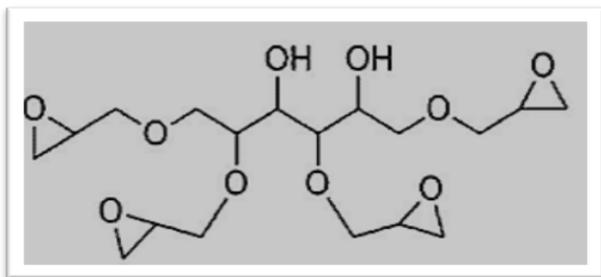
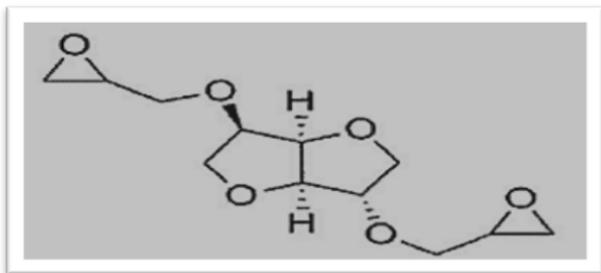


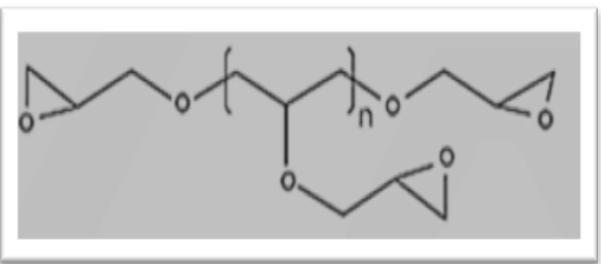
Epoxy Resins from BioRenewable Raw Materials



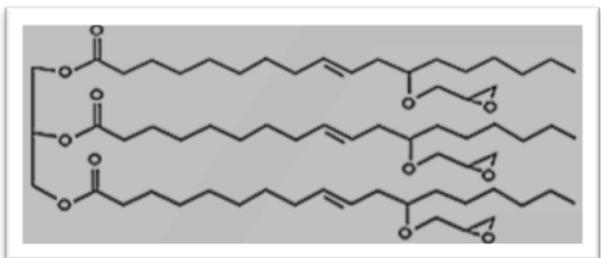
ERISYS™ GE60
Sorbitol polyglycidyl ether
Cas no : 68412-01-1



ERISYS™ ISDGE
Isosorbide glycidyl ether
Cas no : 13374-44-2



ERISYS™ GE38
Polyglycerol-3- glycidyl ether
Cas no : 118549-88-5



ERISYS™ GE35 & 35H
Castor oil glycidyl ether
Cas no : 74398-71-3



An Emerald Performance Materials® Company

DATE : 3/30/17

In recent years there has been an increasing demand for the application of natural products to address problems in the environment, in waste disposal, and in the depletion of non-renewable resources. Renewable resources can provide a sustainable platform to substitute partially, and to some extent totally, petroleum-based polymers through the design of biobased polymers. Renewable raw materials can compete or even surpass the existing petroleum-based materials on a cost-performance basis, with positive environmental impact.

Clearly, the current move of the chemical industry to substitute a growing part of fossil feed stocks with renewable carbon is not driven only by a fear of dwindling fossil resources or global warming; there are other driving forces at play. In some cases the knowledge and technology to process one type of biomass is already present, demanding only small capital investments, such that the low-value nature of a certain biomass feedstock may be exploited. A second factor is the general demand for renewable or green products from consumers. Such initiatives provide a sustainable image to all agents involved in the value chain: something everybody can benefit from. Finally, on the political side, subsidies and funding are provided to reduce the dependence of fossil resources and to decrease the environmental impact.

The interest in converting biomass into chemicals has increased sharply over the last ten years within industrial companies. With this being the case, companies have changed direction, finding valuable markets outside of fuels and are opting for higher-margin products such as specialty chemicals.

CVC Thermoset Specialty (CTS) has invested in technology to develop and promote epoxy resin products manufactured from BioRenewable raw material. These products not only reduce our carbon foot print but also see potential as a replacement to Bisphenol-A epoxy resin for food applications.

Product	BioRenewable raw materials	% carbon in final product from renewable raw materials
ERISYS™ GE 7	C8-C10 fatty alcohol	80.75
ERISYS™ GE 8	C12-C14 fatty alcohol	81.75
ERISYS™ GE 35	Castor oil	86.38
ERISYS™ GE 35H	Castor oil	86.38
ERISYS™ GE 38	Polyglycerol-3	43.67
ERISYS™ GE 60	Sorbitol	17.81
ERISYS™ ISDGE	Isosorbide	48.28
ERISYS™ GS120	Dimer acid	90

CVC Thermoset Specialties

844 N. Lenola Road, Moorestown, NJ 08057

PH: 856-533-3000/FAX: 856-533-3003

Web: www.cvc.emeraldmaterials.com

Formulation properties:

ERISYS™GE60 (Sorbitol Glycidyl Ether) cured with TETA as curing agent:

Physical and mechanical property measured using various percentage of ERISYS™ GE60 (Sorbitol Glycidyl Ether) with standard Bisphenol-A epoxy resin.

Ratio LER/ ERISYS™ GE60	0%	20%	40%	60%	80%	100%
Pot Life (mins)	39	25	20	15	-	10
Tg (°C)	115	119	117	112	105	91
Shore D	86	86	85	87	86	83
RT H ₂ O absorption (%)	0.3	0.5	0.5	0.9	1.5	2.4
Tensile strength, psi	6200	6200	6200	5800	5900	6300
Flexural strength, psi	9300	8500	8500	8200	8000	7900
Compressive strength, psi	14100	14500	15000	14000	14200	14200

Formulation properties with ERISYS™ ISDGE (Iso-sorbide Glycidyl Ether) cured with PACM as curing agent:

Epoxy Resin	ERISYS ISDGE	Standard BPA Resin
Flexural Strength (psi)	14,200	11,800
Flexural Modulus (ksi)	369	269
Compressive Strength (psi)	13,300	11,600
Compressive Modulus (ksi)	274	212
Tg (°C)	104	160

HEALTH & SAFETY PRECAUTIONS

Refer to **CVC Thermoset Specialties** Material Safety Data Sheet on ERISYS™ for additional safety and health information. The MSDS is revised as new data becomes available.

PACKAGING & AVAILABILITY

ERISYS™ reactive modifiers are available in 55 gal. non-returnable steel drums (net weight 480 lbs.). Bulk shipments are available with adequate lead-time. Drum inventory is available at most CVC regional warehouses. Check with your local sales representative for the shipping location nearest you.

DISCLAIMER

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DATE: 3/31/17