



enabling sustainable
polyurethanes



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Biosuccinium™ sustainable succinic acid is a 100% bio-based succinic acid that enables customers to manufacture polyester polyol-based polyurethane products with substantially lower environmental footprints.

A NEW RENEWABLE RAW MATERIAL

A plant-based alternative for fossil-based succinic acid and adipic acid

Biosuccinium™ sustainable succinic acid is produced from renewable, plant-based resources which are converted via fermentation, 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. Adipic acid is a conventional raw material used for the production of polyester polyols and polyurethanes. With Biosuccinium™, Reverdia offers polyester polyol and polyurethane producers the opportunity to create unique, high quality and sustainable polyurethanes (see figure 1).

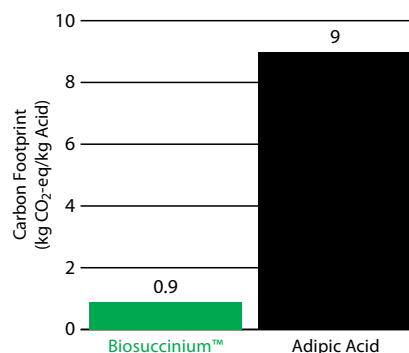
BIO-SUCCINIUM™ IN POLYURETHANES

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 and glycols.

By using Biosuccinium™ 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 and renewable, requiring less from the earth's limited fossil resources, as well as delivering a reduction in greenhouse gas emissions (see figures 2 and 3).

Figure 2: Reduction of the Carbon Footprint Using Biosuccinium™ vs. Petrochemical Adipic Acid*



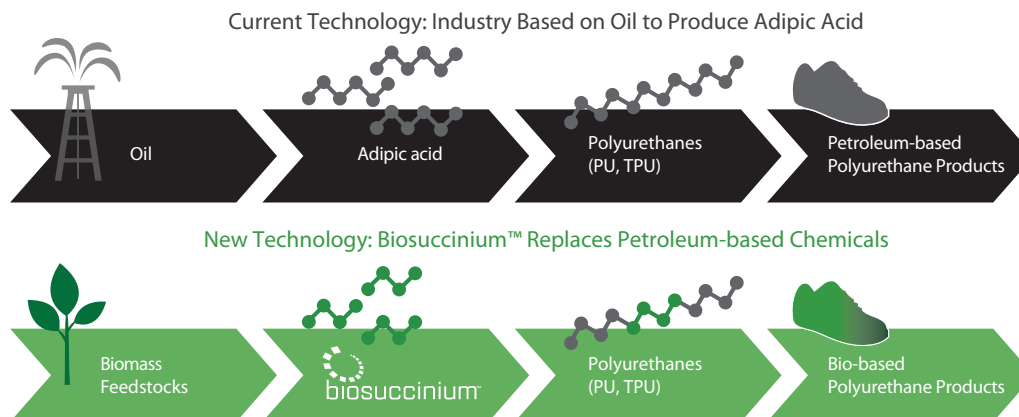
* This Biosuccinium™ study was executed by the Copernicus Institute at Utrecht University, the Netherlands. Data is pending publication. The adipic acid data is executed by DSM for a best in class plant with 98% N₂O abatement.

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.

Polyurethanes are formulated for performance in their respective applications and the use of Biosuccinium™-based polyester polyols is dependent on the desired performance of the polyurethane.

At Reverdia, we have successfully evaluated the feasibility of using Biosuccinium™ in various polyurethane applications, and we welcome a more specific technical evaluation of Biosuccinium™ for your particular application.

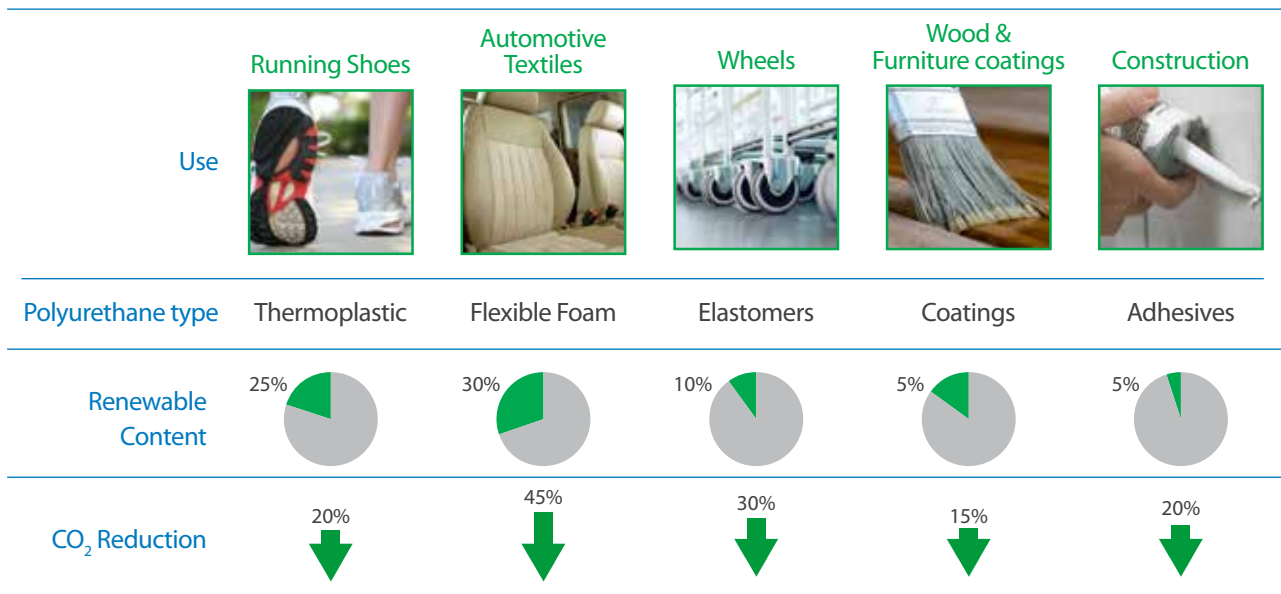
Figure 1: Bio-Based Biosuccinium™ is an Alternative to Fossil-based Chemicals



ENVIRONMENTAL IMPACT

Figure 3 displays examples indicative of sustainability improvements in typical applications through the use of Biosuccinium™ in polyurethane materials.

Figure 3: Examples of Biosuccinium™ Improving the Environmental Footprint of Polyurethanes



Renewable feedstocks

The choice of feedstock for Biosuccinium™ production is critical to both production cost and the environment. Today Reverdia is using agricultural feedstocks that are currently available, starch from corn dedicated solely for industrial products, with plans 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™—A UNIQUE VALUE PROPOSITION FOR THE POLYURETHANES INDUSTRY

Excellent Product Quality

The purity level of Biosuccinium™ is typically higher than petro-based acids and is odor-free. A high quality and purity is essential for applications where color and performance is important. Reverdia's unique production process generates very little impurities. Biosuccinium™ has been tested and validated to meet or exceed current product quality and purity standards.

Reliable Supply

Reliable supply for Reverdia means consistent quality, logistics and stable pricing. Reverdia is powered by the experience and technological capabilities of DSM and Roquette. These two large international companies have been supplying bio-based products globally for decades. Furthermore, Reverdia has validated, proven and optimized its unique and proprietary yeast-based fermentation technology in a 300 tons demonstration plant. This robust technology is used in our commercial scale production plant. This ensures a reliable process with a Biosuccinium™ product with consistent quality. Reverdia offers stable pricing, both in the short- and long-term.

Sustainable

Biosuccinium™ is not only renewable but also provides a more favorable environmental footprint (LCA) compared to alternative succinic acid and adipic acid products. This feature is becoming increasingly important to downstream customers to enable their products to become more environmentally friendly to meet new, more stringent environment regulations and increasing consumer demand for more sustainable products.

Unique and Proprietary Yeast Technology

Reverdia is the only company to use 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 produced with a best-in-class environmental footprint and economics.

ADDITIONAL MARKET APPLICATIONS

Biosuccinium™ drives a portfolio of more renewable materials in a broad range of markets (see figure 4) while at the same time substantially improving their environmental footprint. These markets include the production of polybutylene succinate (PBS), plasticizers, thermoset resins, solvents and many more.

Figure 4: Potential Biosuccinium™ Market Applications Beyond Polyurethanes



HOW TO ORDER BIOSUCCINIUM™ / SPECIFICATIONS

Table 1: Biosuccinium™ Specifications	
Parameter	Specification
Appearance	White crystalline powder
Water content	≤0.5w%
Purity (dry basis)	≥ 99.5 w%
Other (small) organic acids	≤ 0.1 w% each ≤ 0.5 w% total
Iron	≤ 5 ppm

Availability

Biosuccinium™ will soon become available in commercial quantities from the first large scale commercial production plant (10 kta capacity) in Cassano Spinola, Italy. The new facility is scheduled to be operational by the end of 2012.

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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