

PERFORMANCE MATERIALS SOLUTIONS FOR THE POLYMER INDUSTRY





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IMPROVING WELL-BEING BY OFFERING THE BEST OF NATURE

Roquette is a global leader in plant-based ingredients, a pioneer of plant proteins and a leading provider of pharmaceutical excipients.

Roquette provides high performing, innovative and sustainable plant-based solutions for industrial applications.

In collaboration with its customers and partners, the group addresses current and future societal challenges by unlocking the potential of nature to offer the best ingredients for food, nutrition and health markets. These ingredients respond to unique and essential needs, enable healthier lifestyles and are critical components of life-saving medicines.

Thanks to a constant drive for innovation and a long-term vision, the group is committed to improving the well-being of millions of people all over the world while taking care of resources and territories.

Roquette currently operates in over 100 countries, has a turnover of around 3.7 billion euros and employs 8,670 people worldwide.

Roquette is a monomer producer from 100% biomass feedstock to serve brand owners and consumers.

ROQUETTE GROUP KEY FIGURES

100+

countries served
by ONE Global
Commercial Network

5000+

customers

85

years of industrial
and operational
excellence

8670

employees

45+

nationalities

25

industrial sites

40

patents / year

€3.7

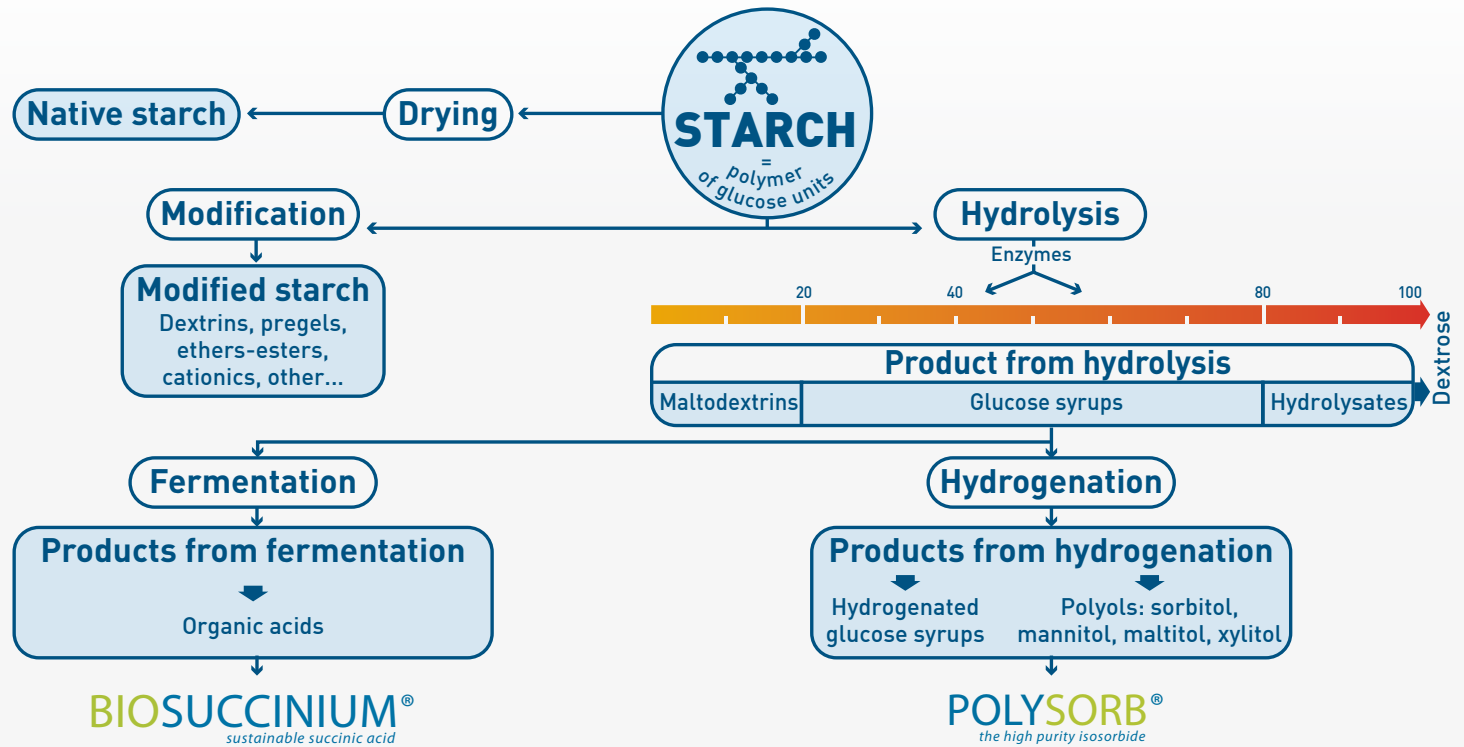
bn turnover

300+

R&D workforce

PRODUCTION EXPERTISE

STARCH PRODUCTION SCHEME



INDUSTRIES EXPERTISE

Our Customer Technical Services dedicated to industries' applications plays a key role in our ambition to be the key provider of plant-based solutions delivering performances and health benefits for industrial customers.

We work **hand-in-hand** on developments to create new products, processes and solutions adapted to your needs by offering:

Our expertise: know-how, in-depth knowledge of products used in your applications;

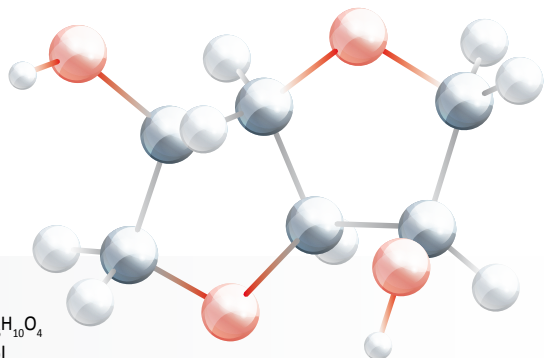
Our technologies: equipment, laboratories, pilots, pre-industrial units;

Our formulation support: always listening to your needs and providing sustainable, cost-effective and innovation solutions.



OUR BIO-BASED SOLUTIONS

In the global development of plant-based chemistry, Roquette offers the industrial markets new, innovative and sustainable monomers to create solutions for safer and more sustainable polymers.



. Isosorbide $C_6H_{10}O_4$
. 146.14 g/mol
. CAS 652-67-5

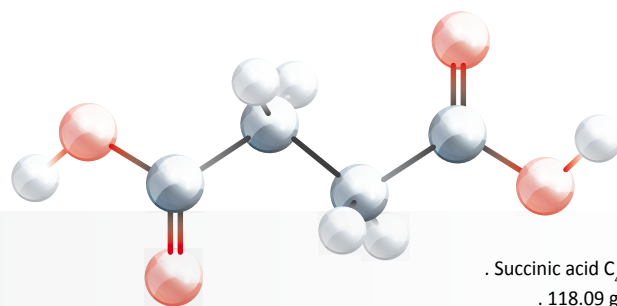
POLYSORB® ISOSORBIDE - THE FIRST HIGHEST PURITY ISOSORBIDE IN THE WORLD

Roquette is the global leader in production and supply of high purity isosorbide for the polymer industry.

For almost 20 years, Roquette has acquired and developed a special knowledge in production and stabilization of isosorbide, which materializes into the first worldwide scale plant in Lestrem, France.

POLYSORB® is a plant-based molecule, sustainable and non-toxic, and is REACH compliant. There are different grades adapted to all applications including pharmaceuticals and polymers.

We provide the highest purity and the most stable isosorbide to our customers.



. Succinic acid $C_4H_6O_4$
. 118.09 g/mol
. CAS 110-15-6

BIOSUCCINIUM® BIO-SUCCINIC ACID FROM THE BEST-IN-CLASS BIOTECHNOLOGY PROCESS

The biotechnology process to produce BIOSUCCINIUM® was developed by Reverdia, a joint venture between DSM and Roquette. Since Reverdia's dissolution in April 2019, Roquette now manufactures and sells BIOSUCCINIUM® under license from DSM.

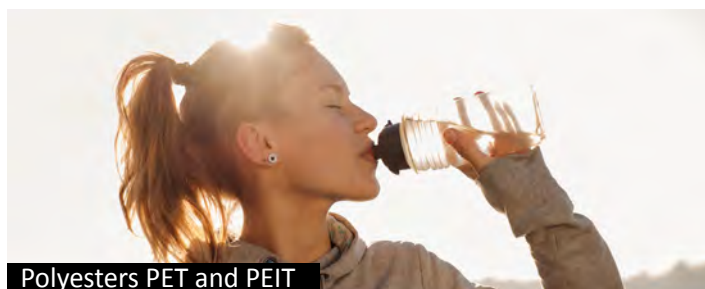
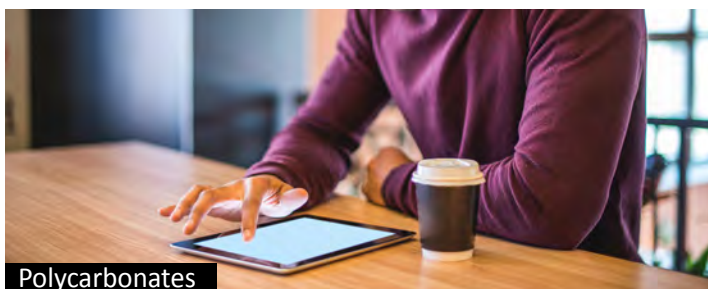
This unique production process generates no by-products and very little impurities. BIOSUCCINIUM® has been produced for several years and has been tested and validated in various applications and by numerous customers.

BIOSUCCINIUM® is available from the first large scale commercial production plant, located in Cassano Spinola, Italy.



APPLICATIONS, BENEFITS AND PERFORMANCES

ROQUETTE PROVIDES HIGH PERFORMING, INNOVATIVE AND SUSTAINABLE PLANT-BASED SOLUTIONS FOR INDUSTRIAL APPLICATIONS



Applications

- Polyester, polyester-copolymers, polyester polyol
- Polycarbonate, polyester-polycarbonate-copolymers, polycarbonate-polyols
- Polyurethanes
- Epoxy, epoxy resins
- Acrylates, acrylic resins
- Plasticizer, additives
- Solvents
- Surfactants

Benefits

- Bio-based, sustainable, renewable
- Safe, non-toxic, low VOC
- Non-endocrine disruptor
- BPA replacement
- For bio-based recyclable, biodegradable, compostable plastics

Performances

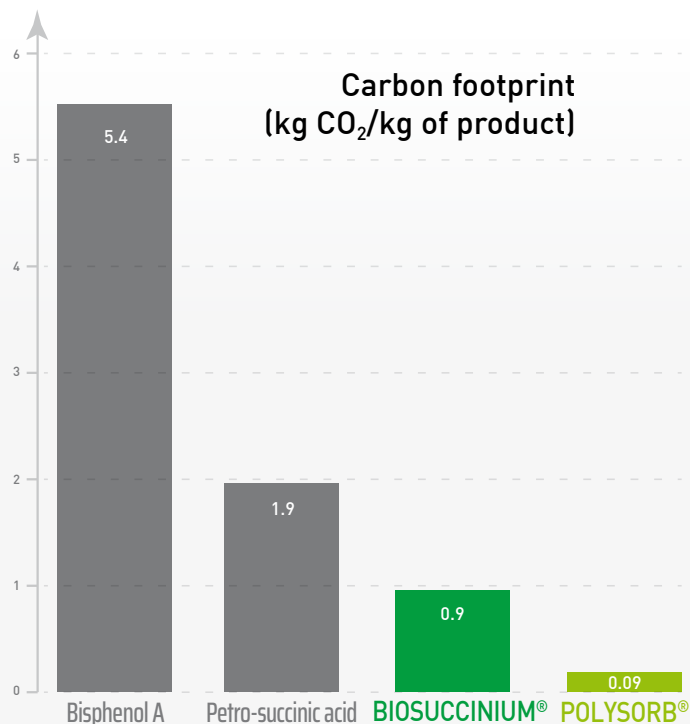
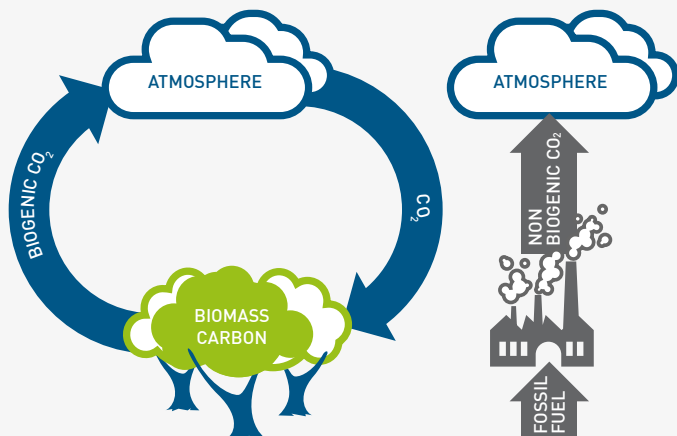
- Tg values, thermal behavior
- UV resistance, optical properties
- Mechanical, chemical properties
- Adhesion, hardness

OUR PROMISES ON ENVIRONMENTAL IMPACT

LOW ENVIRONMENTAL FOOTPRINT

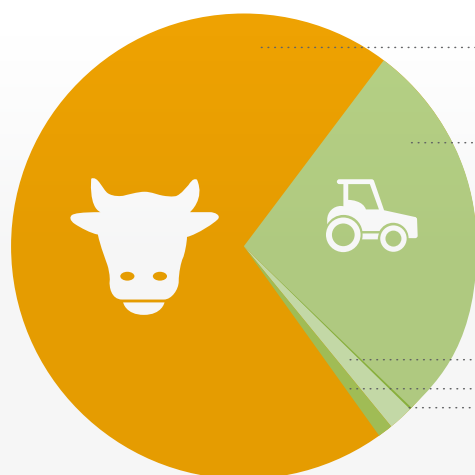
Our BIOSUCCINIUM® and POLYSORB® solutions have low carbon footprint because:

- Raw materials partake in the natural carbon cycle.
- Production takes place in a highly efficient biorefinery.



- Biogenic carbon (Carbon retained by a plant during its development.) reduction is taken into account.
- POLYSORB®: Internal comparative study based on LCA methodology, which was peer reviewed by an external auditor.
- BIOSUCCINIUM®: Executed by the Copernicus Institute at Utrecht University, the Netherlands. Data is published as an early view (August 2013).

LAND USE ESTIMATION FOR BIOPLASTICS 2018 AND 2023



Food and feed
1.24 billion ha = 25%*

Material use***
106 million ha = 2%*

Biofuels
53 million ha = 1%*

Bioplastics:
2018: 0.81 million ha = 0.016%*
2023: 1.02 million ha = 0.020%*

GLOBAL AGRICULTURAL AREA
Pasture: 3.3 billion ha

ARABLE LAND**
1.4 billion ha

Source: European Bioplastics (2018), FAO stats (2014), nova-Institute (2018), and Institute for Bioplastics and Biocomposites (2016). More information: www.european-bioplastics.org

* In relation to global agricultural area
** Including approx. 1% fallow land
*** Land-use for bioplastics is part of the 2% material use

ONLY 0.02% OF GLOBAL AGRICULTURAL AREA USED FOR BIOPLASTICS

OUR PROMISES FOR SUSTAINABLE PACKAGING

The high amount of plastic waste has led the industries to move toward more sustainable production.

Our innovative solutions allow the production of recyclable, reusable and biodegradable plastics.

POLYSORB® and BIOSUCCINIUM® solutions are 100% bio-based monomers for your sustainable packaging.

RECYCLABLE PLASTICS

PET modified with POLYSORB® keeps their semi-crystalline properties to a certain extent. In that case, the material could be mechanically recycled in the PET stream. The properties of the resulting recycled material fulfill all tests described by EPBP up to 50% of modified PET. In addition, the material could be identified with the Recycling Identification Code #1 based on the requirements of Standard ASTM D7611-D7611M. It is a good solution for hot fill, pasteurization, aerosols and cosmetic bottles.

REUSABLE PLASTICS PACKAGING

PEIT is high temperature, dishwashing resistant and safer material for reusable plastic packaging such as sports bottles and food containers.



PEIT (PolyEthylene co-Isosorbide Terephthalate)
“glass-like, heat resistant, hot fillable copolyester”

BIODEGRADABLE PLASTICS

Environmentally-friendly packaging is not just about recycling. The production process and raw materials can also boost the sustainability of packaging.

Modern bio-based plastics, based on BIOSUCCINIUM®, can completely degrade in compost or soil. Biodegradable plastics offer alternative disposal scenarios when it is difficult to collect and recycle products at the end of their lifespan. Biodegradable plastic bags based on bio-based PBS copolyesters can help to meet regulations such as France and Italy's ban on disposable bags.



PBS (PolyButylene Succinate)
“biodegradable aliphatic polyester”

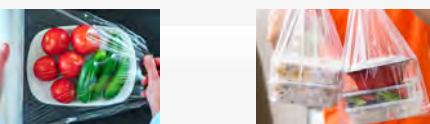
REUSABLE PLASTICS



Flexible packaging/coating



Packaging film



Shopping bag

RECYCLABLE PLASTICS



Hot fill, pasteurization



Aerosol



Cosmetic bottles



Paper coating

Other rigid packaging



Water jar



Cutlery



Coffee capsule



Blisters



Medical package

OUR PROMISES FOR SAFE COATINGS AND ADHESIVES

Environmental concerns are key drivers of the coatings, adhesives, sealants and elastomers (CASE) market.

Consumers and regulatory authorities demand products that are more sustainable and eco-friendly. The market search solutions to eliminate hazardous chemicals, to lower the emissions of greenhouses gases and VOC and to replace fossil-based chemicals by bio-based raw materials without compromising performance.

POLYSORB® isosorbide and BIOSUCCINIUM® bio-succinic acid are two bio-based raw materials that can fine-tune applications and bring valuable properties to coatings, adhesives, sealants and elastomers.



**Biodegradability
recyclability**



Eco-toxicity



**Reduction
of emissions**



**Renewable raw
materials**



Performance



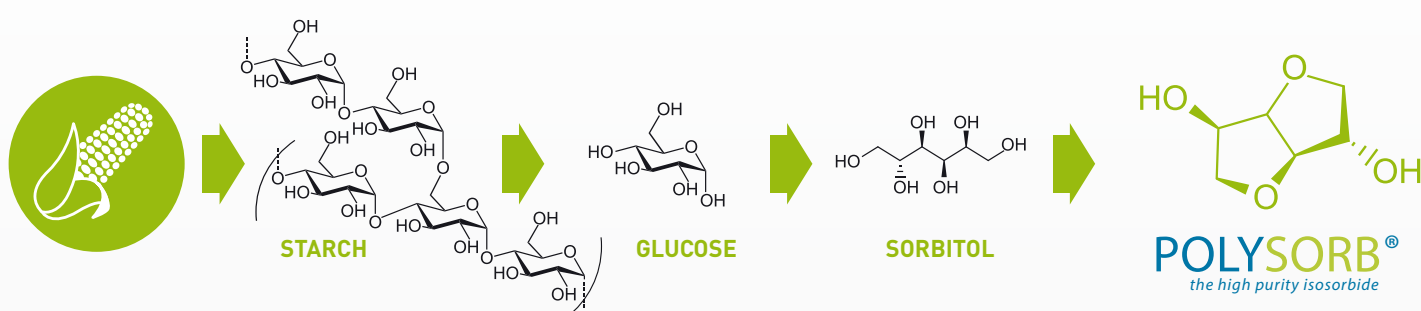
Eco-friendly

PRODUCTS OVERVIEW

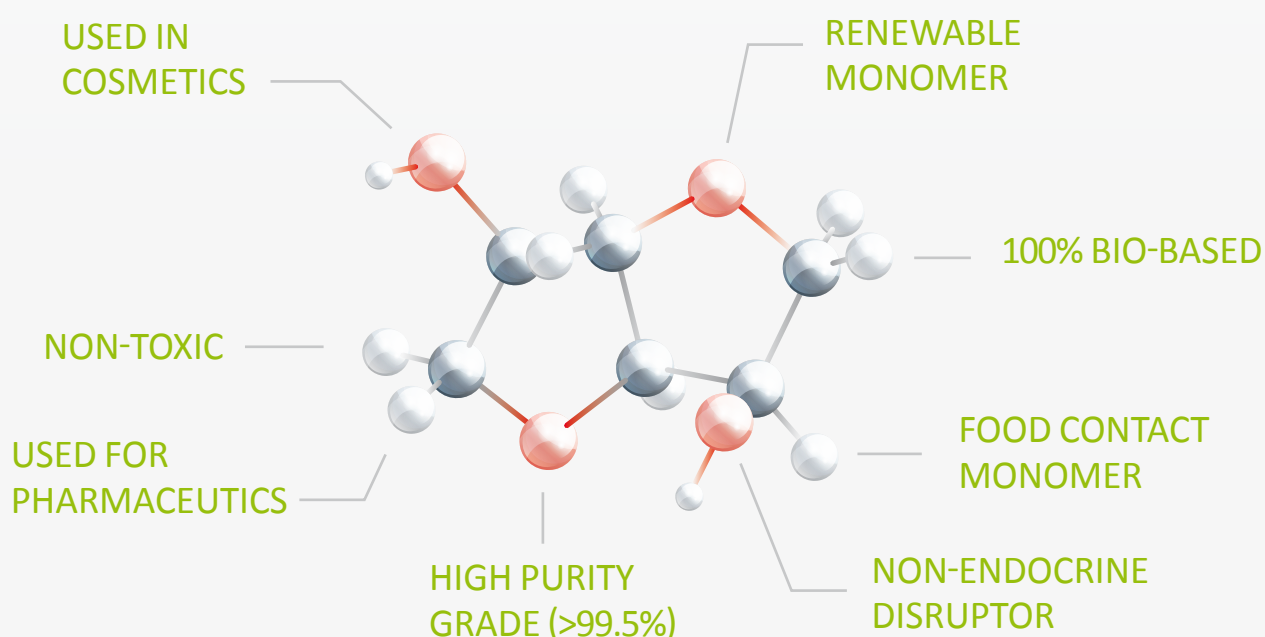
WHAT IS POLYSORB® ISOSORBIDE AND WHAT CAN IT DO FOR YOU?

POLYSORB® is a high purity isosorbide integrally produced from annually renewable feedstock. Due to its specific structure, it brings unique properties to your materials and offers you new applications and developments.

POLYSORB® is a perfectly safe product. It has been proven as a non-toxic, non-endocrine disruptor, suitable for food contact, cosmetic and pharmaceutical compatible components.



Safe to use for your customer and your business



PRODUCTS OVERVIEW

KEY BENEFITS OF POLYSORB® ISOSORBIDE IN POLYMERS



Thermal properties

Increase glass transition temperature of your materials, no deformation of the materials when heated



High chemical resistance

No deterioration in various solvents, from water to organic solvents (acetone, esters, etc.)



Optical performance

Bring transparency, possibility to produce glass-like materials



UV resistance

No yellowing of the material once exposed to sunlight

Find below the other benefits of using POLYSORB®

BENEFITS OF POLYSORB® PER MARKET



PLASTIC PACKAGING

- Thermal resistance and crystalizability
- Improvement of chemical resistance
- Improve carbon footprint
- Suitable for household applications
- Recyclable



AUTOMOTIVE AND OPTICAL

- Scratch resistance
- UV resistance
- Birefringence
- Impact resistance



CASE

- UV resistance
- Bending resistance
- Improved aspect
- Water soluble
- Abrasion resistance
- Scratch and impact resistance
- Better adhesion

PRODUCTS OVERVIEW

POLYSORB® ISOSORBIDE A FULL RANGE WITH OUTSTANDING PROPERTIES

SPECIFICATIONS

	POLYSORB® PA	POLYSORB® LP	POLYSORB® PSA
Application	all	polyesters	Polycarbonate, polyurethane
Color	white	colorless	white
Type	pellets	liquid	pellets
Purity (% DS-HPLC)	>=99.5	>=99.5	>=99.5
Water content	-	20.0% max.	-
pH (40% in water)	6.5-8.5	6.5-8.5	8.0-9.0

APPLICATIONS FOR POLYSORB®

SEMI-CRYSTALLINE POLYESTERS



Cosmetic
bottles



Aerosol



Hot filling
bottles

AMORPHOUS POLYESTERS



Food
container



Sport bottles

POLYURETHANES



Coatings
and paints



Adhesives



Composites

POLYCARBONATES



Car interiors



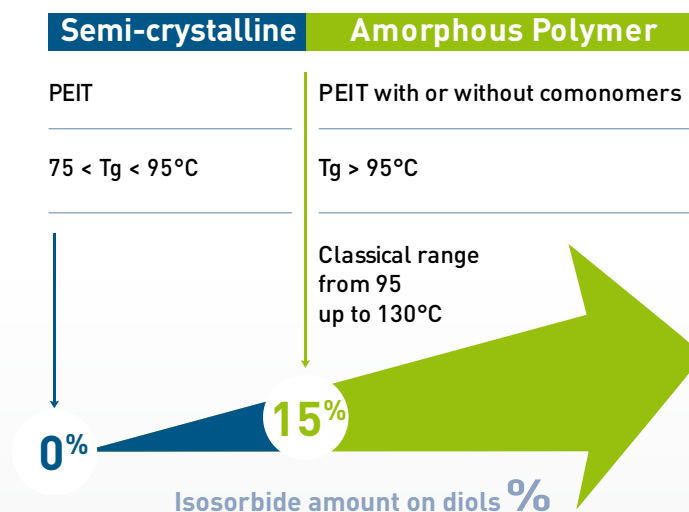
Optical

POLYSORB® IN POLYESTER

THERMAL RESISTANCE AND CRYSTALIZABILITY

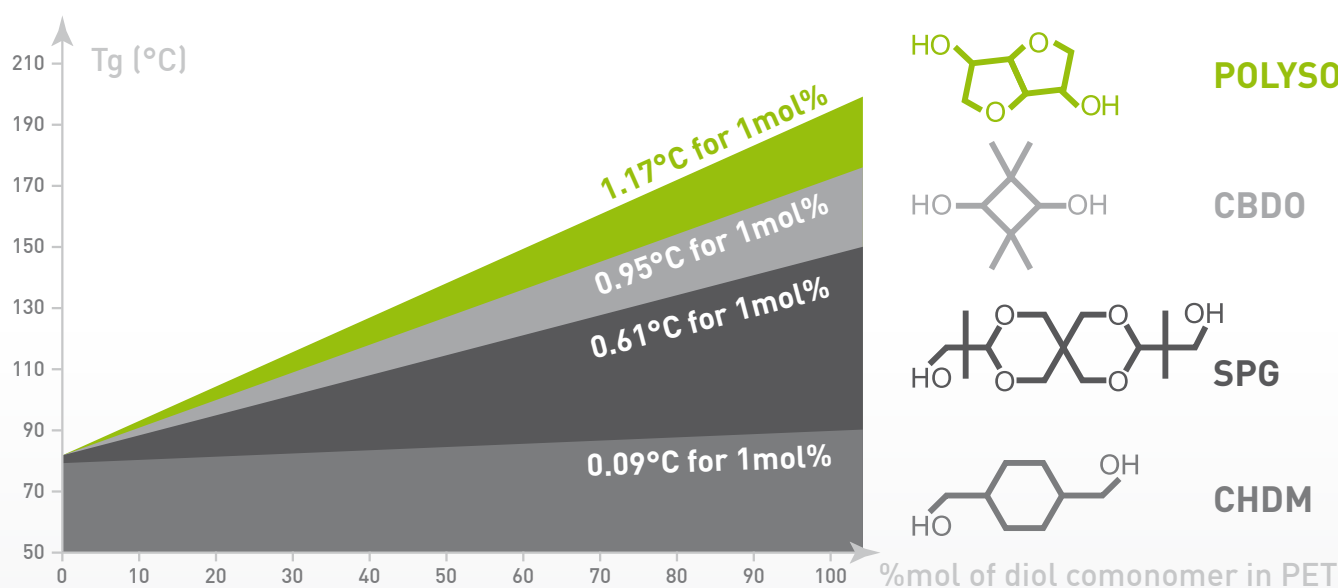
PolyEthylene-co-Isosorbide Terephthalate (PEIT) is a semi-aromatic copolyester, which is obtained from bulk polymerization at high temperature of isosorbide, ethylene glycol and terephthalic acid.

These copolyesters give an improved thermal stability (T_g) compared to classical polyester like PolyEthylene Terephthalate (PET). Depending on the isosorbide content in polymers chains, these copolyesters can be semi-crystalline or amorphous by adjusting the amount of contents.



THE MOST EFFECTIVE DIOL IN INCREASING THE T_g

POLYSORB®, the high purity isosorbide, is the most effective diol in increasing the T_g for specialty copolyesters and is the only bio-based molecule.



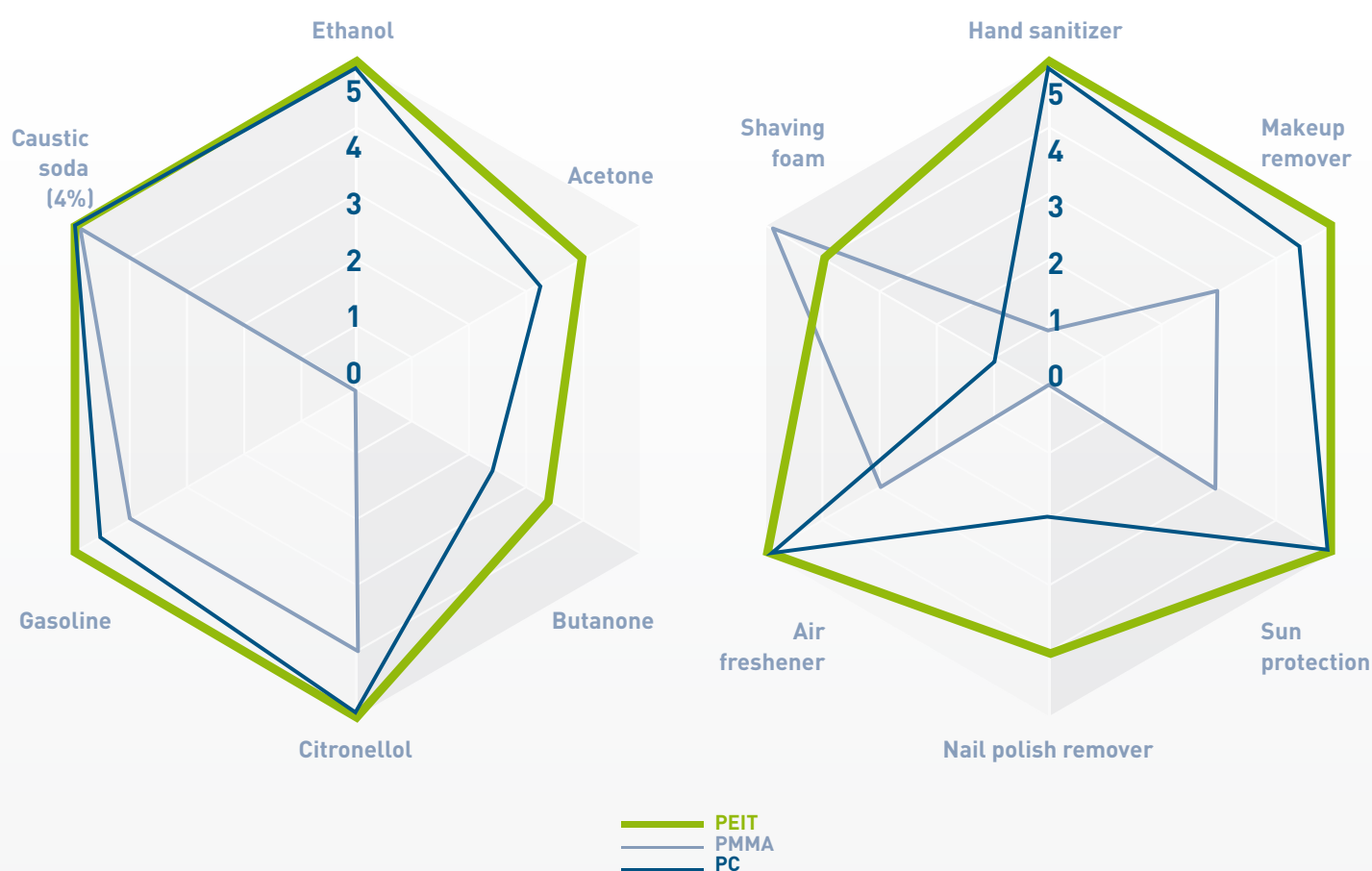
POLYSORB® IN POLYESTER

POLYSORB® ISOSORBIDE FOR HIGH VALUE PACKAGING

Thanks to its unique structure, POLYSORB® allows the addition of new functionalities to packaging, such as high gloss, good optical properties and high impact resistance. All of those properties make it a good candidate for high value packaging such as cosmetic bottles.

POLYSORB® can modify the chemical resistance of cosmetic packaging to improve its compatibility with polar molecules like ethanol or gasoline and shows very good resistance to nail polish remover, shaving foam and makeup remover.

IMPROVEMENT OF CHEMICAL RESISTANCE



POLYSORB® IN POLYESTER

INNOVATIVE SOLUTION FOR YOUR SUSTAINABLE PACKAGING

It is also a new era to be innovative for sustainable packaging industry due to the Circular Economy initiative in the EU.

Hot fill packaging is very popular in today's beverage industry and works great with non-carbonated beverage and liquid food products such as fruit and vegetable juices, nectars, soft drinks, water and teas.

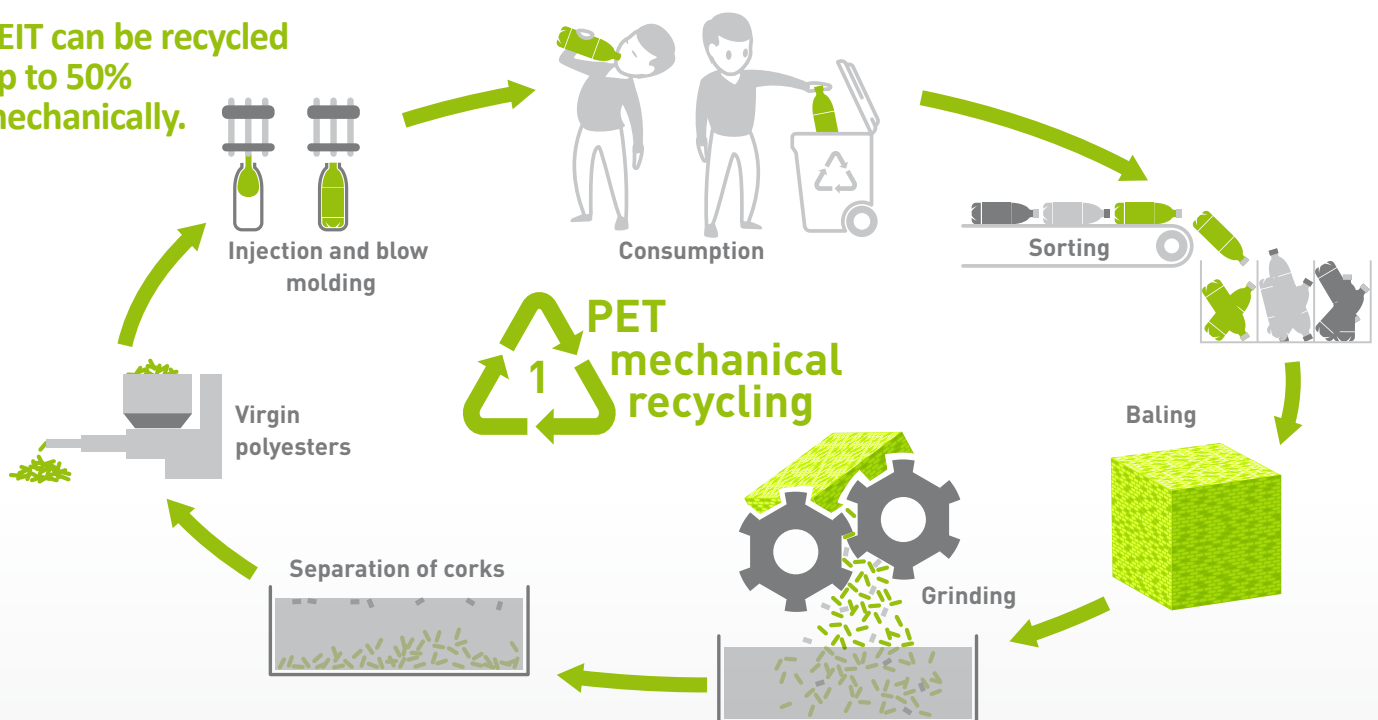
The product is heated and filled at a high temperature to ensure the sterilization of the product, the container and closure. To preserve the product and taste, the container is immediately cooled after the filling process. Hot fill is far less expensive than the aseptic process, and the shelf life of hot-filled products can last from 6 to 12 months.

Thanks to their thermal resistances that are higher than the one of PET, PEIT is well adapted for hot filling applications. Containers of PEIT can be made without vacuum panels, which offers a design flexibility that was not possible with PET.

POLYSORB® isosorbide can be applied for applications like hot fill and pasteurization by replacing aseptic filling.



PEIT can be recycled up to 50% mechanically.



POLYSORB® IN POLYESTER

OTHER APPLICATIONS

As POLYSORB® isosorbide increases the thermal resistance of PET, POLYSORB® can be used in technical applications such as tire cord where the thermal resistance is a key factor.



Thanks to POLYSORB®, PEIT exhibits better dyeability than PET. PEIT can be stained at a lower temperature than PET, reducing the energy consumption during the process. This is of high interest for applications such as carpets, seats or headliners.



PET



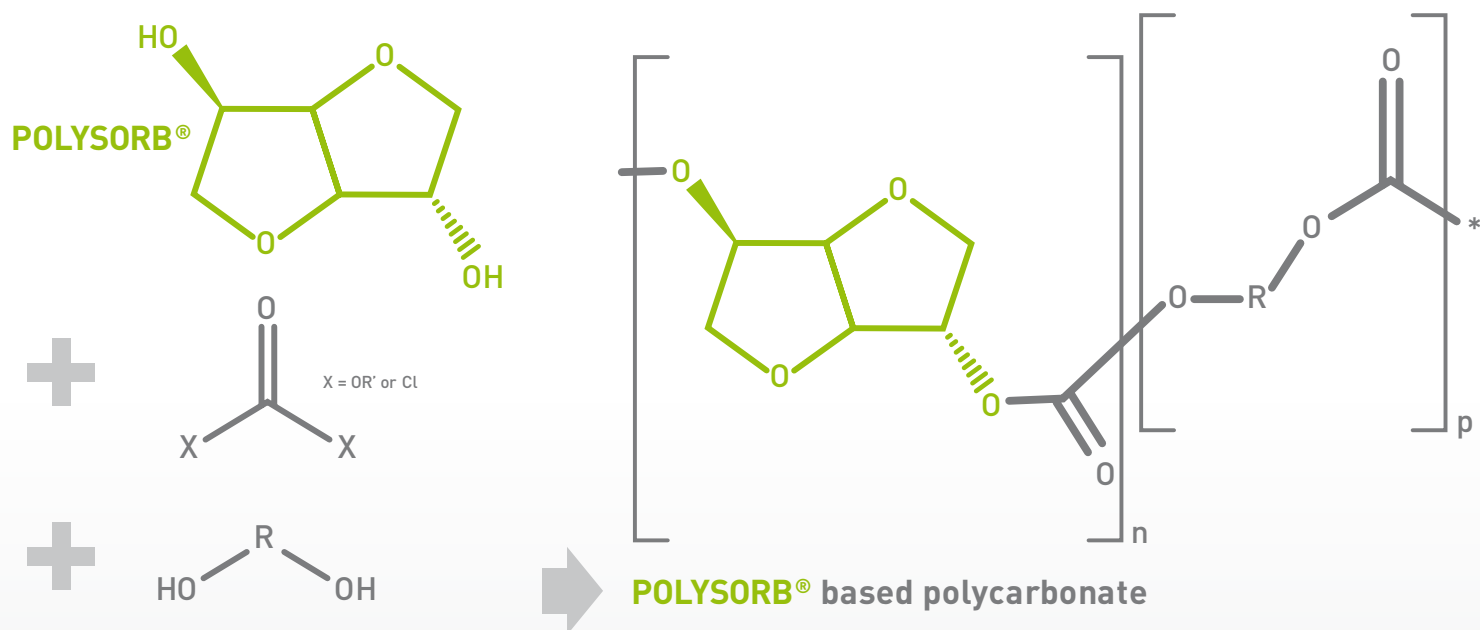
PEIT

Coloration temperature at 130°C

POLYSORB® IN POLYCARBONATE

POLYSORB® ISOSORBIDE IS MORE THAN JUST A DROP-IN SOLUTION TO REPLACE BISPHENOL A!

REACH compliant • No toxicity • Non-carcinogenic activity



POLYSORB® IN POLYCARBONATE

OPTIMIZING OPTICAL PROPERTIES AND UV RESISTANCE

POLYSORB® isosorbide is an alternative to bisphenol A, but it is more than just a drop-in solution.

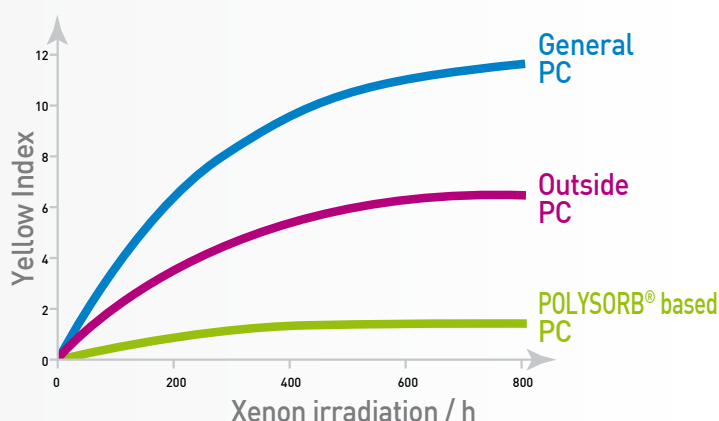
POLYSORB® based polycarbonate exhibits excellent mechanical strengths, scratch resistance, heat resistance, a small refractive index, a large Abbe number, small birefringence and excellent transparency. Thanks to removing aromatic parts from polycarbonate, it can be used for automotive and outdoor applications because of its very good resistance to UV.

OPTICAL PROPERTIES

	POLYSORB® based PC	Usual PC	PMMA
Refractive index	1.500	1.584	1.491
Abbe number	64	32	55
Light transmittance	92%	90%	92%

POLYSORB® based polycarbonate is the best compromise between PMMA and BPA-based polycarbonate.

UV RESISTANCE



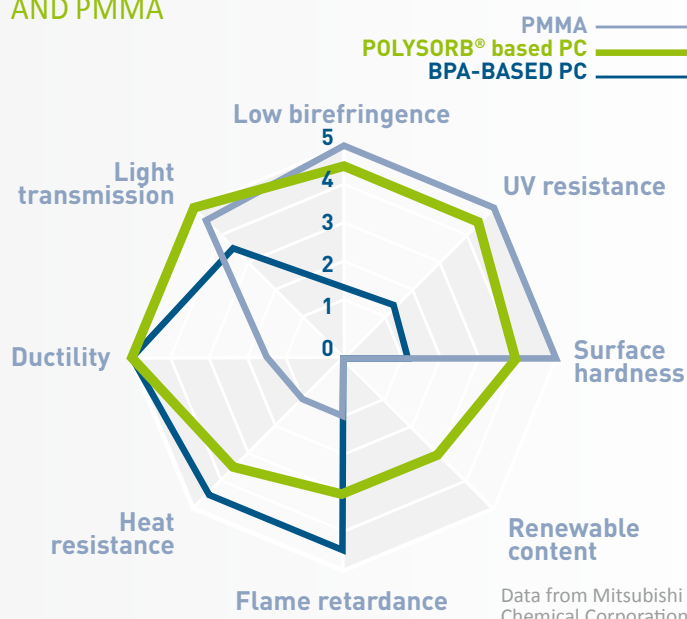
Xenon weather meter

Irradiation intensity: 180 W/m² (300-400 nm)

B.P.T. 53°C; humidity 50%

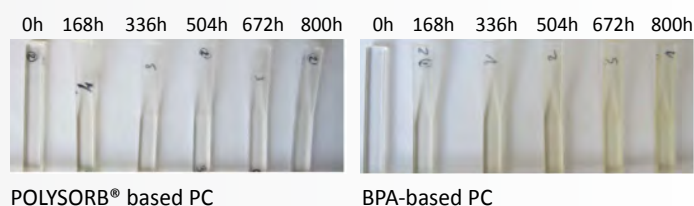
Data from Mitsubishi Chemical Corporation and Teijin

POLYSORB® BASED PC COMPARED TO BPA-BASED PC AND PMMA



UV STABILITY

UV aging test according to ISO 4892-2/A
(Xenon light 60W / m²)



Removing aromatic parts from polycarbonate allows its use for outdoor applications.

POLYSORB® IN POLYCARBONATE

OPTIMIZING IMAGE AND LIGHT QUALITY

Thanks to the low optical birefringence of POLYSORB® isosorbide-based polycarbonate and its simultaneously high Abbe number, light dispersion is kept to a minimum. As a result, the occurrence of optically disturbing color fringes on the periphery of the product is avoided.



Touch screen: high image quality thanks to high transparency and low birefringence and high resistance to scratches.



Optics: optimal light transmittance, impact and UV resistance.

OPTIMIZING SCRATCH RESISTANCE AND REDUCING VOC EMISSION

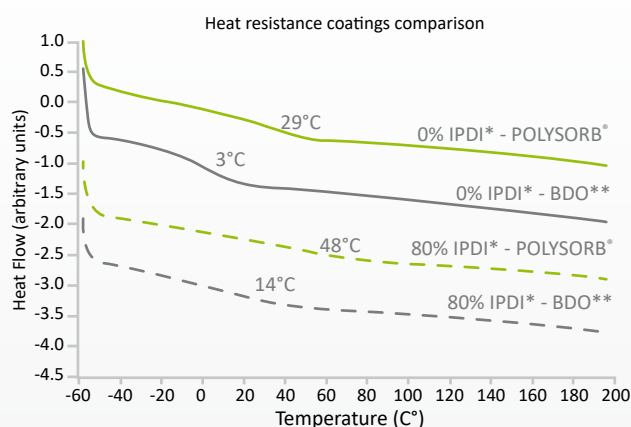
- POLYSORB® based polycarbonate has a hard surface which makes POLYSORB® based polycarbonate highly resistant to scratch when compared to bisphenol A based polycarbonate. This eliminates the need for coating.
- POLYSORB® based polycarbonate is also highly colorable, with an excellent pigment dispersion that makes the need for painting unnecessary.
- With POLYSORB® based polycarbonate, high gloss colored parts for automotive interior and exterior components are obtained with reduced VOC emission.

POLYSORB® IN PU COATINGS

In PU coatings, POLYSORB® isosorbide could be used as a chain extender in replacement of the commonly used 1,4-butanediol.

HIGHER HEAT RESISTANCE

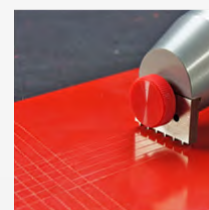
Thus, in comparison to BDO-based PU, POLYSORB® brings a higher heat resistance judging from its higher T_g (graph).



IMPROVED ADHESION

Also, the adhesion of the **aluminum Q-panel** is **improved** with the formulation containing isosorbide.

Practical adhesion test
ISO 2409



Cross cuts
+ tape peeling



POLYSORB® based



BDO-based

ISO score	0	1	2	3	4	5
Surface aspect						

(-) Good (+) Poor

Finally, POLYSORB® based PU coatings show higher impact resistance. Contrary to the BDO-based coating, when the ball drops on the support, both the Q-panel and the coating deforms without any breakage.

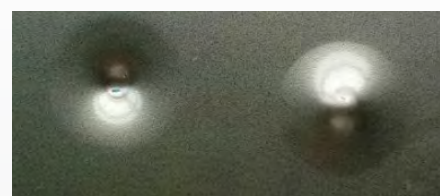


BDO-based



Red coloration, indicating copper oxidation
= coating failure

POLYSORB® based



No breakage

POLYSORB® IN EPOXY

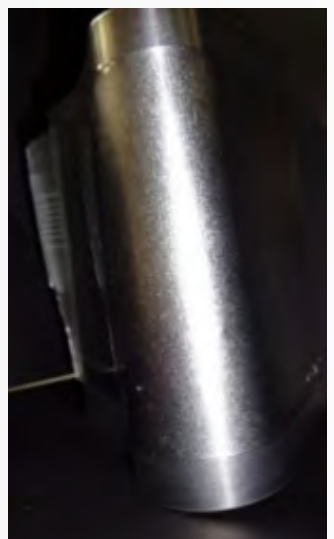
In epoxy resins, POLYSORB® isosorbide-based diglycidyl ether can provide a substitute to replace toxic bisphenol A based diglycidyl ether (DGEBA).

In comparison with DGEBA, POLYSORB® based diglycidyl ether offers an **improved aspect** due to lower carbonation, provides **better resistance to UV** and **has the ability to solubilize in water**. In a more general manner, POLYSORB® brings **high adhesion and mechanical resistance to coatings**.

CONICAL MANDREL BENDING TEST

The bending tests were made on epoxy amine based coating after application on a normalized Q-panel. The bending of the panel with a conical mandrel shows **superior resistance to deformation and superior adherence to the Q-panel** of the POLYSORB® based coating.

POLYSORB® based epoxy coating

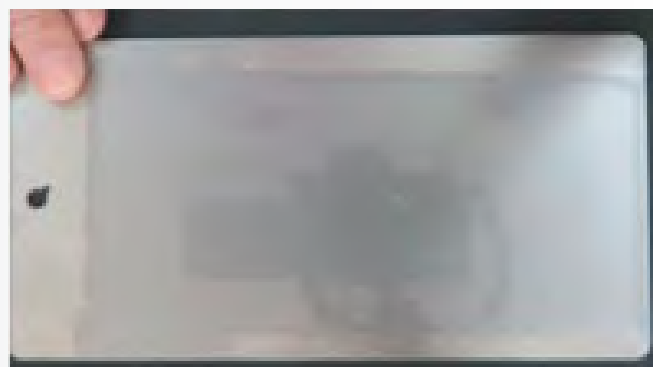


BPA-based epoxy coating



ADHESION TEST

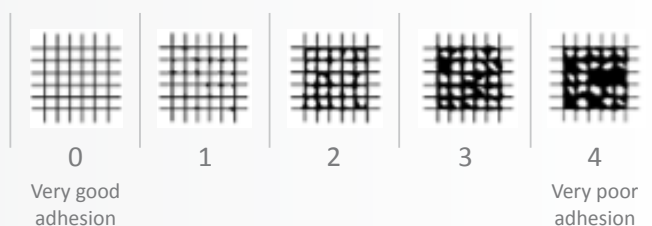
In this second test, the same epoxy amine formulation was evaluated with a cross cutter test. Once again, the POLYSORB® based epoxy coating shows better adhesion than the reference.



POLYSORB® based epoxy



BPA-based epoxy



POLYSORB® IN EPOXY

HIGH TOUGHNESS AND IMPACT RESISTANCE

Toughness improvement versus DGEBA* and TGETMP**

EPOXY	HARDENER	K1c (Mpa.m ^{1/2})
DGEISO***	IPDA	1.3 (0.15)
DER 332	IPDA	0.74 (0.05)
80% DER 332 + 20% DGEISO***	IPDA	0.85 (0.04)
TGETMP**	IPDA	1.02 (0.07)
80% TGETMP** + 20% DGEISO***	IPDA	1.15 (0.08)

* DGEBA (Bisphenol A diglycidyl ether) **TGETMP (Trimethylolpropane triglycidyl ether) ***DGEISO (Isosorbide diglycidyl ether)

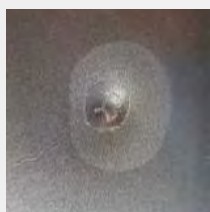


Impact test ISO 6272



Impact resistant

Face



Reverse



DGEBA + IPDA

Face



Reverse

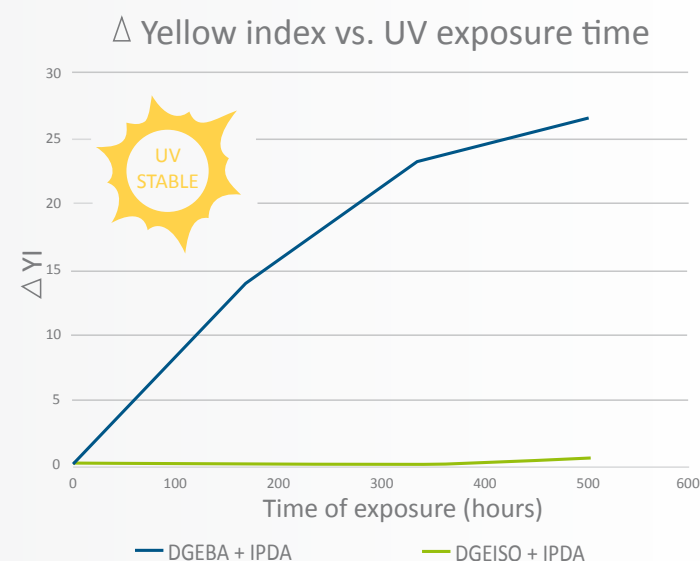


DGEISO + IPDA

UV STABILITY

The epoxy-amine formulation is subjected to aging under UV light. In this case, the replacement of aromatic parts of the epoxy-resin allows retention of the original coating coloration.

UV stability improvement with DGEISO

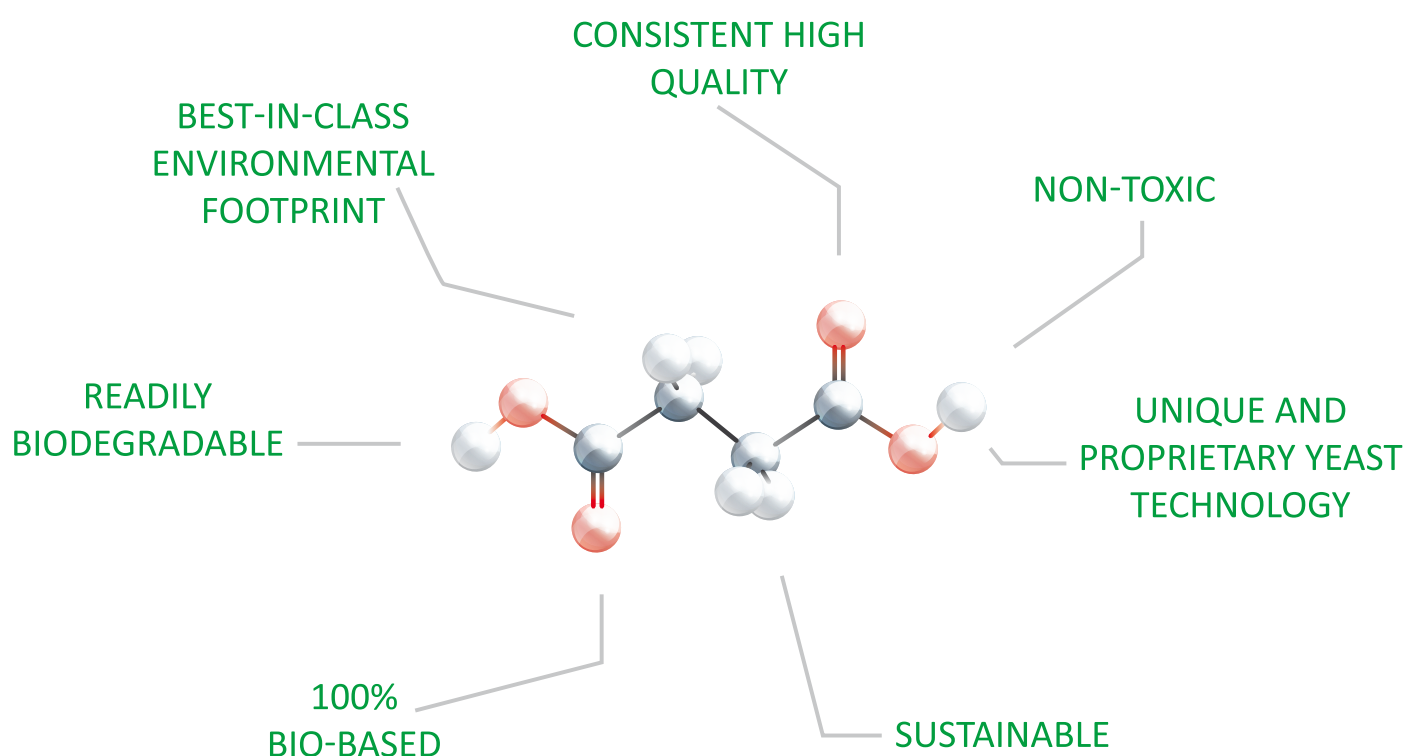


PRODUCTS OVERVIEW

WHAT IS BIOSUCCINIUM® BIO-SUCCINIC ACID AND WHAT CAN IT DO FOR YOU?

Innovate sustainably with BIOSUCCINIUM® bio-succinic acid

From packaging to footwear markets, BIOSUCCINIUM®, 100% bio-based succinic acid, allows customers to choose a bio-based material with an improved environmental footprint to develop superior sustainable products.



BIOSUCCINIUM® typically has a **purity level similar or higher than petro-based acids**, and it is **odor free**. High quality and purity are especially essential for demanding applications where, for example, color and performance is important.

BIOSUCCINIUM® is based on renewable feedstocks and provides a more **favorable environmental footprint** (measured via cradle-to-gate Life Cycle Analysis methodology) compared to alternative chemicals such as petro-based succinic acid and adipic acid. It helps to produce more sustainable materials and products in many markets.








PRODUCTS OVERVIEW

BIOSUCCINIUM® BIO-SUCCINIC ACID RANGE AND SPECIFICATIONS

	BIOSUCCINIUM®	BIOSUCCINIUM® S
Characteristics	100% bio-based succinic acid	100% bio-based succinic acid certified for halal, kosher and 100% natural origin by ECOCERT
Application	packaging, coating resins, polymer modification	high quality chemical intermediate for pharma, cosmetics and food
Color	crystalline	crystalline
Type	powder	powder
Succinic	99.5% min.	99.5% min.
Water content	0.5% max	0.3% max

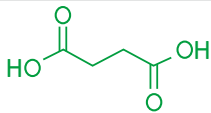
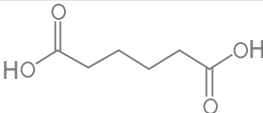
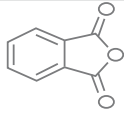
APPLICATIONS FOR BIOSUCCINIUM®

Enabling more sustainable opportunities in many markets

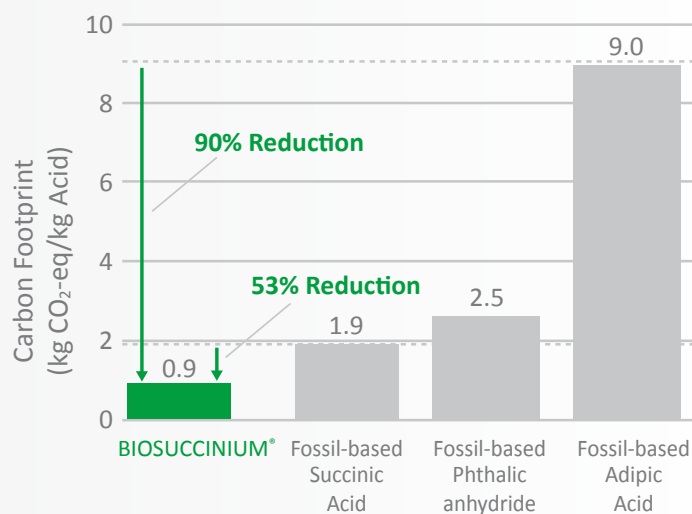
Polyurethanes					Resins	
Running Shoes 	Automotive Textiles 	Wheels 	Wood and Furniture Coatings 	Construction 	Coating Resins 	Composite Resins 
Polybutylene Succinate (PBS)					1,4 BDO/THF	
Plastic Utensils 	Disposable Cups 	Food Packaging 	Agricultural Films 	Non-woven Fibers 	Elastic Fibers 	Engineering Plastics 
Pyrrolidones		Miscellaneous			Plasticizers	
Solvents 	Cables 	Pharmaceuticals 	Food Flavor 	Metal Plating 	Lubricants 	Polymer Modification 

PRODUCTS OVERVIEW

A PLANT-BASED ALTERNATIVE FOR FOSSIL-BASED CHEMICALS SUCH AS ADIPIC ACID

	Succinic acid	Adipic acid	Phthalic anhydride
Molecular formula	$C_4H_6O_4$	$C_6H_{10}O_4$	$C_6H_4(CO)_2O$
Molecular structure			
Molecular mass (g/mol)	118,1	146,1	148,1
Melt temperature (°C)	184	152	131
Bio-based content (%)	100	0	0
Carbon footprint (kg CO ₂ -eq/kg acid)	0.9	1.9	1.7-2.5

BIOSUCCINIUM®, sustainable bio-succinic acid, is **produced from renewable, plant-based resources** which are converted via a unique low pH yeast process, a biotechnology process. It allows customers to choose a bio-based alternative with an **improved environmental footprint** for a broad range of applications, from packaging to footwear. The availability of bio-based succinic acid will also open new applications like (non-phthalate) plasticizers, resins and polyester polyols for polyurethanes.



* Executed by the Copernicus Institute at Utrecht University, the Netherlands. Data is published as an early view (August 2013).

BIOSUCCINIUM® IN BIODEGRADABLE PLASTICS

ENABLING BIO-BASED PBS

BIOSUCCINIUM®, a 100% bio-based succinic acid, enables the production of a partially bio-based **PBS (polybutylene succinate)** with a substantially reduced carbon footprint. PBS is a biodegradable polymer that can be used as a single polymer or in compounds for both durable and biodegradable applications such as packaging.

BIOSUCCINIUM® can also be used as a source for 1,4-butanediol to generate fully bio-based PBS.

GOOD FLEXIBILITY, HEAT RESISTANCE, EXCELLENT PROCESSABILITY AND SHORT CYCLES

PBS can be used as a stand-alone polymer or in compounds to optimize physical properties for both biodegradable as well as durable applications. PBS is commonly used in compounds with PLA and/or starch, to improve flexibility, reduce brittleness, increase heat resistance and/or tune rate of biodegradation.

APPLICATION POTENTIAL

PBS allows for a wide range of applications.

Disposables



Non-woven



Agricultural film



Packaging



Cutlery



Durable application



BIOSUCCINIUM® IN POLYURETHANES




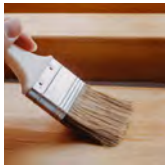

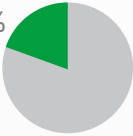
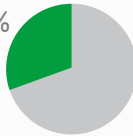
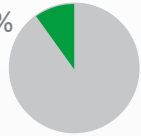
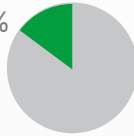
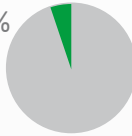





A GREEN DI-ACID FOR POLYESTER POLYOLS

Polyurethanes are manufactured from isocyanates and polyols. Polyester polyols are one of two types of polyols used in polyurethanes, and they are typically made from di-acids, such as adipic acid, and glycols.

By using BIOSUCCINIUM® bio-succinic acid as a “green” di-acid to produce the polyester polyol, polyurethane made from this more sustainable polyol has a greatly improved environmental footprint. Subsequently, polyurethane products containing BIOSUCCINIUM® are at least partially bio-based, requiring less from the earth’s limited fossil resources, as well as delivering a reduction in greenhouse gas emissions. Polyurethanes are formulated for performance in their respective applications, and the successful use of BIOSUCCINIUM® based polyester polyols has been demonstrated in many polyurethane applications.

ENVIRONMENTAL IMPACT

Indications of the potential sustainability improvements through the use of BIOSUCCINIUM® in polyurethane materials.

Use					
Polyurethane type	Thermoplastic	Flexible Foam	Elastomers	Coatings	Adhesives
Renewable Content	25% 	30% 	10% 	5% 	5% 
CO ₂ Reduction	20% 	45% 	30% 	15% 	20% 

Executed by the Copernicus Institute at Utrecht University, the Netherlands. Data is published as an early view (August 2013). The adipic acid data is reflects a best in class plant with 98% N2O abatement.

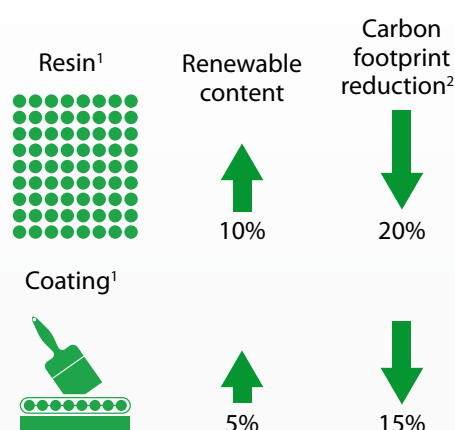
BIOSUCCINIUM® IN RESINS AND COATINGS

A GREEN DI-ACID

By using BIOSUCCINIUM® bio-succinic acid as a “green” di-acid to produce resins, coatings, adhesives or sealants, you will be able to manufacture products with a reduced carbon footprint thus enabling a **reduction in greenhouse gas emissions**.

Additionally, products containing BIOSUCCINIUM® are at a minimum partially bio-based, **requiring less from the earth's limited fossil resources**. The process to manufacture BIOSUCCINIUM® is also environmentally sensitive. It uses non-fossil raw materials, sequesters carbon dioxide (CO₂), is **energy efficient, and does not produce unnecessary by-products**. Opportunities have been successfully identified for using BIOSUCCINIUM® as raw material for alkyd, polyester, polyurethane and composite resins.

Improving the environmental footprint of resins and coatings by replacing fossil-based adipic acid with BIOSUCCINIUM® bio-succinic acid

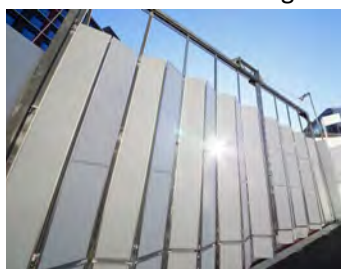


¹ The case assumes a typical formulation, i.e., adipic acid content 10 w% and 5 w% in the resin and finished coating product respectively.

² The carbon footprints of the resin and coating are assumed at values of 4 and 3 kg CO₂ eq./kg product respectively.

Thus, BIOSUCCINIUM® presents a wide range of new market opportunities for more sustainable architectural coatings, product finishes, special purpose coatings, bio-based adhesives and sealants. Roquette welcomes a more specific technical evaluation of BIOSUCCINIUM® for your particular application.

Architectural Coatings



Special Purpose Coatings



Solvents



Product Finishes



Adhesives and Sealants



Pigments



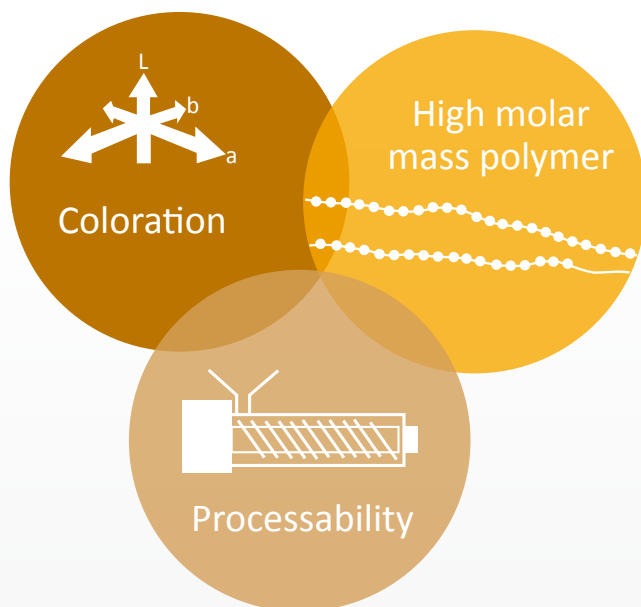
Plasticizers



SERVICES

WE CAN SUPPORT YOU FOR TECHNICAL CHALLENGES

We can give you useful tips to improve processing polymer. Adapting process parameters and limiting water uptake can result a better quality product.



How to manage low reactivity

How to manage discoloration

How to improve to adapt the processing

ROQUETTE MAKES IT POSSIBLE

Our dedicated team for production, quality and technical experts assure you to go to market quickly and support you to be successful.



Production site of POLYSORB® isosorbide
Lestrem, France



Production site of BIOSUCCINIUM® bio-succinic acid
Cassano, Italy

CONTACT US



CONTACT US

For more information, please contact us at:

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