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BRINGING NEW FUNCTIONALITIES TO POLYESTERS AND POLYCARBONATES WITH ISOSORBIDE

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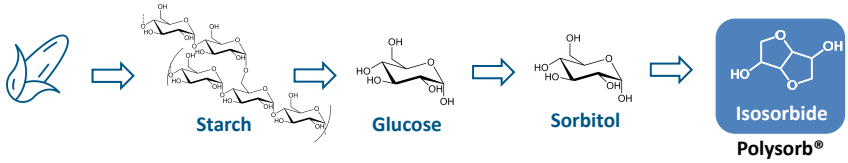
INTRODUCTION

Isosorbide

Isosorbide or 1,4-3,6 dianhydrohexitol, derivated from starch and more precisely from sorbitol, is one of the chemical intermediates of interest in the field of thermoplastic materials and for curable resins application [1].



POLYSORB® Isosorbide at Roquette:
- A sustainable and non-toxic functional molecule
- REACH approved
- Different grades adapted to all applications including pharmaceuticals and polymers
- World largest production capacity 20kt/y.

Main applications of isosorbide in thermoplastics

Aliphatic Polyesters oligomers
- Macromonomers for TPU / PU
- Reactive resins for powder coatings
- Tuning of properties

Thermoplastic polyurethanes
- Excellent thermo mechanical properties
- Impact-resistant polyurethane

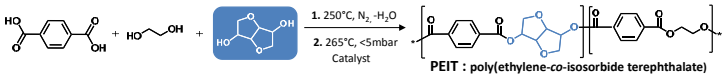
Thermoplastic Polymers

Aromatic polyesters
- Improved temperature resistance (vs PETg)
- Excellent clarity
- Excellent chemical resistance

Polycarbonates
- Excellent optical properties
- Chemical & UV resistance
- High temperature resistance

ISOSORBIDE IN POLYESTERS

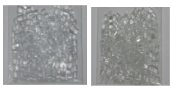
Synthesis and Polymer Design [2,3]



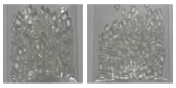
PEIT : poly(ethylene-*co*-isosorbide terephthalate)

TIPS TO REDUCE COLORATION
- High purity POLYSORB® Isosorbide from Roquette
- Avoid Presence of Oxygen
- Polymerization conditions (time, temperature, catalyst)
- Use appropriate Additives

Iso<15mol% Semi-crystalline

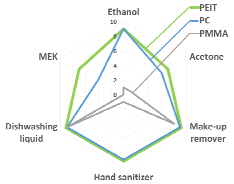


Iso>15mol% Amorphous



Polymer functionalities

Chemical resistance



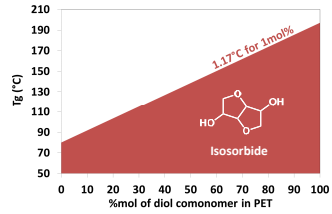
Good chemical resistance of PEIT in comparison with other transparent materials.

Optical properties

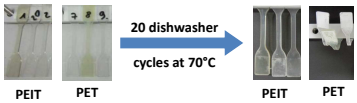
Polymer	% Transmitance
PEIT	90%
PC	89%
PMMA	94%
PETg	91%

Optical properties of PEIT close to PETg.

Heat resistance



Isosorbide has an exceptional ability to increase the Tg of PET.

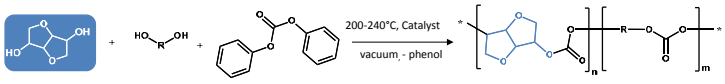


Applications

Heat resistant tea bottles | BPA free baby bottle (resistant to sterilization) | BPA free water jars | Heat resistant food containers | Technical fibers

ISOSORBIDE IN POLYCARBONATES

Synthesis and Polymer Design



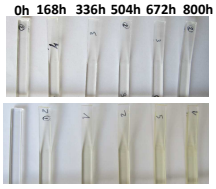
Property	Sample
Tg (°C)	119°C
Mn (g/mol)	20 500 g/mol
Mw (g/mol)	35 600 g/mol
IP	1.7
Red. viscosity	46 mL/g
Residual phenol	0.71%

PIC : isosorbide based copolycarbonate

Polymer functionalities

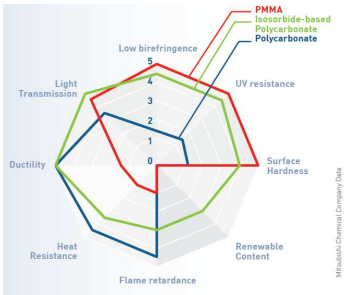
UV stability

UV ageing test according to ISO 4892-2/A (Xenon light 60W/m²)



Removing aromatic parts from polycarbonate allows its use for outdoor applications.

Isosorbide based PC compared to PC and PMMA [4]



Isosorbide polycarbonate is the best compromise between PMMA and BPA based polycarbonate.

Applications

UV resistant acoustical walls

Sun glasses

Due to its excellent dyeability, high gloss and scratch resistance it could replace painted ABS in automotive.

CONCLUSION

The incorporation of isosorbide in polyesters increases the glass transition temperature, opening to this new polymer several usual applications of amorphous polymers such the replacement of BPA based PC for food contact applications.
In polycarbonate, isosorbide is much more than just a solution for Bisphenol A replacement. Hence, Isosorbide containing polycarbonates present significantly increased properties like mechanical strength, heat resistance and optical properties with resulting properties between usual Polycarbonate and PMMA.

References :

[1] F. Fenouillot, A. Rousseau, G. Colomines, R. Saint-Loup, J.-P. Pascault, *Prog. Polym. Sci.* 2010, 35, 578.
[2] JC Bersot, N Jacquel, R Saint-Loup, et al. *Macromol. Chem. Phys.* 2017, 212 (19), 2114.
[3] N Stanley, T Chenal, T Delaunay, R Saint-Loup, N Jacquel, P Zinck, *Polymers* 2017, 9 (11), 590
[4] Data from Mitsubishi Chemical Corporation