

ENABLING SUSTAINABLE MATERIALS



BIOSUCCINIUM®, A 100% BIO-BASED SUCCINIC ACID, ENABLES MORE SUSTAINABLE MATERIALS AND PRODUCTS

WHAT IS BIOSUCCINIUM®

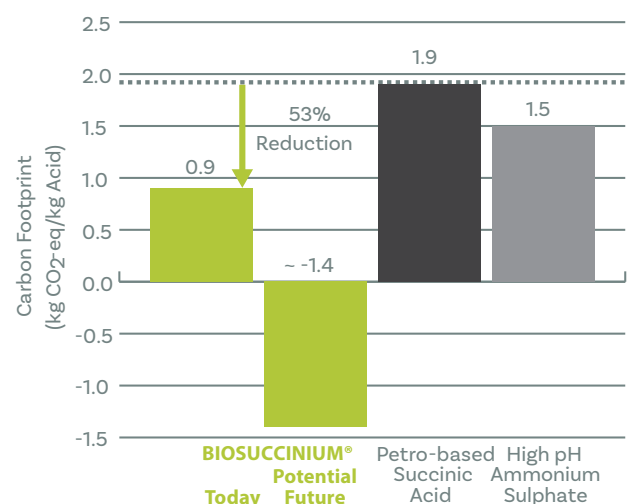
A plant-based alternative for fossil-based chemicals such as adipic acid

BIOSUCCINIUM® sustainable succinic acid is produced from renewable, plant-based resources which are converted via a unique low pH yeast process, a biotechnology process. BIOSUCCINIUM® offers an alternative to chemicals such as fossil-based succinic acid and adipic acid. It allows customers to choose a bio-based alternative with an improved environmental footprint for a broad range of applications, from packaging to footwear. Succinic acid today is produced from fossil resources. It is used in a variety of industry applications, such as solvents, pigments, food flavors and the emerging market for biodegradable polybutylene succinate (PBS). The availability of bio-based succinic acid will also open new applications like (non-phthalate) plasticizers, resins and polyester polyols for polyurethanes.

BIOSUCCINIUM® is renewable and provides an improved environmental footprint

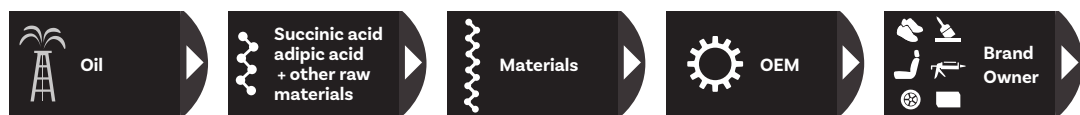
BIOSUCCINIUM® is not only renewable but also provides a more favorable environmental footprint compared to alternative petro-based chemicals. BIOSUCCINIUM® contributes to limiting the impact on climate change and reducing the dependence on the world's limited fossil resources (see figure 2). These sustainability aspects are becoming increasingly important to downstream customers who are more and more faced with new, more stringent environment regulations and increasing consumer demand for more sustainable products. With BIOSUCCINIUM® their products can become more environmentally friendly.

Figure 2: The Carbon Footprint of BIOSUCCINIUM® vs. Alternative Succinic Acid*



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

Chemicals Industry Based on Oil to Produce Petro-based Chemicals



BIOSUCCINIUM® Replaces Petroleum-based Chemicals



Figure 1: Bio-Based BIOSUCCINIUM® is an Alternative to Fossil-Based

BIOSUCCINIUM® PROVIDES UNIQUE VALUE FOR DEVELOPMENT OF SUSTAINABLE MATERIALS

Consistent, High Quality Product

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

Reliable Future Supply

Reliable supply means consistent high quality and logistics in the short- and long-term. Roquette has been developing, producing and supplying bio-based products globally for decades.

Sustainable

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 enables to produce more sustainable materials and products in many markets.

Unique and Proprietary Yeast Technology

Yeast technology to convert bio-based feedstock into succinic acid is unique. The novel process is simple, stable, energy efficient and since operated at low pH values, it generates very little waste (no salts). This results in a unique, high quality product with a best-in-class environmental footprint and economics.

ENABLING MORE SUSTAINABLE OPPORTUNITIES IN MANY MARKETS

Polyurethanes

Running shoes



Automotive textiles



Wheels



Wood & furniture coatings



Construction



Resins

Coatings 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



RENEWABLE FEEDSTOCK

The choice of feedstock for BIOSUCCINIUM® production is critical to both production cost and the environment. Roquette is using agricultural feedstocks, starch from corn dedicated solely for industrial products. Developments are ongoing to implement technologies using agricultural residues, once commercially available. The use of available feedstocks with fermentation technology offers an environmentally friendly solution and next generation feedstocks hold the promise to even further improve sustainability.

BIOSUCCINIUM® SPECIFICATIONS

Table 1: BIOSUCCINIUM® Specifications

Parameter	Specification	Analytic methods*
Appearance	White crystalline powder	MCL 086G – Visual
Water content	≤0.5w%	MCL 006A – Titrimetric
Purity (dry basis)	≥ 99.5 w%	MCL 1462 – HPLC
Other (small) organic acids	≤ 0.1 w% each ≤ 0.5 w% total	MCL 146106A MCL 14611 – HPLC
Iron	≤ 5 ppm	ICP

*Analytical methods by Roquette

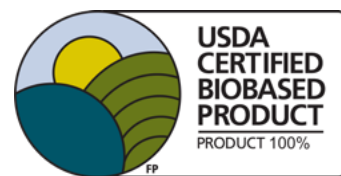
HOW TO ORDER BIOSUCCINIUM®

Production

BIOSUCCINIUM® is available in commercial quantities from the first large scale commercial production plant, located in Cassano, Italy. Samples for evaluation are available, as well. 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 licence from DSM. Please contact Roquette at www.roquette.com for more information.

USDA CERTIFICATION

Roquette has earned the U.S. Department of Agriculture (USDA) Certified Biobased Product label. The product, BIOSUCCINIUM® succinic acid, is now able to display a unique USDA label that highlights its percentage of biobased content. It shows that BIOSUCCINIUM® contains 100% USDA certified biobased content.



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