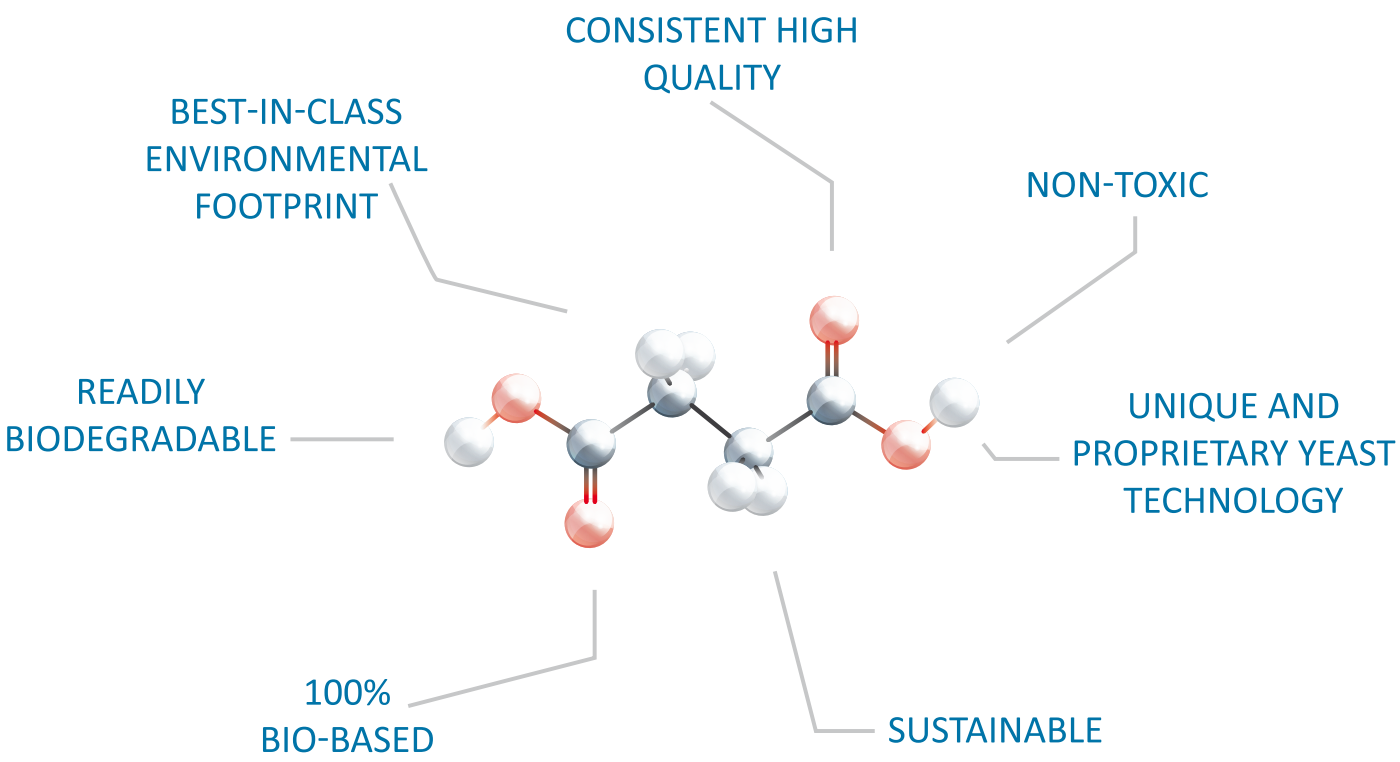
BIOSUCCINIUM®
bio-based succinic acid by Roquette

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.

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

Running Shoes

Automotive Textiles

Wheels

Wood and Furniture Coatings

Construction

Resins

Coating Resins

Composite Resins

Polybutylene Succinate (PBS)

Plastic Utensils

Disposable Cups

Food Packaging

Agricultural Films

Non-woven Fibers

1,4 BDO/THF

Elastic Fibers

Engineering Plastics

Pyrrolidones

Solvents

Cables

Miscellaneous

Pharmaceuticals

Food Flavor

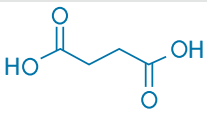
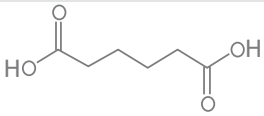
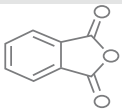
Metal Plating

Lubricants

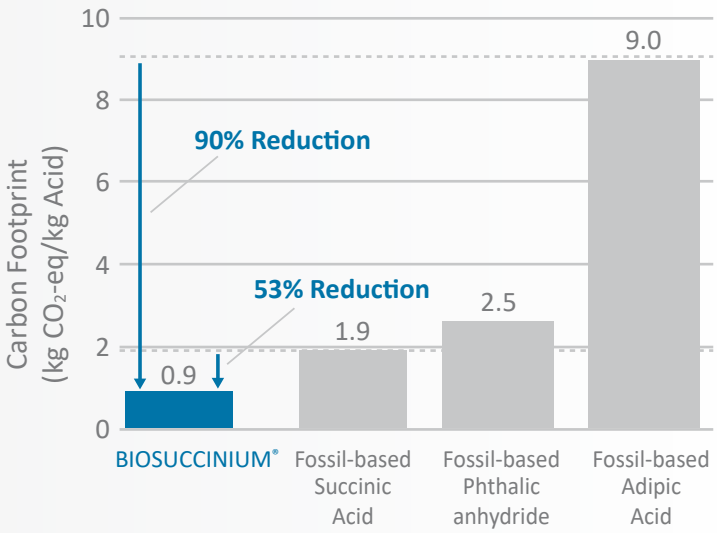
Plasticizers

Polymer Modification

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	0
Carbon footprint (kg CO_2-eq/kg acid)	**0.9**	1.9	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).

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

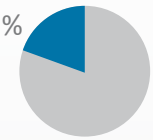
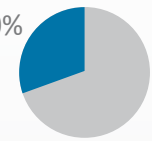
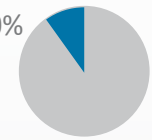
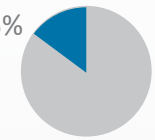
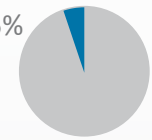
A GREEN DI-ACID FOR POLYESTER POLYOLS

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	Running Shoes 	Automotive Textiles 	Wheels 	Wood and Furniture Coatings 	Construction 
Polyurethane type	Thermoplastic	Flexible Foam	Elastomers	Coatings	Adhesives
Renewable Content	25% 	30% 	10% 	5% 	5% 
CO_2 Reduction	20% 	45% 	30% 	15% 	20% 

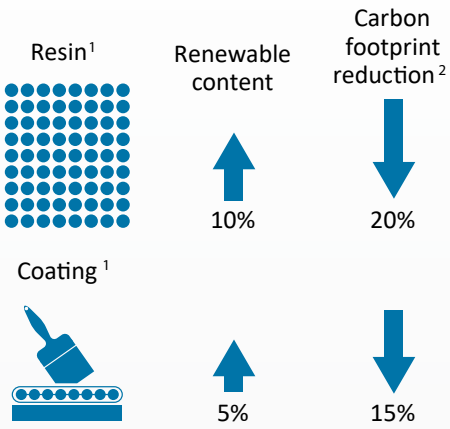
Executed by the Copernicus Institute at Utrecht University, the Netherlands. Data is published as an early view (August 2013).
The adipic acid data is reflects a best in class plant with 98% N2O abatement.

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 (CO_2), 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

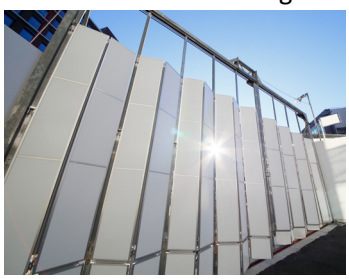


[1] The case assumes a typical formulation, i.e., adipic acid content 10 w% and 5 w% in the resin and finished coating product respectively.

[2] The carbon footprints of the resin and coating are assumed at values of 4 and 3 kg CO_2 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

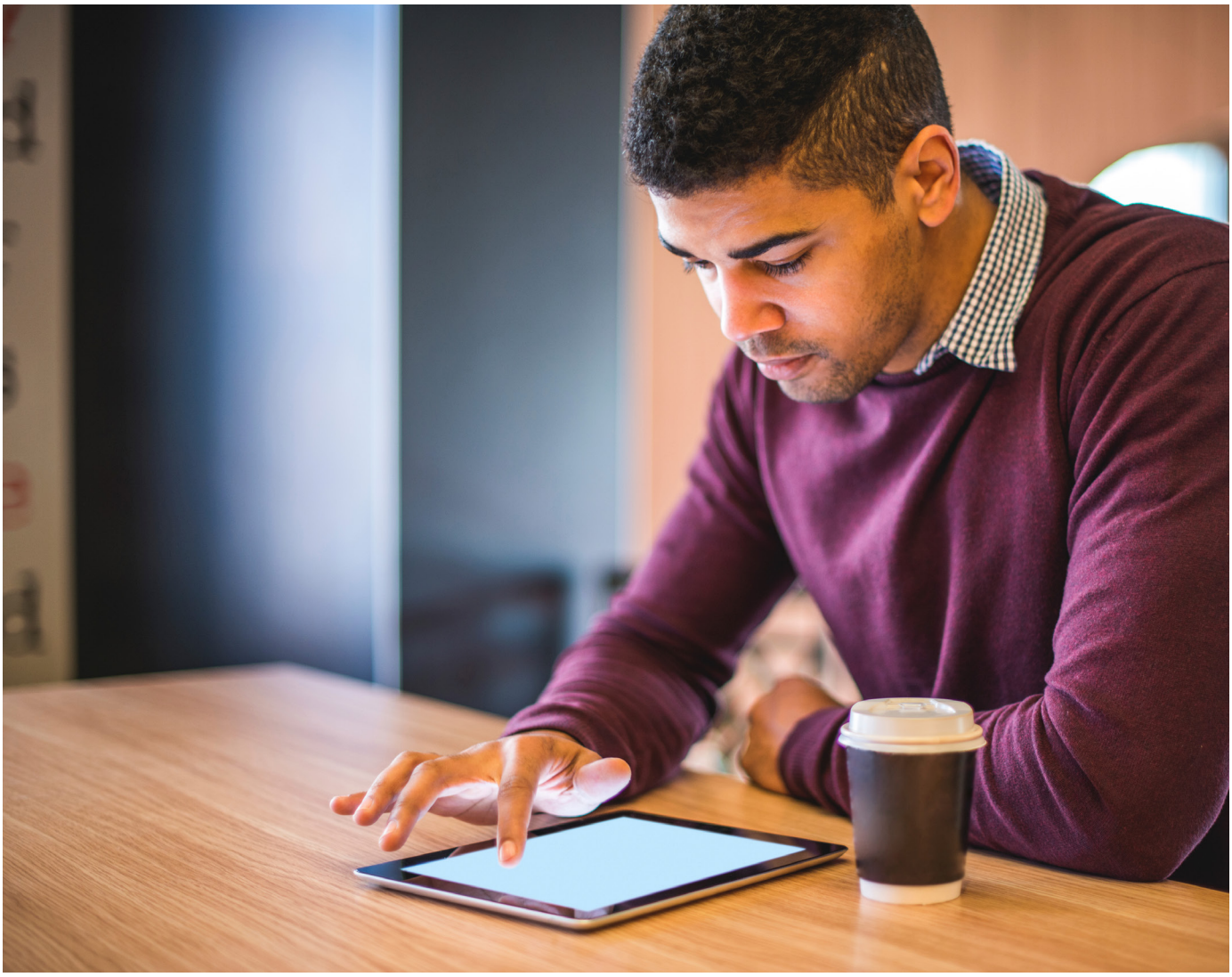
Solvents

Product Finishes

Adhesives and Sealants

Pigments

Plasticizers



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