



## ENABLING PHTHALATE-FREE BIO-BASED PLASTICIZERS

### INTRODUCTION

**BIOSUCCINIUM® is a 100% bio-based succinic acid that enables phthalate-free plasticizers with substantially reduced 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® is a viable and more eco-friendly alternative to many conventional fossil-based raw materials such as adipic acid, phthalic acid/anhydride, fossil-based succinic acid and many more, which are commonly used for the production of polymers and/or other derivatives such as plasticizers.

### BIOSUCCINIUM® IN PHTHALATE-FREE PLASTICIZERS

#### A “green” di-acid

BIOSUCCINIUM® can be used in combination with industry-common alcohols (such as 2-ethylhexyl alcohol, to make DEHS (figure 2), or alternatively a bio-based alcohol can be used in order to obtain 100% bio-based plasticizers. When using suitable diols, BIOSUCCINIUM® can also be used as a building block in linear or branched polymeric plasticizers.

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

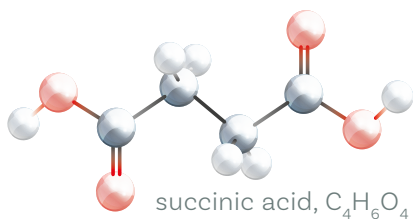
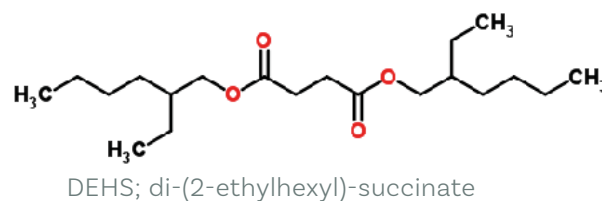


Figure 2: BIOSUCCINIUM® in a Symmetric Monomeric Plasticizer



### BIOSUCCINIUM® IN OTHER DI-ESTER APPLICATIONS

#### Solvents, cleaners, lubricants

When using succinic acid based di-esters as plasticizers, the freedom in choice of alcohol is limited by the final polarity compatibility of the di-ester in the polymer matrix (PVC, PLA, etc.).

However, other choices of alcohols lead to di-esters that have a completely different field of use. For example, solvents such as DMS and DES can be made by combining BIOSUCCINIUM® with short chain alcohols, such as methanol or ethanol, whereas the combination of BIOSUCCINIUM® with long chain alcohols, such as tridecyl alcohol, results in DTDS, a substance suitable as (stock) lubricant.

## SUSTAINABILITY CHARACTERISTICS

### Non-toxic, bio-based, biodegradable, carbon footprint

First of all, BIOSUCCINIUM® based plasticizers are phthalate-free, and therefore appeal directly to today's preference for phthalate-free products. Furthermore, succinic acid is a naturally occurring substance, and is considered safe in the amounts that can reasonably be expected to be released from plasticized products.

Furthermore, BIOSUCCINIUM® is 100% bio-based. Depending on the choice of alcohol used, the final plasticizer is partly or fully bio-based. Although most of the alcohols commonly used for plasticizers are fossil-based, there is a (growing) number of alcohols available from bio-based raw materials.

Last but not least, BIOSUCCINIUM® based plasticizers have a strongly reduced carbon footprint compared to most of the incumbents. This reduction is especially pronounced when compared to adipic acid based plasticizers, like DOA or polymeric adipates

## BIOSUCCINIUM® BASED PLASTICIZERS

### Good efficiency, excellent low temperature behavior, very low plastisol viscosity

BIOSUCCINIUM® based plasticizers have been evaluated in various polymers such as PVC (both emulsion and suspension) and PLA. Succinate plasticizers of average molecular weight (DEHS and DPHS) are efficient plasticizers (figure 3) and enable excellent low temperature flexibility in PVC compounds. Furthermore, in emulsion PVC, the plastisol has a very low viscosity and a very good paste stability over time (figure 4).

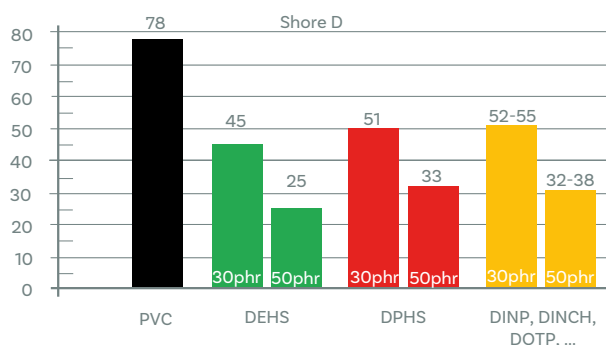


Figure 3: Shore D hardness of plasticized S-PVC

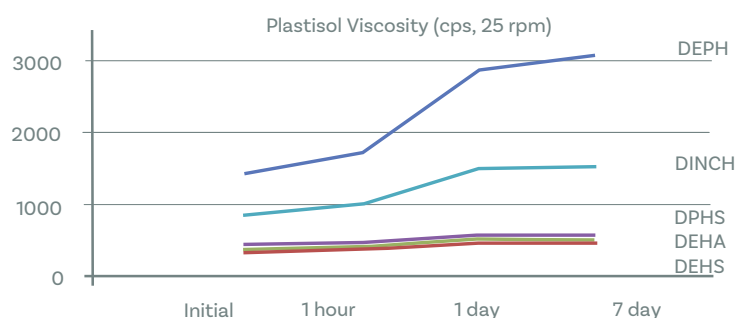


Figure 4: Plastisol viscosity and ageing

## 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 [www.roquette.com](http://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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