



enabling bio-based PBS



Biosuccinium[®], a 100% bio-based succinic acid, enables the production of a (partially) bio-based PBS (polybutylene succinate) with a substantially reduced carbon footprint. PBS is a biodegradable polymer that can be used as a single polymer or in compounds for both durable and biodegradable applications.

A UNIQUE RENEWABLE RAW MATERIAL

A 100% bio-based alternative to traditional chemicals

Biosuccinium sustainable succinic acid is produced by Reverdia from renewable, plant-based resources.

Reverdia's world class commercial plant in Cassano, Italy, uses a novel and proprietary yeast-based fermentation process to consistently and economically produce a high quality, bio-based succinic acid while maintaining a best-in-class environmental footprint.

Biosuccinium is an alternative for fossil-based acids such as succinic acid and adipic acid, which are commonly used for the production of aliphatic (biodegradable) polyesters.

BIO-SUCCINIUM IN PBS

Good flexibility, heat resistance, excellent processability and short cycles

The term "biopolymers" refers to polymers that are bio-based or biodegradable, or both. Most of the biodegradable biopolymers available today are aliphatic polyesters, manufactured from diacids and diols.

PBS made with Biosuccinium is biodegradable and (partly) bio-based.

Biosuccinium can be used in combination with 1,4-butanediol to produce PBS, poly-butylene-succinate (figure 1).

Biosuccinium can also be combined with other monomers which allows for the production of a wide range of co-polyesters with diverse performance characteristics. For example, PBSA can be formed by combining Biosuccinium, adipic acid, and BDO, or PBST can be formed by combining Biosuccinium, terephthalic acid, and BDO.

Figure 1: Biosuccinium enables the creation of sustainable, (partially) bio-based PBS

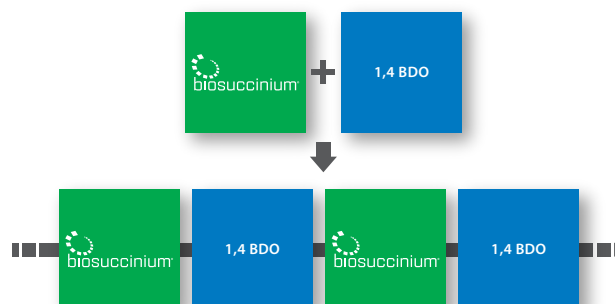


Table 1 shows a comparison of PBS versus a selection of alternative bio-based and fossil-based polymers.

Table 1: Indicative performance comparison of a selection of biopolymers and fossil-based polymers

| Property | Units | PBS | a-PLA | c-PLA | PBAT | PE-LD | PE-HD | PP | PS |
|--|-------|------|-------|-------|------|-------|-------|------|------|
| Morphology semicrystalline - amorphous | - | SC | A | SC | A | SC | SC | SC | A |
| Melting temperature | [°C] | 115 | ~58 | >150 | ~115 | 110 | 130 | 165 | - |
| Heat Deflection Temp-B | [°C] | 85 | 55 | <100 | 40 | 50 | 75 | 105 | 90 |
| Tensile modulus | MPa | 550 | 3500 | 3500 | 80 | 200 | 1000 | 1500 | 3000 |
| Tensile elongation at break | % | 300 | 3 | 2 | 600 | 400 | 150 | 150 | 1,6 |
| Processability | | fast | fast | slow | fast | fast | fast | fast | fast |

PBS-BASED COMPOUNDS

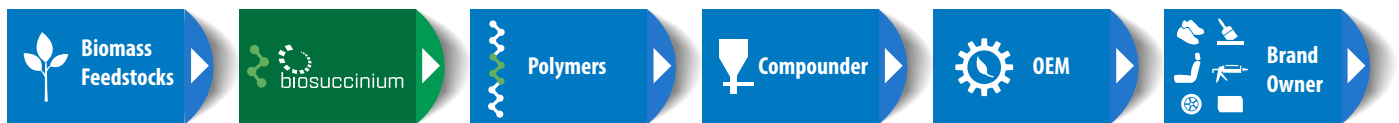
Ability to match application requirements

PBS can be used as a stand-alone polymer or in compounds to optimize physical properties for both biodegradable as well as durable applications.

PBS is commonly used in compounds with PLA and/or starch, to improve flexibility, reduce brittleness, increase heat resistance and/or tune rate of biodegradation.

Figure 2 shows the position of Biosuccinium and Biosuccinium-based polymers in the value chain.

Figure 2: Biosuccinium plays a key role in the value-chain



APPLICATION POTENTIAL

PBS allows for a wide range of applications (see figure 3).

Figure 3: PBS finds potential uses in a broad range of applications



HOW TO ORDER BIOSUCCINIUM

Please contact Reverdia at info@reverdia.com or via www.reverdia.com.

Since 2012, Reverdia has produced Biosuccinium at our facility in Cassano, Italy. To order please contact Reverdia at info@reverdia.com or order a free sample via our website at www.reverdia.com.



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