ABOUT SUCCINIC ACID
Succinic acid is used directly in a variety of industry applications, such as pharmaceuticals, food and automotive but also as an intermediate for the production of several polymers and resins. The chemical is currently produced from crude oil and natural gas.

Biosuccinium™, sustainable succinic acid, will be produced via fermentation of renewable resources. The novel production process developed by DSM and ROQUETTE will be able to replace existing fossil based succinic acid as well as open new applications, while at the same time delivering a better environmental performance. This innovative technology to produce bio-based succinic acid is unique in the world.

ENVIRONMENTALLY CONSCIOUS GREEN PRODUCTION
Biosuccinium™ is a 100 percent bio-based succinic acid and will enable customers to produce products with substantially lower environmental footprints. Our new production route delivers a reduction in greenhouse gas emissions, as it sequesters carbon dioxide ($\text{CO}_2$), and the proprietary process does not produce salts as waste. Bio-based succinic acid will thus enable customers to produce products with substantially lower environmental footprints.

Further, fermentation processes with the use of renewable resources are sustainable and will in this case lead to significant energy savings compared to a typical chemical process, thus reducing $\text{CO}_2$ emissions. Fermentation processes not only lead to positive effects on the environment, they also save money by reducing the need for energy.

The choice of feedstock is critical to both production cost and the environment. Today DSM and Roquette are using currently available agricultural feedstocks (starch from corn used solely for industrial products) to produce Biosuccinium™ with plans to implement technologies using lignocellulosic feedstocks, 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.

WHAT MAKES BIOSUCCINIUM™ UNIQUE TO THE CHEMICAL INDUSTRY
Proprietary Technology
Biosuccinium™ is protected by a robust patent portfolio surrounding its low pH fermentation process which produces no waste salts. This translates into higher performance and value for chemical producers allowing them to open up new markets faster overtime.

Excellent Product Quality/Purity
Providing a chemical intermediate that is of the highest quality and purity is essential for applications where color and other criteria are important. Biosuccinium™ produced by DSM and Roquette has been tested and validated to meet or exceed current production quality and purity standards.

More Stable Pricing
Integrated biorefinery will achieve the best economics and more stable pricing is expected in both the short and longer-term.

Favorable Life Cycle Assessment (LCA)
Biosuccinium™ is not only renewable but also provides a more favorable LCA and carbon footprint compared to alternative succinic 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.
**PARTNERS IN COMMERCIALIZATION**

In June 2010 Royal DSM N.V., the global Life Sciences and Materials Sciences company headquartered in the Netherlands, and Roquette Frères, the global starch and starch-derivatives company headquartered in France, announced the signing of a joint venture agreement for the production, commercialization and market development of bio-based succinic acid, subject to regulatory approvals and notifications. The joined venture will be named Reverdia™.

Since early 2008 the two companies have been working together to develop the best and most sustainable fermentative technology to produce bio-based succinic acid.

**BIOSUCCINIUM™ MARKET APPLICATIONS**

### Biosuccinium™ Market Applications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>White crystalline powder</td>
</tr>
<tr>
<td>Water content</td>
<td>≤ 1.0 w%</td>
</tr>
<tr>
<td>Purity (dry basis)</td>
<td>≥ 99.5 w%</td>
</tr>
<tr>
<td>Other (small) organic acids</td>
<td>≤ 0.1 w% each, ≤ 0.5 w% total</td>
</tr>
<tr>
<td>Iron</td>
<td>≤ 5 ppm</td>
</tr>
</tbody>
</table>

**PRODUCT AVAILABILITY**

Biosuccinium™ is currently available in small quantities for testing and ton quantities for purchase from the demonstration plant in Lestrem (France).

DSM and Roquette are actively seeking development partners.

**BIOSUCCINIUM™: ENABLING SUSTAINABLE NEW PRODUCT INNOVATION**

**DRIVING MARKET GROWTH**

The development of Biosuccinium™ succinic acid will drive a portfolio of more renewable, bio-based sustainable products.

While current markets for succinic acid include pharmaceuticals, food, coatings and pigments, we contend that the production of a high quality, bio-based succinic acid, such as Biosuccinium™, will cause new applications to emerge. Among these markets include the production of bio-based polyurethanes, thermoplastic polyurethanes, polybutylene succinate, biopolymer modifiers, coatings and resins, and greener solvents for many applications.

**PRODUCT SPECIFICATIONS**

**NEW APPLICATIONS**

- **Polyurethane**
  - Shoes: Coatings, Adhesives, Elastomers
  - Car Seats/Mattresses: Flexible Foams
  - Insulation: Fibers and Foams
  - Hard Wheels: Elastomers

- **Polybutylene Succinate**
  - Plastic Utensils
  - Disposable Cups
  - Food Packaging
  - Agricultural Films

- **Pyrrolidones**
  - Solvents
  - Cables

- **1,4 BDO/THF**
  - Elastic Fibers
  - Engineering Plastics

- **Plasticizers**
  - Polymer Modification

- **Freezing Point Depression Agents**
  - Deicing

Biosuccinium™ enables the production of a wide variety of green and innovative polyurethane-based products by substituting or complementing adipic acid.

Biosuccinium™ can be combined with 1,4 butanediol to make a more renewable bio-polymer, polybutylene succinate (PBS), which can be used in products ranging from disposable cutlery to mulching film.

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