



Biosuccinium™, enabling sustainable polymer solutions

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Reverdia: Powered by DSM + Roquette



- Ranked among top global manufacturers of renewable raw materials (starch) for food ingredients & bio-based products
- Biorefinery experts
- €2.5 billion Euros turnover
- 6600 people in more than 100 countries worldwide
- Member of UN Global Compact



Complimentary
Competencies Create
a Single Force for
Market Success



- Life Science and Material Science company
- Biotechnology leader
- 22,000 employees in 200 locations across all continents
- Annual net sales of around €9 billion
- Top ranking Dow Jones Sustainability Index



Reverdia Mission



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 **strengths**



Global Megatrends

Drive the Need for Products Made from Green Materials

Sustainability Renewability



- Long-term maintenance of planet's well being
- Drives the growth of jobs & the economy

Decreasing Oil Dependency



- Scarcity
- Price volatility
- Energy security

Environmental Concern



- Consumer demand for sustainability
- Governmental regulation on climate change

Commercialization Strategy

TECHNOLOGY

World Class
Sustainable



BUSINESS MODEL

Manufacture and
Sales



MARKET DEVELOPMENT

Customer
Partnerships

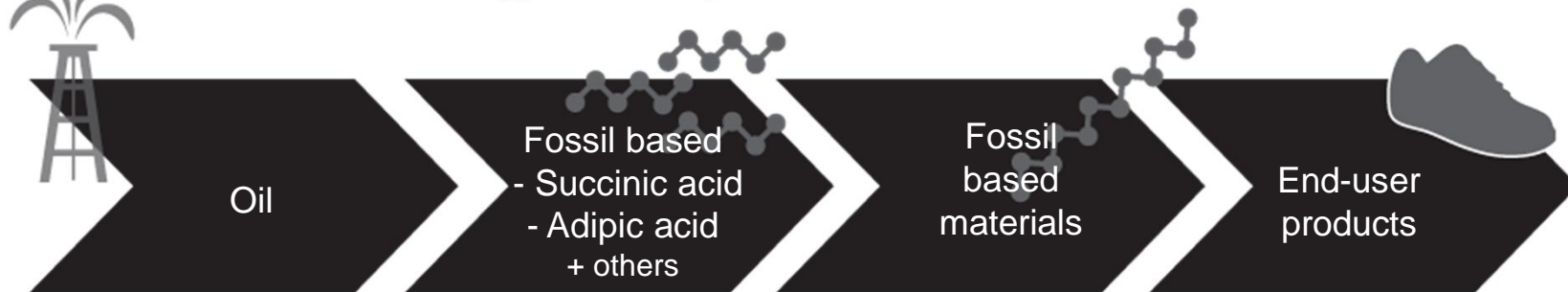


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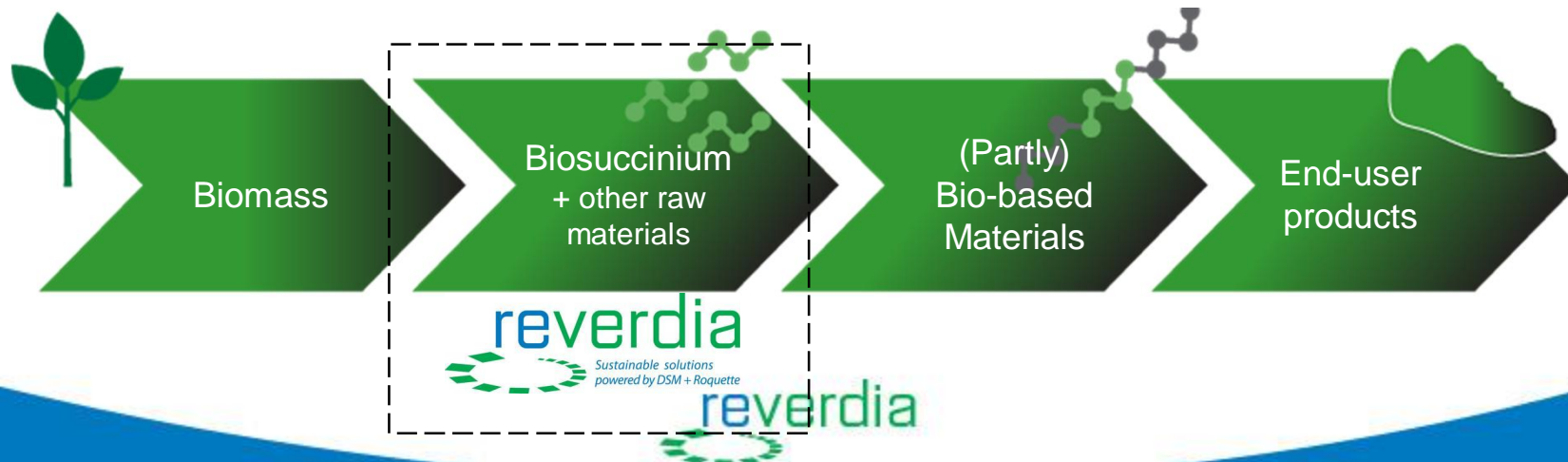
Emerging Value Chain for Sustainable Materials

Biosuccinium™, a bio-based alternative for fossil-based raw materials

Current Technology: Industry based on fossil-based raw materials



New Technology: Biosuccinium replaces fossil based raw materials



Large CO₂ reduction potential using Biosuccinium™

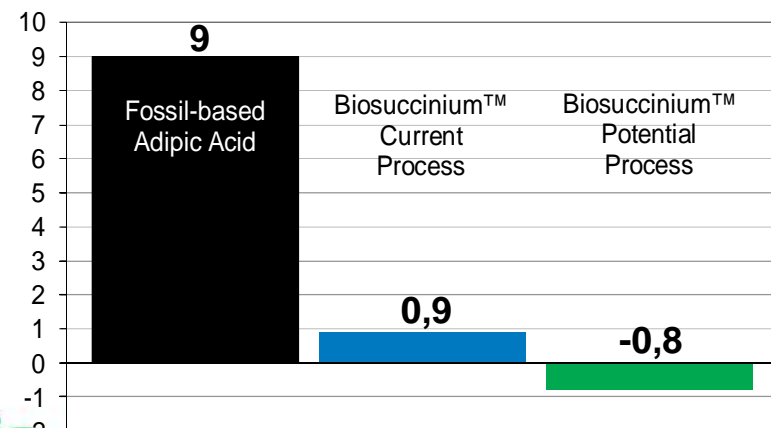
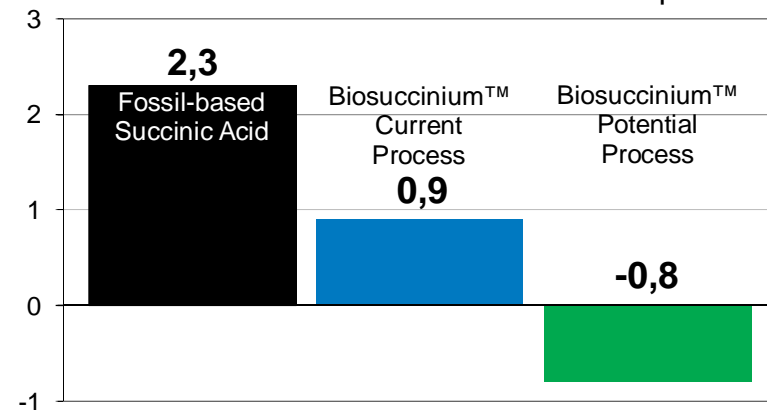
Biosuccinium™, a bio-based alternative for fossil-based raw materials

- In polymer-related applications Biosuccinium™ typically replaces:

- fossil based succinic acid
 - reduced carbon footprint
 - Increased biocontent

- fossil based adipic acid
 - strongly reduced carbon footprint
 - Increased biocontent

• Calculated Cradle-to-Gate for Biosuccinium and Adipic Acid



Biosuccinium™

Portfolio of Products and Applications

Packaging	Industrial	Sports and Footwear
 <ul style="list-style-type: none"> ■ PBS <ul style="list-style-type: none"> – Food packaging – Cutlery and utensils – Disposable cups and lids – Shopping bags 	 <ul style="list-style-type: none"> ■ PU foams <ul style="list-style-type: none"> – Insulation ■ TPU <ul style="list-style-type: none"> – Building and construction – Mining equipment ■ Plasticizers ■ Pigments ■ Resins <ul style="list-style-type: none"> – Coatings – Composites 	 <ul style="list-style-type: none"> ■ TPU and PU <ul style="list-style-type: none"> – Footwear – Outdoor garment ■ Spandex / Elastane <ul style="list-style-type: none"> – Apparel ■ PBS <ul style="list-style-type: none"> – Packaging – Buttons – Plastic parts
Non-wovens and Fibers	Automotive	Agricultural
 <ul style="list-style-type: none"> ■ PBS <ul style="list-style-type: none"> – Diapers – Hygiene products – Fishing lines and nets 	 <ul style="list-style-type: none"> ■ PU foams <ul style="list-style-type: none"> – Seats ■ TPU <ul style="list-style-type: none"> – Interior and sealing ■ PBS <ul style="list-style-type: none"> – Interior 	 <ul style="list-style-type: none"> ■ PBS <ul style="list-style-type: none"> – Mulch films – Plant pots

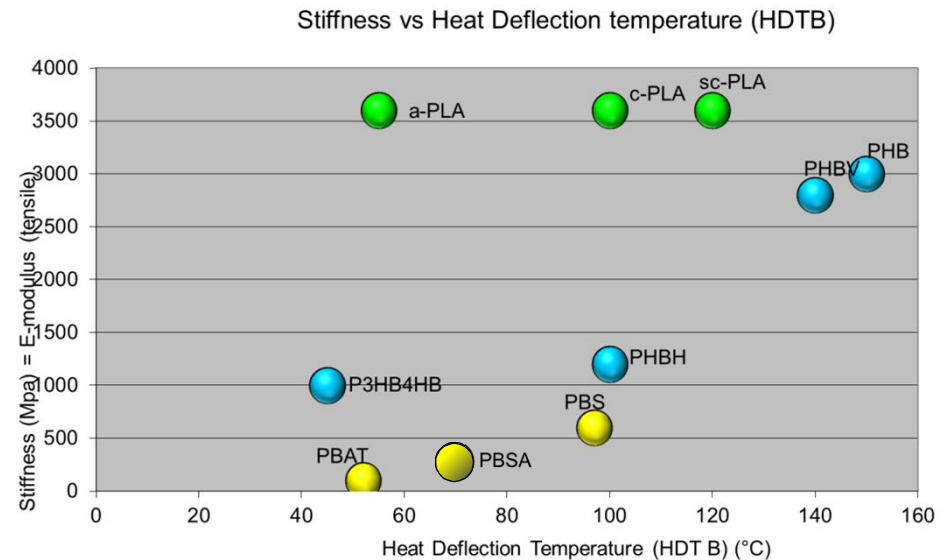
➤ TPU = thermoplastic polyurethane; PU = polyurethanes; PBS = polybutylene succinate: new biopolymer; Spandex / Elastane = elastic fibers

Application of Biosuccinium™ in biodegradable polyesters

PBS-(X) – A family of Biosuccinium™ based co-polyesters

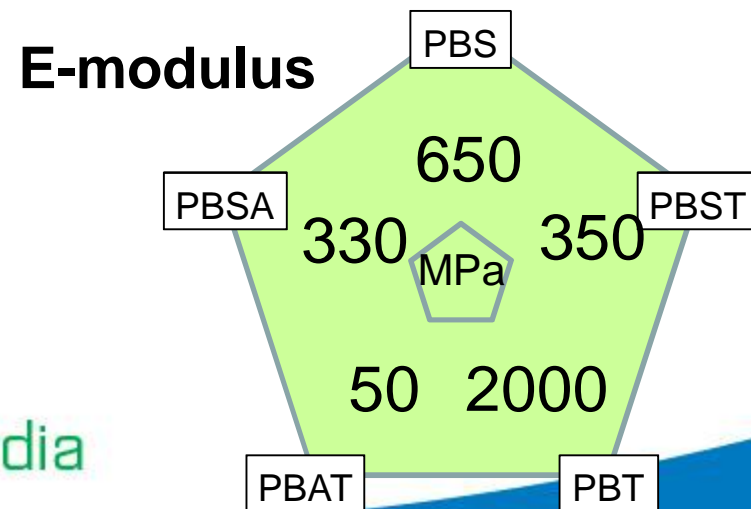
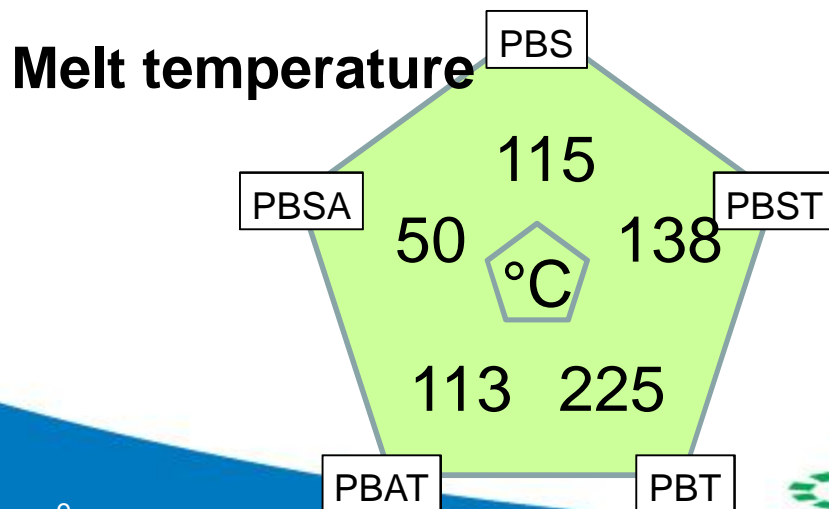
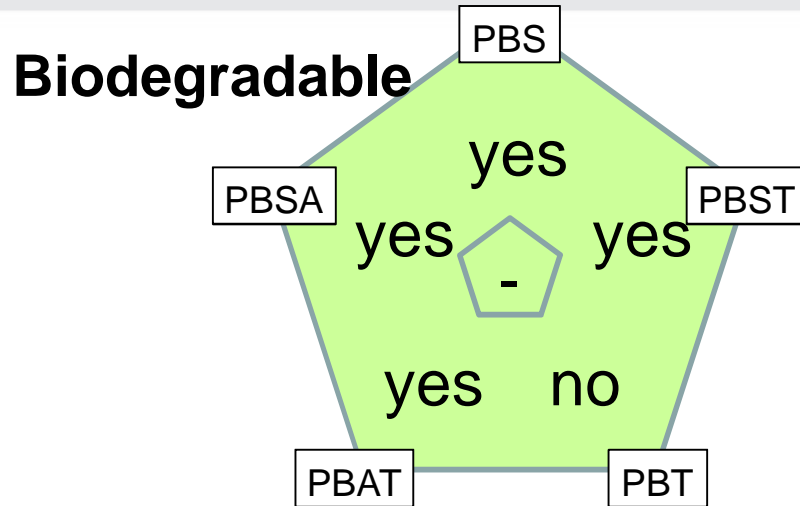
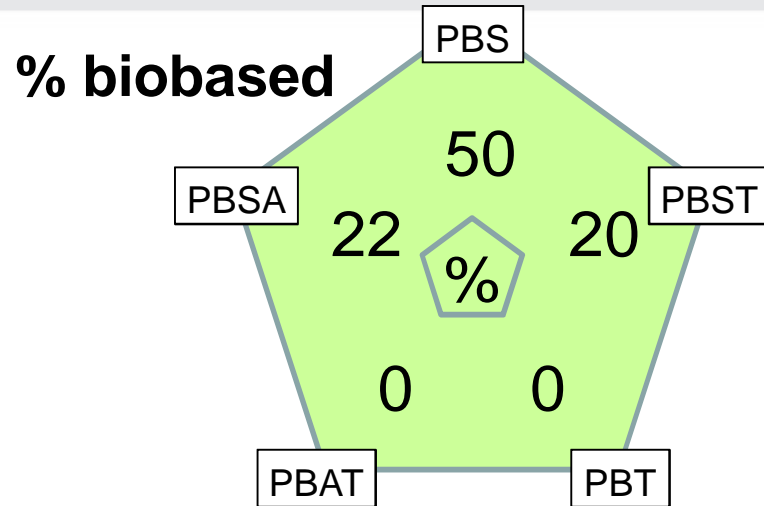
- PBS-X actually represents a family of copolymers, based on combinations of
 - succinic acid,
 - adipic acid, and
 - terephthalic acid

- By varying the type and content of co-monomer a range of properties can be obtained

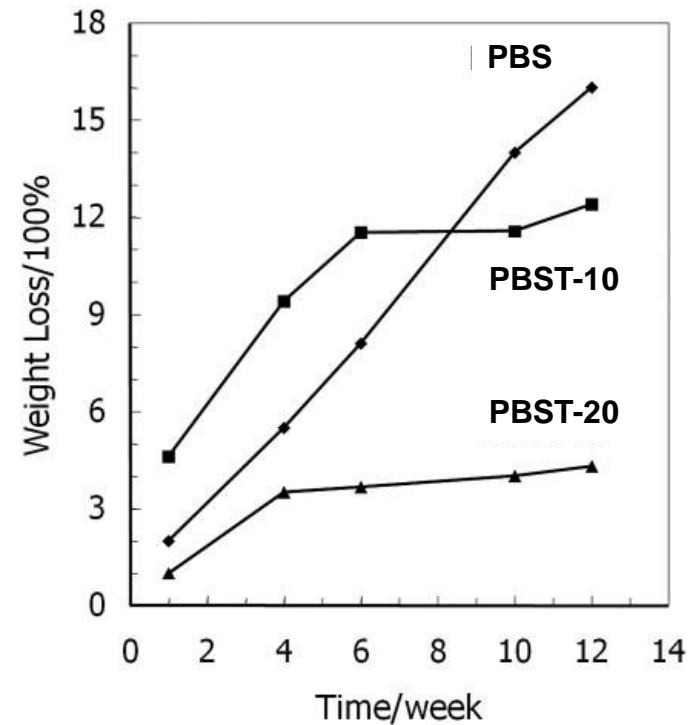
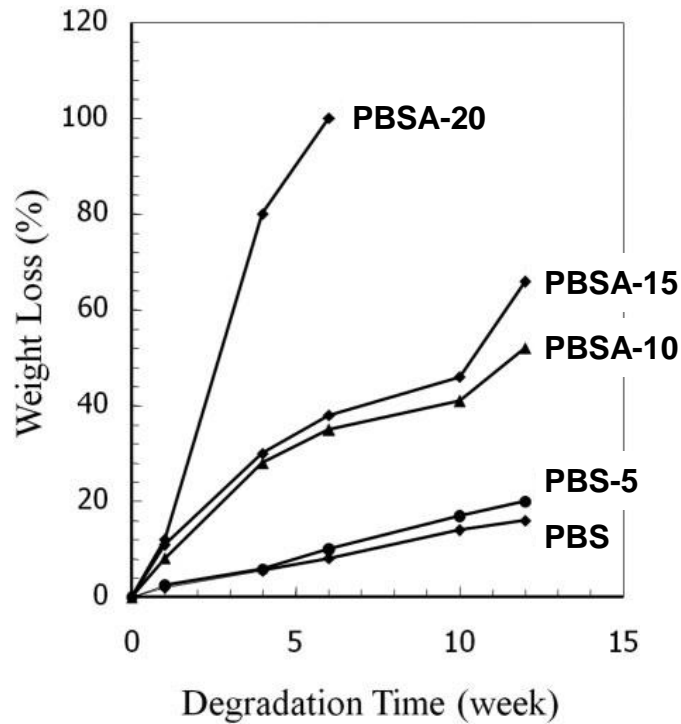


High level comparison (copolymer ratio 50/50)

PBS-(X) – A family of Biosuccinium™ based co-polyesters



Influence of copolymer composition on biodegradability



Source: Poly(butylene-succinate) and its copolymers: Research, development and industrialization

Jun Xu and Bao-Hua Guo, Tsinghua University, Beijing, China

Institute of Polymer Science & Engineering, Department of Chemical Engineering,



Conclusions

- Biosuccinium™ based family of (co)polyesters are a versatile addition to the biopolymer toolbox
 - Properties can be tuned within a relatively wide range
 - Already today a significant biobased content, with significant future potential to increase (ie bio-BDO)
- Although known for a long time in scientific , the materials (and some of it's suppliers) are relatively new to the commercial industrial scene
- Reverdia has relationships to these suppliers, and can establish connections where desired



**World's 1st commercial bio-succinic acid plant
Cassano, Italy; start-up Q4-2012**

Thank you for your attention

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