

## Vinyl Ether Terminated Monomers: Reactive Agents for RadCure

Radiation-curable chemicals cross-link under the influence of electromagnetic radiation—ultraviolet light (UV), electron beams (EB), visible light, or gamma emissions. The advantages of UV-curable systems over thermally cured, solvent based systems have fueled the phenomenal growth of this technology.<sup>1</sup> Two classes of polymerization reactions are used in UV curing: free radical and cation-initiated polymerization. Typically, the monomer used to reduce the viscosity of the prepolymer, viz., the reactive diluent, is an acrylate or methacrylate. The growing concern over environmental and health hazards of acrylic esters has led to extensive research on nonacrylate alternatives.<sup>2-9</sup> Vinyl ether monomers not only have a low primary toxicity data profile, but are among the most reactive monomers to photopolymerize cationically.<sup>3,4</sup> Vinyl ether (VE)

reactive diluents have been used in hybrid systems including VE/acrylate, VE/epoxy, and VE/acrylate/epoxy systems, offering high cure speeds and resulting in enhanced performance of UV-cured coatings.<sup>5,6</sup> More recently, photoinitiator-free polymerization of electron donor/electron acceptor(D/A) systems employing the electron-rich VEs has been reported with greatly reduced sensitivity towards oxygen inhibition as compared to that of acrylate systems.<sup>7-9</sup>

Aldrich has vastly expanded its line of vinyl ethers to include new, **multifunctional, liquid and solid monomers** as given below. For our complete product offering, search the product database on our Web site at [www.sigma-aldrich.com](http://www.sigma-aldrich.com).

Catalog No.	Product Name	Linear Formula	Melt Viscosity	Unit Size
<a href="#">49,644-8</a>	4-(Vinylloxy)butyl benzoate, 98% (VEctomer <sup>®</sup> 3010)	$C_6H_5CO_2(CH_2)_4OCH=CH_2$	8 (cps @ 22°C)	50mL 250mL
<a href="#">49,649-9</a>	Bis[4-(vinylloxy)butyl] adipate, 98% (VEctomer <sup>®</sup> 4060)	$[-CH_2CH_2CO_2(CH_2)_4OCH=CH_2]_2$	15 (cps @ 22°C)	50mL 250mL
<a href="#">49,648-0</a>	Bis[4-(vinylloxy)butyl] succinate, 98% (VEctomer <sup>®</sup> 4030)	$[-CH_2CO_2(CH_2)_4OCH=CH_2]_2$	43 (cps @ 22°C)	50mL 250mL
<a href="#">49,645-6</a>	4-(Vinylloxymethyl)cyclohexylmethyl benzoate, 95% (VEctomer <sup>®</sup> 3040)	$C_6H_5CO_2CH_2C_6H_{10}CH_2OCH=CH_2$	62 (cps @ 22°C)	50mL 250mL
<a href="#">49,646-4</a>	Bis[4-(vinylloxy)butyl] isophthalate, 98% (VEctomer <sup>®</sup> 4010)	$C_6H_4-1,3-[CO_2(CH_2)_4OCH=CH_2]_2$	85 (cps @ 22°C)	50mL 250mL
<a href="#">49,647-2</a>	Bis[4-(vinylloxymethyl)cyclohexylmethyl] glutarate (VEctomer <sup>®</sup> 4020)	$CH_2[CH_2CO_2CH_2C_6H_{10}CH_2OCH=CH_2]_2$	230 (cps @ 22°C)	50mL 250mL
<a href="#">49,650-2</a>	Tris[4-(vinylloxy)butyl] trimellitate, 96% (VEctomer <sup>®</sup> 5015)	$C_6H_3[CO_2(CH_2)_4OCH=CH_2]_3$	253 (cps @ 22°C)	50mL 250mL
<a href="#">51,484-5</a>	4-(Vinylloxy)butyl stearate, 98% (VEctomer <sup>®</sup> 3080)	$CH_3(CH_2)_{16}CO_2(CH_2)_4OCH=CH_2$	9(cps @ 44°C)	100g 1 kg
<a href="#">51,482-9</a>	Bis[4-(vinylloxy)butyl] hexanediylbiscarbamate (VEctomer <sup>®</sup> 4230)	$[-(CH_2)_3NHCO_2(CH_2)_4OCH=CH_2]_2$	15 (cps @ 106°C)	100g 1 kg
<a href="#">51,481-0</a>	Bis[[4-[(vinylloxy)methyl]cyclohexyl]methyl] terephthalate, 90% (VEctomer <sup>®</sup> 4051)	$C_6H_4-1,4-[CO_2CH_2C_6H_{10}CH_2OCH=CH_2]_2$	20 (cps @ 116°C)	100g 1 kg
<a href="#">51,485-3</a>	Bis[[4-[(vinylloxy)methyl]cyclohexyl]methyl] isophthalate, 90% (VEctomer <sup>®</sup> 4040)	$C_6H_4-1,3-[CO_2CH_2C_6H_{10}CH_2OCH=CH_2]_2$	65 (cps @ 80°C)	100g 1 kg
<a href="#">49,651-0</a>	Bis[4-(vinylloxy)butyl] (4-methyl-1,3-phenylene)-biscarbamate (VEctomer <sup>®</sup> 4220)	$CH_3C_6H_3[NHCO_2(CH_2)_4OCH=CH_2]_2$	85 (cps @ 84°C)	50g 250g
<a href="#">49,652-9</a>	Bis[4-(vinylloxy)butyl] (methylenedi-4,1-phenylene)biscarbamate, 97% (VEctomer <sup>®</sup> 4210)	$CH_2[C_6H_4NHCO_2(CH_2)_4OCH=CH_2]_2$	130 (cps @ 105°C)	50g 250g

VEctomer is a registered trademark of AlliedSignal Inc.

**References:** (1) *Chemistry and Technology of UV and EB Formulations for Coatings, Inks, & Paints*; Oldring, P.K.T., Ed.; SITA Technology: London, UK, 1991; Vol. II; Aldrich Catalog No. [224,910-6](#). (2) Scholnick, F. et al. *J. Am. Leather Chem. Assoc.* **1992**, *87*, 20. (3) Lapin, S. C.; Snyder, J.R. In *RadTech '90 North Am., Conf. Proc.*; RadTech Int. North Am.: Northbrook, IL, 1990; Vol. 1, p 410. (4) Hilborn, J.G. et al. In *Proc. Water-Borne, Higher-Solids, Powder Coat. Symp.*, 18th; 1991; p 54; *Chem. Abstr.* **1991**, *115*, 138226c. (5) Sitzmann, E.V. et al. In *RadTech '98 North Am. UV/EB Conf. Proc.*; RadTech Int. North Am.: Northbrook, IL, 1998; 53. (6) Sitzmann, E.V. et al. *RadTech Rep.* **1998**, *12*, 37. (7) Hoyle, C.E. et al. In *Photopolymerization: Fundamentals and Applications*; ACS Symposium Series 673; American Chemical Society: Washington, DC, 1997; p 133. (8) Joensson, S. et al. *Nucl. Instrum. Methods Phys. Res., Sect. B* **1997**, *131*, 276. (9) Kohli, P. et al. *Macromolecules* **1998**, *31*, 5681.