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Isosorbide, a safe monomer for thermosetting

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PURPOSE OF THE ABSTRACT

I) Introduction

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. It can be used directly as a monomer or after chemical modification.

Hence, isosorbide found its place as a monomer suitable for polycondensates synthesis [1] like polyesters, polycarbonates and thermoplastic polyurethanes. Concerning aliphatic [2] or semi-aromatic polyesters [3], the addition of isosorbide increases glass transition temperature, opening to this new polymer several usual applications of amorphous polymers. The properties of other thermoplastics like polycarbonates [4] or TPU can as well be improved by the incorporation of iso-sorbide.

Either directly as a monomer or introduced in macromonomers [5] for curable resins, isosorbide can improve the properties of coatings, especially for optics and improved scratch resistance applications.
The use of isosorbide in thermosetting resins can impact the coating properties such as gloss and hardness of the surface.
Its use in PUs has been proved also to increase Tg and compression strength in foam applications [6].

UV curable resins from isosorbide derivatives, like (meth) acrylic isosorbide derivatives or acceptor/donor systems such as blends of vinyl ether and maleate functionalized isosorbide have been investigated. It has been proved that these monomers can cross link under UV radiation to form new valuable coatings [7]. The epoxy derivative of isosorbide and its use in coatings and composites will be described in this poster.

II) Isosorbide derivated epoxy resins
For several years already, studies have been performed to find a good solution to replace hazardous substances like the Bisphenol A and its derivatives. For this purpose, several studies were performed by different research institutes like NJIT [8] for instance. ROQUETTE developed in recent years an industrial process to obtain a compound from pure isosorbide (see Figure 1), bringing good properties, like a high Tg (around 103°C when cured with IPDA, a very good reactivity, a low coloration and a very good toughness (see Figure 2).

The main issue identified when using this epoxy resins as a replacement of usual BADGE resins is its very high water uptake significantly higher.
As shown in the table figure 2, using the isosorbide based epoxy resins as component of a formulation is a very good way to associate good properties of isosorbide based resins without its main drawback.

For these reasons, the use of isosorbide based epoxy resins as additives for flooring and RT cured paint

applications presents the asset of improving in the same time the appearance of the coating, its adhesion on the substrate and its main surface properties like hardness and scratch resistance.

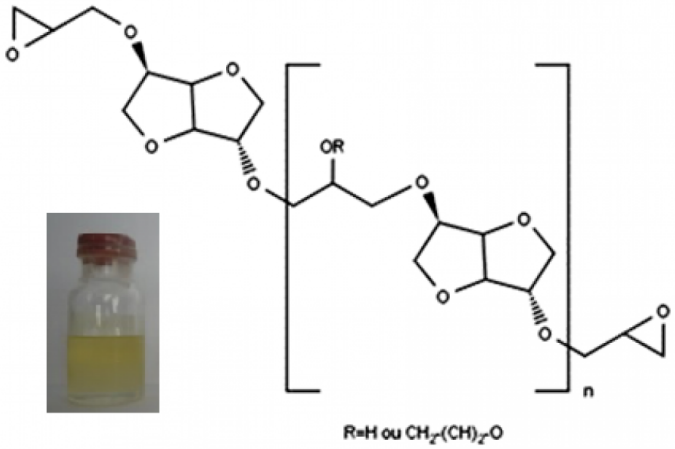
The same effect can be observed when using the isosorbide based epoxy resins in post-cured formulations for uses in metal protective coatings or in composites applications, with an improvement of the toughness of the resin and an enhancement of the surface properties.

All these formulated products evidenced in the same time the best parts of properties of isosorbide based epoxy and of the rest of the formulation.

III) Conclusions

Even if, at the moment, a lot of studies are focused on using isosorbide in thermoplastic resins, it is in the same time a very interesting building block that improves several properties of the coatings and compo-sites. Several researches programs are now focused on using isosorbide and its derivatives for thermosetting resins.

FIGURES



Epoxy	Hardener	K1c (MPa.m$^{1/2}$)	Tα (onset)	Tα (peak)
DGE-isosorbide	IPDA	1.3 (0.15)	111	120
DER 332	IPDA	0.74 (0.05)	158	168
80% DER332 + 20% DGE isosorbide	IPDA	0.85 (0.04)	154	163
TGETMP	IPDA	1.02 (0.07)	82	92
80% TGETMP + 20% DGE-isosorbide	IPDA	1.15 (0.08)	82	93

FIGURE 1
Isosorbide based epoxy resin
Generic formula and picture.

FIGURE 2
Impact of DGE isosorbide on mechanical/thermal properties (with post-curing).

KEYWORDS
isossorbide | epoxy

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