

# VISIOMER® GLYFOMA

## New low odor methacrylate monomer for composite resins and other reactive systems

In the recent past there has been a growing concern in the composites industry regarding the usage of Styrene in unsaturated polyester (UPR) and vinyl ester (VE) formulations. Reduction of styrene in applications like open mold and hand lay-up where the workers are exposed to styrene vapors, is an area of interest for many companies.

The Acrylic Monomers business line of Evonik Industries, one of the world's leading specialty chemical companies, has developed a solution for complete replacement of styrene in vinyl ester based formulations. The new grade developed by Evonik is called VISIOMER® GLYFOMA which is partially bio based and has practically no odor.

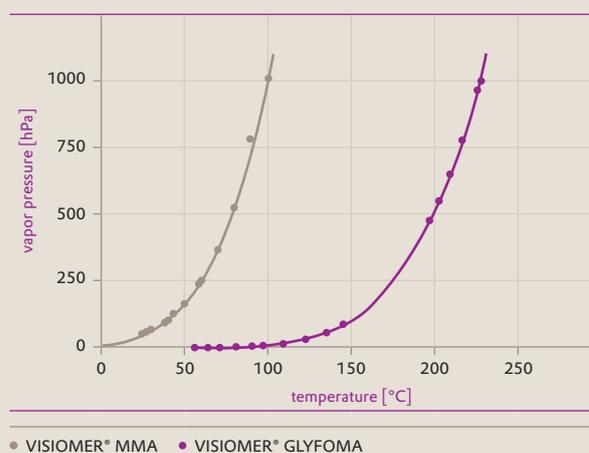
### VISIOMER® GLYFOMA – properties and advantages

VISIOMER® GLYFOMA is especially suitable for all applications in which reactive resins have to be handled in open atmosphere. It is comparable in its properties to VISIOMER® MMA. Its glass transition temperature is 80–95 °C in comparison to MMA with a  $T_G$  of 105 °C. Most important is the significantly lower vapor pressure of VISIOMER® GLYFOMA in comparison to styrene ( $p = 600 \text{ Pa}$  at 20 °C) or MMA (see Figure 1). The low vapor pressure leads to a significantly reduced VOC behavior. This makes VISIOMER® GLYFOMA an ideal candidate for substituting styrene as reactive diluent. Further physical properties are summarized in Table 1. The evaluation on its hydrolytically stability showed that it is stable against hydrolysis under alkaline as well as under acidic conditions.

**Table 1: Physical Data of VISIOMER® GLYFOMA**

Physical Data	
Boiling Point	69 °C at 2 mbar
Refractive Index	1.46 at 20 °C
Density	1.138 g/cm <sup>3</sup> at 20 °C
Viscosity	6.6 mPas at 20 °C
$T_G$	80–95 °C

**Figure 1: Comparison of vapor pressure of VISIOMER® GLYFOMA and MMA**



### Performance of VISIOMER® GLYFOMA as reactive diluent in vinyl ester resins

VISIOMER® GLYFOMA was tested in combination with VISIOMER® 1,4-BDDMA, a difunctional crosslinker, as substitute for styrene in vinyl ester resins. Here the results for a complete styrene replacement are shown. Three formulations with increasing crosslinker content of VISIOMER® 1,4-BDDMA were under investigation. Table 2 shows the resin viscosities and the gel times in reference to a standard styrene containing vinyl ester formulation with 55 wt% styrene content. VE resins con-

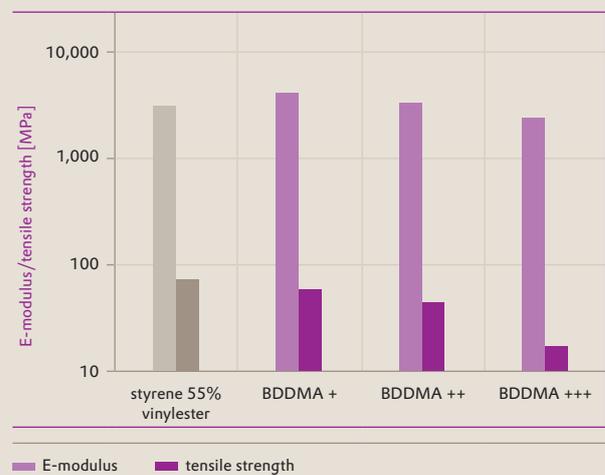
taining methacrylates show in general higher viscosities compared to styrene diluted systems. The gel time in contrast is lower in the methacrylate based formulations due to the high reactivity of VISIOMER® GLYFOMA, which shortens curing times in the final application. Figure 2 compares the mechanical properties of the tested resins. The addition of VISIOMER® GLYFOMA and 1,4-BDDMA as reactive diluent results in comparable mechanical properties to the styrene based system.

**Table 2: Viscosity and gel time of VE resin diluted with VISIOMER® 1,4 BDDMA/GLYFOMA in reference to styrene as reactive diluent**

Reactive diluent	Cone-plate viscosity [mPas]	Gel time [min]
Styrene (55 wt%)	15	125
GLYFOMA/BDDMA +	165	23
GLYFOMA/BDDMA ++	148	27
GLYFOMA/BDDMA +++	133	34

+ indicates the increasing amount of crosslinker VISIOMER® 1,4-BDDMA

**Figure 2: Comparison of mechanical properties of VE resins diluted with VISIOMER® 1,4 BDDMA/GLYFOMA**



**VISIOMER® GLYFOMA-crosslinker combinations are an applicable approach to substitute styrene in composite or other reactive resins, for example methacrylate based structural adhesives, where low VOC is necessary.**

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® = registered trademark

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