier future to coexist with the Earth.

Brand Color

LETZero Jade Pantone 7466C	C90 M10 Y30 K0 R0 G154 B177 #009AB1
LETZero Green Pantone 381C	C30 M0 Y80 K0 R199 G214 B79 #C7D64F



LETZero Product

LETZero is a brand that reflects our determination to create a sustainable future where humans can coexist with nature. Through LETZero, we aim to reduce carbon emissions that pollute the environment and help resolve the harmful effects on the Earth’s ecosystem. Our products are divided into three main categories: 'PCR (Post-Consumer Recycled) materials' made of reprocessed waste plastics, 'Biodegradable materials' made of glucose and waste glycerol extracted from corn, and 'Bio-Circular Balanced materials' made of Bio-based renewable materials. LG Chem will start the journey toward Zero (0) with LETZero for world's better future.



PCR Materials

PCR materials are recycled plastics produced by collecting, sorting, and pulverizing discarded plastics and processing them with LG Chem’s proprietary technology.

Key Materials
PCR ABS, PCR PC & PC/ABS,
PCR PE, PCR PP



Biodegradable Materials

Biodegradable materials are eco-friendly biodegradable plastics that naturally decompose into water and carbon dioxide by micro-organisms within a few months.

Key Materials
PBAT, PLA, PLH



Bio-Circular Balanced Materials

Bio materials are eco-friendly products that reduce carbon emissions at the raw material stage, using renewable feedstock extracted from Bio-based renewable oil.

Key Materials
(Bio-Circular Balanced) SAP, NPG, IPA,
Acrylates, ABS, PE, PP, PC, PC/ABS,
PVC, NBL, BR, SSBR



Post-Consumer Recycled Materials

PCR Materials

They are produced with less energy, which reduces carbon emissions.

The plastic material made by recycling plastic used and discarded by the end consumer is called PCR (Post-Consumer Recycled) plastic. PCR plastics can be produced with relatively little energy because they recycle plastics that are discarded after use.

By reducing the amount of energy used in the production process, we can decrease carbon emissions. It also helps protect the environment by recycling discarded products, reducing waste.

PCR ABS

PCR PC

PCR PC/
ABS

PCR PE

PCR PP



PCR ABS

Post-Consumer Recycled Acrylonitrile Butadiene Styrene

LG Chem was the first to develop high-quality white PCR ABS using recycled ABS (acrylonitrile butadiene styrene). LG Chem's PCR ABS maintains excellent physical properties after repeated use.



Conventional PCR ABS is made of recycled ABS with multiple colors, generally resulting in dark or black coloration. This has restricted its applications, for instance, on the exterior of white home appliances.

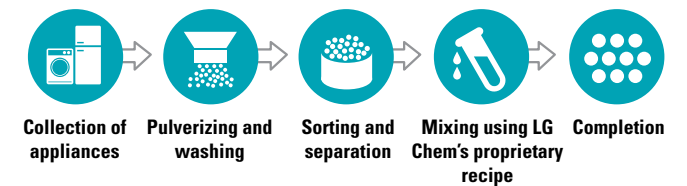
In August 2020, LG Chem became the first in the world to successfully develop and mass-produce PCR ABS in white color with physical properties equivalent to existing products. For producing white PCR ABS, light-colored plastics need to be sorted out before the pulverization process. Selecting and blending white pigments also require a high level of technology. LG Chem has standardized the screening process for recycling ABS, and through proprietary technology, is mass-producing perfectly white-colored material with quality equivalent to that of existing ABS.

Main Product Features

- It helps protect the environment by using discarded home appliances as raw materials, reducing plastic waste.
- Less incineration of plastic means less fine dust and greenhouse gas emissions.
- It can be produced in bright colors, even white, which is applicable to the exterior of white home appliances.
- It has excellent retention of physical properties after multiple extrusions and has thermal stability and chemical resistance comparable to virgin products.

Manufacturing Process

LG Chem currently produces PCR ABS products using mechanical recycling. When recycling plastic, it is key to singularly sort out ABS from discarded plastic products. Then, a separation process removes impurities, and these recycled plastics are mixed with raw materials created by LG Chem's proprietary technology for making the final product.

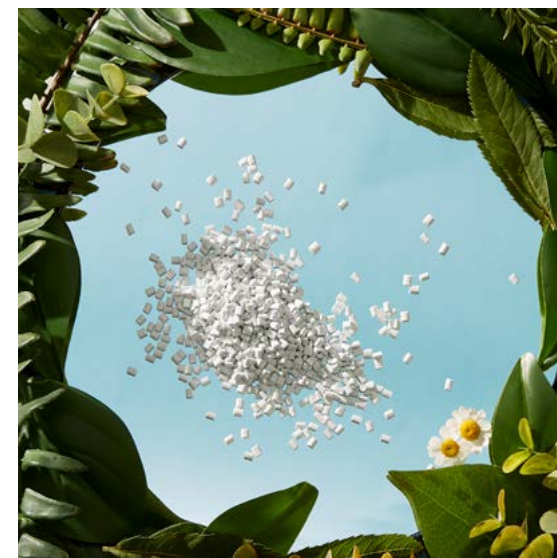


Scope of Applicability

In addition to home appliances and various electronic devices, the demand and uses of PCR ABS are diversifying day by day, from automobiles to building materials. LG Chem's R&D efforts focus on various product applications that our customers want.

Main Applications

Appliances such as TV, copying machines, and air purifiers



Color Samples for PCR ABS

PCR PC & PC/ABS

In 2009, LG Chem commercialized PCR PC and PC/ABS products from recycling engineering plastics called Polycarbonate (PC). By producing 50% PCR PC/ABS products, about 40% of carbon emissions was reduced compared to existing products.



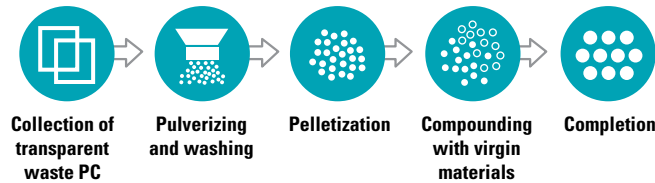
PC is an engineering plastic that can replace metal and ceramics as an industrial material. The material is transparent, 150 times stronger than tempered glass, and withstands heat above 120°C. PCR plastics are produced with relatively less energy because they are made by recycling used plastics that are discarded. Using less energy also means emitting less carbon. Moreover, it reduces waste by recycling discarded products.

Main Product Features

- It helps protect the environment by recycling discarded transparent PC, reducing plastic waste.
- We produce PCR PC using up to 90% recycled PC and compounded PCR PC/ABS products using up to 75% recycled PC.
- We have achieved the same level of impact resistance, heat resistance, and transparency as virgin materials with high content of recycled materials.
- Our PCR products are 150 times stronger than tempered glass and withstand heat over 120°C. They are easy to process and have excellent color expression and durability, allowing the versatility of applications in product exteriors.

Manufacturing Process

It is essential to establish an assured process that singles out transparent PCs from a pool of plastics. After collecting and crushing transparent waste PC, it is washed and pelletized. Then, it is mixed with virgin materials at a specific ratio to produce the final PCR product.



Scope of Applicability

Thanks to its excellent impact resistance, heat resistance, and processability, it has wide applications in making electronic devices, such as laptops and AI speakers, and automobile interiors and exteriors.

Main Applications

Laptops, TV, multi-function devices, network equipment, IT appliances, adapters, chargers, industrial materials, automotive interior and exterior materials, exterior building materials



Smartphone cases made of PCR PC

PCR PE & PCR PP

Post-Consumer Recycled Polyethylene & Polypropylene

LG Chem produces PCR PE and PCR PP by recycling Polyethylene (PE) and Polypropylene (PP).

PE is a common material used in food handling, industrial and agricultural films, and containers for household goods, and PP has diverse purposes from automotive materials to medical applications.



PCR PE

LG Chem has developed high-quality PCR PE and PCR PP by recycling PE and PP, which are general-purpose plastics used in various fields in our daily life. Our PCR products can replace existing virgin PE and PP as they have identical qualities. A wide range of PCR products is available for the client's preference, from film to injection molding.

Main Features

- It helps protect the environment by using discarded home appliances as raw materials, reducing plastic waste.
- Less incineration of plastic means less fine dust and greenhouse gas emissions.
- Our products achieved physical properties equivalent to the quality of virgin materials despite the high content (50–80%) of recycled materials in each product.

Scope of Applicability

LG Chem's PCR PE and PP can be applied to packaging materials of various shapes and uses, such as packaging films, containers, and lids. We have developed several such product groups, and are accelerating our efforts to research and develop an even wider range of applications.

Main Applications

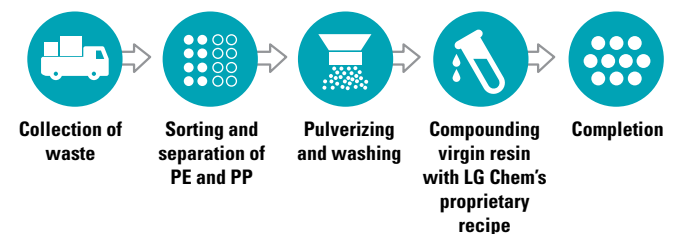
PCR PE: Flexible packaging materials, stretch wraps, heavy-duty bags, blow-molded containers, and injection molded products (pallets, crates, etc.)

PCR PP: Injection molded containers and caps

Manufacturing Process

LG Chem produces PCR PE and PP products through mechanical recycling.

PE and PP are plastics widely used in the home and industries, including disposable products, logistics, and appliances, accounting for the majority of plastic waste. In recycling these, the most critical process is sorting and separating. Then, the pulverizing and washing process removes impurities, and these recycled plastics are mixed with raw materials created by LG Chem's proprietary technology for making the final product.



PCR PP



PCR PE



Biodegradable Materials

Biodegradable Materials

It comes from nature and returns to nature.

LG Chem is taking the lead in developing bio materials using Bio-based materials and biodegradable materials that decompose in the ground within a few months. In line with global trends such as regulations on disposable products, increasing demand for biodegradable materials, and reducing carbon emissions, we are developing Bio-based and biodegradable products for diverse applications from plastic bags to disposable cups.



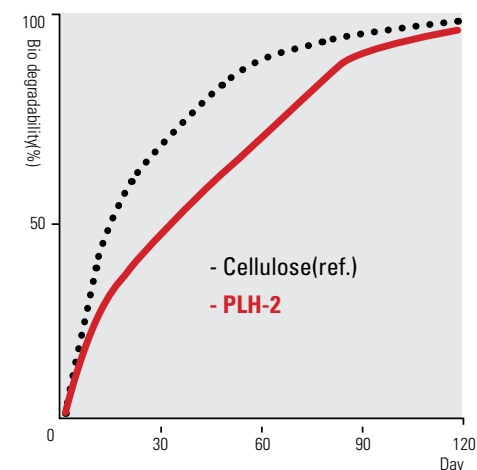
PLH

PolyLactate-co-Hydracrylate

PLH, developed by LG Chem, is a biodegradable material with 100% bio content using glucose and waste glycerol from corn. It is the only material that satisfies high levels of flexibility, transparency, and biodegradability as a single material.



Existing biodegradable materials had to be mixed with other plastic materials or additives to enhance their physical properties and flexibility, which resulted in differentiated quality and price for each product. However, PLH developed by LG Chem is a single material that has improved flexibility by up to 20 times compared to existing biodegradable products and maintains transparency even after processing. It has a wide range of applications in plastic bags, bubble wraps, disposable cups, foam products, and non-woven fabrics for masks.



DIN CERTCO's test results on PLH's biodegradation

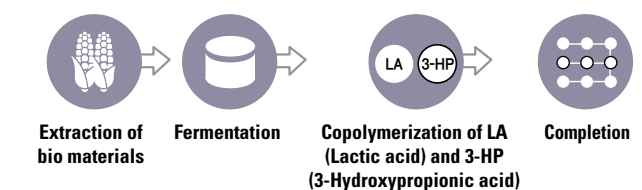
*International certification body for biodegradable materials in Germany

Main Features

- It is a biodegradable material with 100% bio content using corn glucose and waste glycerol.
- DIN CERTCO, an international certification body for biodegradable materials in Germany, confirmed that 90% of the material is biodegradable within 120 days.
- It is a single material that is up to 20 times more flexible than conventional biodegradable products while maintaining transparency.

Manufacturing Process

PLH is a biodegradable material originally developed by LG Chem, produced from 100% bio materials. 3-HP (3-Hydroxypropionic acid), one of the monomers used to polymerize PLH, is produced by microbial fermentation using biomass. As 3-HP is difficult to produce with high purity and high yield, and the purification process is complicated, no one had successfully mass-produced materials using the monomer. After many years of research, we have acquired the production and purification technology of 3-HP. This enabled the development of new biodegradable materials with improved flexibility while maintaining transparency.



Scope of Applicability

Adjusting the structure of new materials allows us to implement mechanical properties according to their use. By varying their grades, we are researching the application of these new materials to packaging, such as films, containers, and disposable cups that use existing biodegradable materials.

Main Applications

Films, disposable cups, bubble wraps, etc.

Future Plans

- 2021 / R&D
- 2022 / Begin investment and production
- 2026 / Produce prototypes

PBAT

Polybutylene adipate-co-terephthalate

PBAT is a petroleum-based, biodegradable plastic. Unlike general plastics, it is naturally decomposed by water, light, enzymes, and microorganisms in nature within six months. By compounding with other biodegradable materials such as PLA, it has excellent elasticity, stretches well, and has wide product applications.



PBAT is a fossil fuel-based biodegradable plastic. It is a highly flexible material and has an elongation* of 600 to 800%, which is suitable for making disposable bags and agricultural films. It can be applied to various purposes by compounding with other biodegradable materials such as PLA. LG Chem plans to dramatically reduce the carbon generation rate in the manufacturing process by turning BDO (Butanediol) and AdA (Adipic Acid), the raw materials for PBAT production, into bio materials.

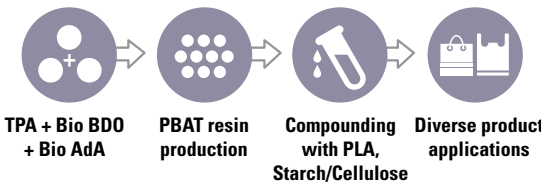
*Elongation: the ratio of stretch without breakage

Main Features

- It is a petroleum-based biodegradable plastic that degrades rapidly in nature.
- It may contain more bio content by adding bio-BDO (Butanediol) and AdA (Adipic Acid).
- It can be used to develop and apply in various products through compounding with other biodegradable plastics such as PLA.

Manufacturing Process

PBAT is made from three organic compounds: BDO (Butanediol), AdA (Adipic Acid), and TPA (Terephthalic Acid). PLA (Poly Lactic Acid), a biodegradable plastic, and starch or cellulose are compounded to adjust the physical properties. Using bio materials at the raw material stage minimizes the carbon emissions produced in the manufacturing process.



Scope of Applicability

Compounding with PLA and starch allows PBAT to have strength, printability, and processability similar to existing plastic films (LD, LLDPE) and have diverse product applications. In addition to industrial composting, it can be biodegraded in the soil, making it an excellent material for agricultural mulch films.

Main Applications

Agricultural mulch film, disposable bags, shopping bags, and volume-based waste bags

Future Plans

- 2022 / Meets international standards for industrial composting
- 2023 / Begins commercial operation
- 2025 / Expands its production capacity

PLA

Poly Lactic Acid



PLA is one of the most widely produced bioplastics using Bio-based materials. It is a biodegradable plastic decomposed by microorganisms within a few months under certain conditions. Because of its material characteristics, high stiffness and easy applicableness, it is widely used in various industries by compounding with other polymers with high flexibility, such as PBAT.



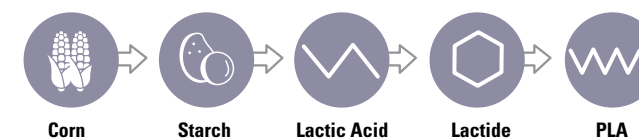
PLA is a bioplastic produced from Bio-based materials such as corn and sugarcane and a biodegradable plastic decomposed by microorganisms. Because of its characteristics, it can contribute to reducing carbon emissions and solving the plastic waste problem. The PLA product market is also expected to grow rapidly as the demand for Bio-based and biodegradable plastics increases due to the recent reinforcement of plastic regulations worldwide.

Main Features

- PLA is produced from lactic acid as the raw material by fermenting corn or sugarcane. PLA is harmless to the human body and is used for food packaging containers, tableware, and medical materials.
- Because the material has high stiffness and is prone to breakage, it is compounded with other polymers with high flexibility, such as PBAT, to improve the physical properties.

Manufacturing Process

PLA is produced from lactic acid, obtained by fermenting glucose extracted from corn starch or sugarcane. After converting lactic acid to lactide, its cyclic form, PLA is manufactured through a polymerization process. Depending on the mixture of raw materials and the polymerization process, PLA can be produced into various grades. It can have diverse applications through compounding with other materials that can compensate for its weaknesses in physical properties.



Scope of Applicability

Because its properties are harmless to the human body, it is mainly used for food packaging and tableware. PLA with improved heat resistance can be applied to various purposes such as disposable products.

Main Applications

Various disposable plastics, Food Packaging, Tableware

Future Plans

- 2021 / Partnership with ADM
- 2025 / Commercial Operation





Bio Materials

Bio Materials

We reduce carbon emissions with Bio-renewable feedstock.

LG Chem produces a variety of products with bio-materials extracted from Bio-renewable feedstock.

We are the first in Korea to acquire the ISCC Plus certification on 50 eco-friendly products, including SAP (Super Absorbent Polymer), PO (Polyolefin), ABS (Acrylonitrile Butadiene Styrene), and PVC (Polyvinyl Chloride). The certification includes the entire process, from raw material procurement to production, purchase, and sales (as of October 2022). Building upon this achievement, LG Chem will continue to do our best to reduce carbon emissions in terms of LCA (Life Cycle Assessment), which evaluates all environmental impacts from raw material production to product shipment.



Bio-Circular Balanced

LG Chem has succeeded in developing Bio-Circular Balanced products based on renewable oil that is derived from sources such as vegetable oil. Using environment friendly material is more beneficial to the Earth's environment as it dramatically reduces carbon emissions during the manufacturing process. LG Chem has acquired ISCC Plus certification, the world's most renowned authentication for eco-friendly bio products, for 50 Bio-Circular Balanced products (as of September 2022). We plan to expand the scope of green products in the future.



It is an eco-friendly bio product manufactured using fossil-based oil along with bio-renewable feedstock extracted from Bio-based renewable oil. LG Chem was the first in Korea to acquire ISCC Plus certification for a total of 50 Bio-Circular Balanced products, including SAP (Super Absorbent Polymer), PO (Polyolefin), and PC (Polycarbonate) compounds (as of October 2022). The reduction of carbon emissions from Bio-Circular Balanced SAP products, measured through LCA (Life Cycle Assessment), which evaluates all environmental impacts from the production of raw materials to product shipment, reached 111%* compared to existing products.

*Based on 100% allocation of bio materials input by Mass balance principles as verified by the Korean Society for Life Cycle Assessment (KSLCA). The amount of carbon reduction is based on the standards that include the cradle-to-gate production stages, and in the case of bio materials, the amount of carbon dioxide (CO₂) absorbed by plants is taken into account when calculating greenhouse gas emissions.

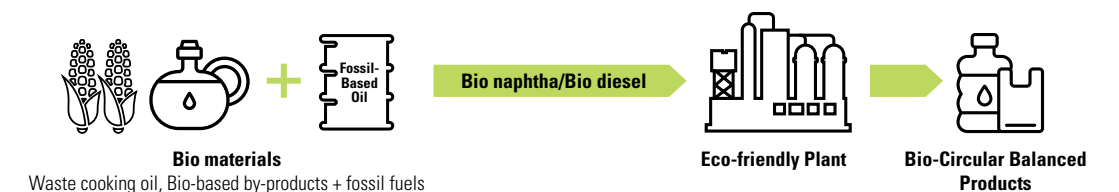


Main Features

- Bio-renewable feedstock extracted from Bio-based renewable oil is incorporated with fossil-based oil to reduce carbon emissions dramatically in the manufacturing process.
- We established a stable supply chain of raw materials by concluding a strategic partnership with Neste, the world's largest producer of bio materials.
- We have acquired the ISCC Plus certification, an international authentication that meets the Renewable Energy Directive of the European Union (EU), which is the world's strictest standards of its kind.

Manufacturing Process

We produce eco-friendly products by using the same existing petrochemical production infrastructure. Our production process incorporates bio materials using Bio-based renewable oil and the existing fossil fuel-based oil. LG Chem's eco-friendly plants can be operated with renewable energy such as hydro-power and solar heat.



What is ISCC Plus Certification?

ISCC Plus certification is an international certification that meets the Renewable Energy Directive of the European Union (EU) and verifies the traceability of sustainable raw materials such as eco-friendly bio products under strict standards.



Bio-Circular Balanced SAP
Diapers, feminine hygiene products



Bio-Circular Balanced NPG
Paint (powder coating, coil coating), PET films, coating agents, adhesives, UPR (Unsaturated Polyester Resin)



Bio-Circular Balanced ABS
Electrical/electronic devices, automobiles, construction materials, other miscellaneous goods



Bio-Circular Balanced PE (HDPE ,LDPE, EVA, POE)
Injection molding, bottle caps, coating, films, foam products



Bio-Circular Balanced IPA
Cleaners for semiconductor/LCD manufacturing, paint, pharmaceuticals, and cosmetics



Bio-Circular Balanced Acrylates
Paint, adhesives, coating



Bio-Circular Balanced PP
Non-woven fabric, automobile interior and exterior materials, injection molding



Bio-Circular Balanced PVC
Flooring, window profile, artificial leather



Bio-Circular Balanced PC

Electrical/electronic devices, automobiles,
industrial materials, building materials



Bio-Circular Balanced NBL

Gloves



Bio-Circular Balanced BR

Tires, shoes



Bio-Circular Balanced SSBR

Tires



LG Chem's Eco-Friendly Materials Brand