

VISIOMER® HEMA-P

Resin strength promoter for glass fiber composites

VISIOMER® HEMA-P products demonstrate improved adhesion to glass fibers (GF) and an increase of total resin strength when combined with vinyl ester (VE) and unsaturated polyester (UP) resins.

The total increase in resin strength of glass fiber laminates due to inclusion of **VISIOMER® HEMA-P** was determined by different mechanical tests: the interlaminar shear strength test (ILSS), the tensile test and the compression test*. Performance was measured in resin load direction using unidirectional (UD)-laminates and showed:

MECHANICAL TEST	PERFORMANCE OF VISIOMER® HEMA-P ADDITION
ILSS	Up to 36% increase in strength
Tensile Test	Up to 45% increase in strength
Compression Test*	Up to 41% increase in strength

Table 1: Strength improvement in mechanical tests by **VISIOMER® HEMA-P**

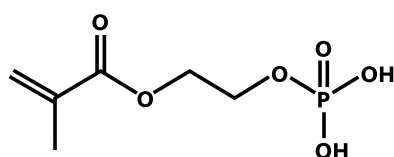
LIGHTWEIGHT STRUCTURAL COMPOSITES

Higher performance composite parts are possible when using VE/UP resin technology. Table 1 shows improvement of mechanical properties of glass fiber laminates caused by incorporation of **VISIOMER® HEMA-P**.

Higher ILSS prolongs the fatigue life of the composite part. Increased durability of composite material may be realized in ship or yacht body parts that can withstand higher water impact. Alternatively, it is possible to reduce the overall amount of composite material. Wind turbine blades can become lighter without sacrificing service life.

VISIOMER® HEMA-P: AN OVERVIEW

Figure 1: Structure of the active ingredient in **VISIOMER® HEMA-P**



2-Hydroxyethyl-Methacrylate-Phosphate (HEMA-P) is a well-known adhesion promoter in applications like adhesives or coating resins, enabling superior adhesion to polar surfaces like minerals, glass, and metals.

Evonik offers this chemistry in two versions — **VISIOMER® HEMA-P 70M** and **VISIOMER® HEMA-P 100** — for polymer design flexibility. Both **VISIOMER® HEMA-P** products stand out due to their high monoester content which helps ensure maximum adhesion performance.

	VISIOMER® HEMA-P 70M	VISIOMER® HEMA-P 100
Supply	In 30% MMA	Pure, MMA-free
Viscosity	40-75 mPa·s	3000-7000 mPa·s
Phosphorous content	10.6%	15%

Table 2: Comparison of **VISIOMER® HEMA-P 70M** and **VISIOMER® HEMA-P 100**

RESIN STRENGTH PROMOTION BY VISIOMER® HEMA-P

VISIOMER® HEMA-P products can be used as functional co-reactive diluents for VE or UP resins. In this study four-layer UD glass fiber laminates were produced by vacuum infusion. The glass fiber HYBON® 2002 from PPG was applied in combination with a composite resin.

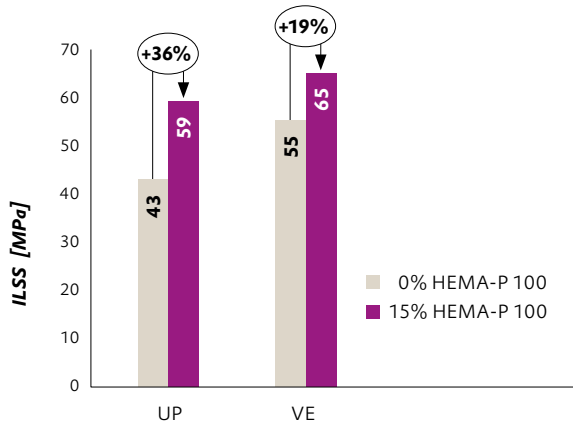
VISIOMER® HEMA-P 100 was added as a co-reactive diluent to a standard styrene containing vinyl-ester respective unsaturated polyester resin. Resin strength improvement in the glass fiber laminates was determined by three different mechanical tests mentioned in Table 1.

The **interlaminar shear strength (ILSS)** was measured using a three-point bending test to provide information on the resin-fiber adhesion strength.

Figure 2 shows that the addition of **VISIOMER® HEMA-P 100** (15wt%) significantly increases the ILSS by 36% for the UP resin and by 19% for the VE resin.

* For details on further mechanical testing and curing conditions register here: <https://methyl-methacrylate-monomers.evonik.com/en/onvisiomer> or contact us at visiomer@evonik.com.

Figure 2: Increase in interlaminar shear strength (ILSS) for UP and VE resins containing **VISIOMER® HEMA-P 100**



The ILSS results prove that **VISIOMER® HEMA-P** as a co-reactive diluent provides a superior fiber-to-resin adhesion.

Additionally, the GF laminates were subjected to tensile strength and compression tests* to further evaluate mechanical properties in the presence of **VISIOMER® HEMA-P**.

Figure 3: Resin failure of tensile strength measurement (90° direction) for UP and VE resins containing **VISIOMER® HEMA-P 100**

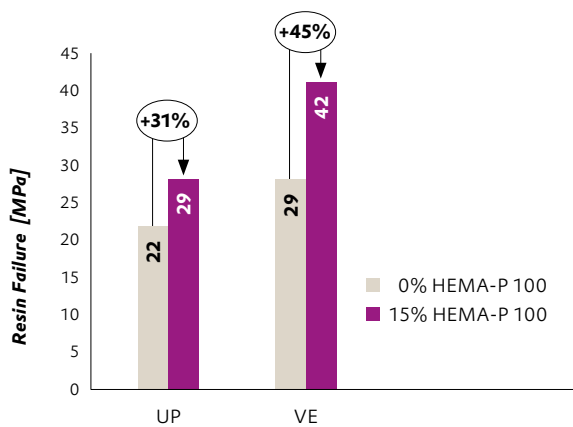


Figure 3 shows the resin failure of the different resin types determined in a 90° tensile testing. In contrast to the ILSS measurement, VE excels over UP with an increase in resin failure of 45% for the VE/GF combination and 31% for the UP/GF combination.

In conclusion, incorporation of **VISIOMER® HEMA-P** specialty methacrylate can significantly improve the total strength of glass fiber reinforced VE/UP composites. This improved mechanical strength allows to produce components with reduced weight and identical performance — creating possibilities for a sustainable world.

VISIOMER® METHACRYLATES — READY FOR THE NEXT LEVEL

Evonik's Specialty Methacrylates team looks forward to supporting you in finding the best solution for your next challenge in polymer design. Contact us for further information on our **VISIOMER® HEMA-P** products.

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* = registered trademark
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