reverdia

sustainable solutions
powered by DSM + Roquette

enabling sustainable materials

biosuccinium®

sustainable succinic acid

enabling
sustainable materials

biosuccinium®
sustainable succinic acid

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

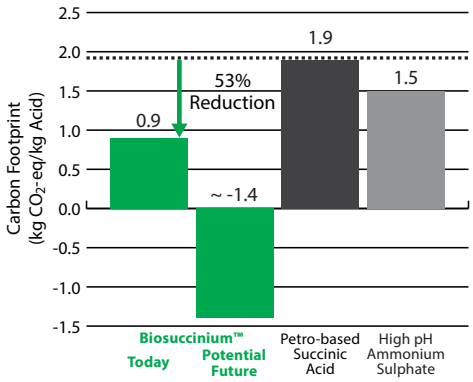
Biosuccinium sustainable succinic acid is produced from renewable, plant-based resources which are converted via a unique low pH yeast process, a biotechnology process. This novel process was developed by Reverdia, a joint venture between DSM and Roquette. Biosuccinium offers an alternative to chemicals 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.

Biosucciniinium is renewable and provides an improved environmental footprint

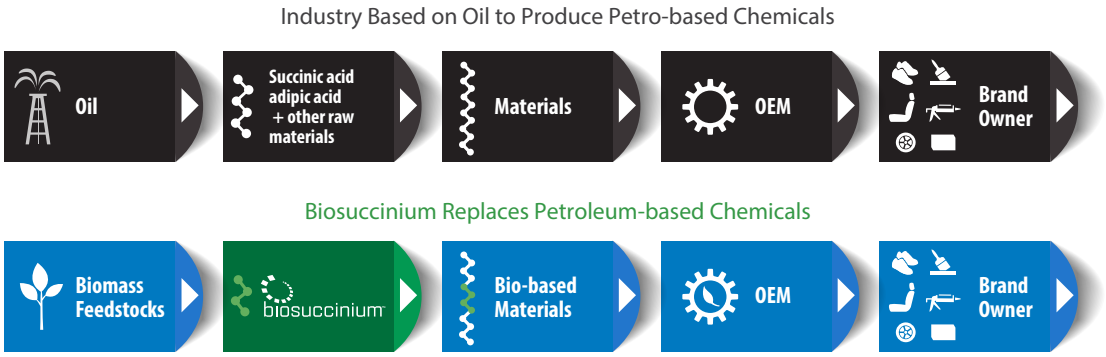
Biosuccinium is not only renewable but also provides a more favorable environmental footprint compared to alternative petro-based chemicals. Biosuccinium contributes to limiting the impact on climate change and reducing the dependence on the world's limited fossil resources (see figure 2). These sustainability 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).

Figure 1: Bio-Based Biosuccinium is an Alternative to Fossil-Based Chemicals



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 is especially essential for demanding applications where for example color and performance is important. Reverdia's 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 for Reverdia means consistent high quality and logistics in the short- and long-term. Reverdia is powered by the experience and capabilities of DSM and Roquette. These two large international companies have been developing, producing and supplying bio-based products globally for decades.

Stable Pricing

Reverdia offers stable pricing, both in the short- and long term. This helps our customers to reduce the impact from the increasing prices and volatility of petrochemical raw materials.

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 petrobased succinic acid and adipic acid. It enables to produce more sustainable materials and products in many markets.

Unique and Proprietary Yeast Technology

Reverdia is the first and only company commercially employing yeast technology to convert bio-based feedstock into succinic acid. 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-wovens Fibers

1,4 BDO/THF

Elastic Fibers

Engineering Plastics

Pyrrolidones

Solvents

Cables

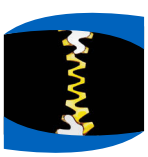
Miscellaneous

Pharmaceuticals

Food Flavor

Metal Plating

Lubricants



Plasticizers

Polymer Modification

RENEWABLE FEEDSTOCKS

The choice of feedstock for Biosuccinium™ production is critical to both production cost and the environment. Reverdia is using agricultural feedstocks that are currently available, 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 Reverdia

HOW TO ORDER BIOSUCCINIUM

Availability

Biosuccinium is available in commercial quantities from the first large scale commercial production plant (~10 kta capacity), located in Cassano Spinola, Italy. Samples for evaluation are available, as well.

For More Information

Please contact Reverdia at info@reverdia.com or visit www.reverdia.com for more information.

ABOUT REVERDIA

Reverdia is a joint venture between Royal DSM, the global Life Sciences and Materials Sciences company, and Roquette Frères, the global starch and starch-derivatives company. Reverdia is dedicated to be the global leader in the market for sustainable succinic acid, focusing on market development by establishing partnerships with direct and indirect customers, building on customer needs and Reverdia's strengths.

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