

ENABLING SUSTAINABLE RESINS AND COATINGS

INTRODUCTION

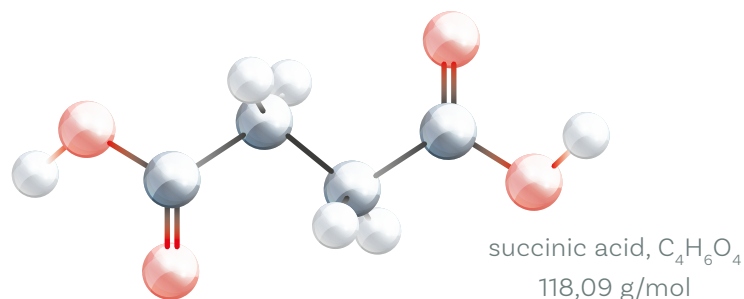
BIOSUCCINIUM®, a 100% bio-based succinic acid, enables resin, coating, adhesive and sealant products with lower environmental footprint.

A UNIQUE RENEWABLE RAW MATERIAL

A 100% bio-based alternative to traditional chemicals

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, adipic acid or terephthalic, conventional raw materials used for resins, coatings, adhesives, and sealants. BIOSUCCINIUM® brings the coatings, adhesives and sealants industry the opportunity to create unique, high quality and sustainable products (see figure 1).

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



BIOSUCCINIUM® IN RESINS AND COATINGS

A “green” di-acid

By using BIOSUCCINIUM® as a “green” di-acid to produce resins, coatings, adhesives or sealants you will be able to manufacture products with a reduced carbon footprint (see figure 2) 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 (see figure 3). 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 (figure 4). In addition, chemical derivatives of succinic acid, which are in part biobased, provide alternative sustainable solutions to the chemicals industry.

These are in various stages of development:

- Dimethyl succinate (DMS), branded Provichem®2511 Eco provided by Proviron⁽⁴⁾
- BIOSUCCINIUM® based polyester polyols⁽⁵⁾
- Plasticizers based on BIOSUCCINIUM®⁽⁶⁾
- Quinacridone and DPP pigments⁽⁶⁾

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.

Figure 2: Reduction of the Carbon Footprint Using BIOSUCCINIUM® vs. Petrochemical Adipic Acid⁽¹⁾

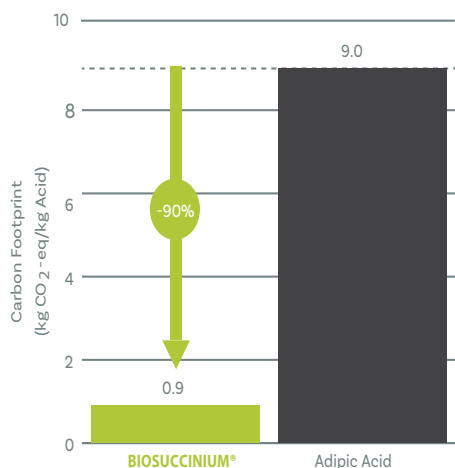


Figure 3: Improving the Environmental Footprint of Resins and Coatings by Replacing Fossil-based Adipic Acid with BIOSUCCINIUM® Succinic Acid

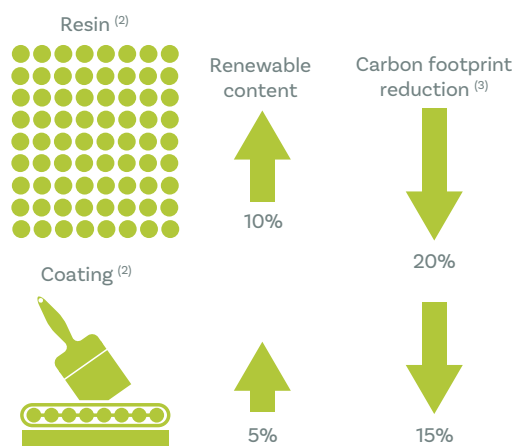
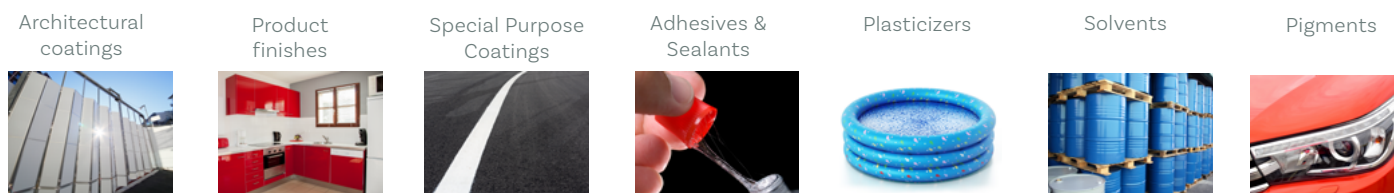


Figure 4: BIOSUCCINIUM® Finds Potential Uses in a Broad Range of Markets



(1) 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.
 (2) The case assumes a typical formulation, i.e. adipic acid content 10 w% and 5 w% in the resin and finished coating product respectively
 (3) The carbon footprints of the resin and coating are assumed at values of 4 and 3 kg CO₂ eq./kg product respectively
 (4) For more information contact Proviron on www.provion.com or www.provion.com/product/provichem-2511-eco-dms
 (5) Refer to the BIOSUCCINIUM® Polyester Polyols and Thermoplastic Polyurethanes Data Sheet
 (6) Request more information from your supplier or contact Roquette directly

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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