

INTRODUCTION

2-Hydroxyethyl methacrylate (2-HEMA; aka. HEMA, CAS# 868-77-9) is perhaps the most widely studied and used neutral hydrophilic monomer. This bifunctional monomer, which contains both acrylate and hydroxyl functionality, is produced from the esterification of methacrylic acid by ethylene glycol or from ethylene oxide via a ring-opening process. The HEMA monomer is water soluble, while its homopolymer is water-insoluble but plasticized and swollen in water.

APPLICATIONS

2-HEMA is often used to increase the hydrophobicity or surface adhesion of polymers and polymer-based materials such as specialty coatings, resins, adhesives, printing inks, and acrylic plastics. As a co-monomer with other acrylic ester monomers, 2-HEMA can be used to control hydrophobicity or introduce reactive sites.

In biomedical applications, the monomer is the basis for many hydrogel products such as soft contact lenses, polymer binders for controlled drug release, absorbents for body fluids, and for lubricious coatings. The 2-HEMA polymer is used in certain contact lenses where it has the additional advantage of being rigid and easy to shape with grinding tools when it is dry and then becomes flexible when it absorbs water.

GRADES OFFERED BY POLYSCIENCES

While HEMA is available in a variety of industrial grades useful for coatings, adhesives and plastics, well-characterized, higher purity material prepared using well-documented processes is required for biomedical applications.

Polysciences offers several grades of 2-HEMA monomer, as listed in Table 1, to accommodate the needs of various applications, including high purity grades for research, and cGMP grades for medical/pharmaceutical applications. Representative properties of cGMP grade HEMA are provided in Table 1. Polysciences also offers custom versions of this material to meet the requirements of highly specialized applications, including tailoring levels of inhibitors and other additives or comonomers specific to the application.

Table 1. Grades of 2-Hydroxyethyl methacrylate (2-HEMA) available from Polysciences.

P/N	Grade	Purity (%)	Acid Content (max %)	EGDMA Content (max %)	Color	Inhibitor	Other Characterization
00227	Technical Grade	>97	1.5	0.2	50	180-220 ppm MEHQ	NA
03699	Low Acid	>98	0.10	0.2	30	180-220 ppm MEHQ	NA
04675	Ophthalmic	>99	0.05	0.15	30	7-13 ppm MEHQ	NA
Inquire	High Purity cGMP Grade	99.6	0.05	0.05	30	7-13 ppm MEHQ or as requested	DEGMA <0.15% Water <0.1%

HIGH-PURITY cGMP 2-HEMA

Polysciences has developed a continuous purification process to provide the highest purity 2-HEMA, with the level of impurities that can impact the polymerization consistency carefully monitored throughout the process. This cGMP grade is prepared under an ISO 13485:2016 Quality Management System with both the process and characterization of the material fully documented and traceable according to those standards. Representative properties of this cGMP grade are provided in Table 1, and custom specifications for this material can be provided upon request. As shown, this material is characterized to ensure impurities are maintained at very low levels while also maintaining an MEHQ inhibitor level that is both low and within a tightly controlled range to ensure consistent batch-to-batch performance. Additional information about the impact of impurities is included in the next section.

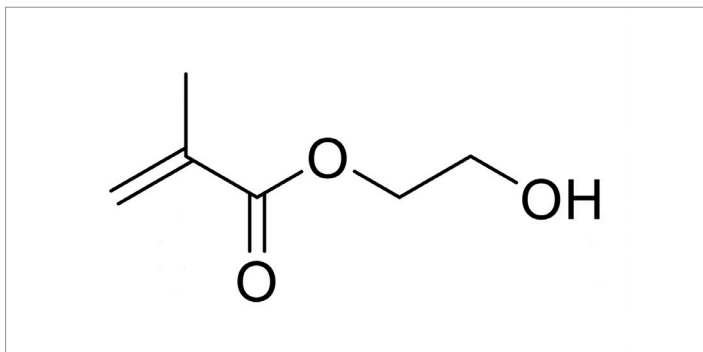


Figure 1: Chemical structure of 2-HEMA

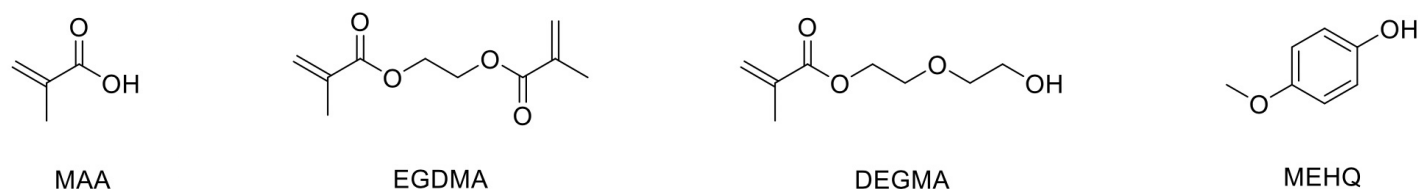


Figure 2. Common impurities found in 2-HEMA

IMPURITY CONTROL

2-HEMA impurities are typically generated from over/under esterification, inhibitors intentionally incorporated to prevent polymerization, or the formation of polymers due to partial polymerization. These impurities (see Figure 2 and Table 2) can cause inconsistent polymerization of 2-HEMA. The EGDMA product formed from reaction of 2 equivalents of methacrylic acid or from transesterification is an effective crosslinker that can increase polymer molecular weights and lead to undesirable formation of gelled products. MAA starting material can be left-over from incomplete reaction with ethylene glycol and will polymerize along with 2-HEMA to provide a higher acid content in the final polymer than is desired in certain applications. The presence of MAA units in the polymer can reduce the polymer Tg, providing a more brittle product. DEGMA, while having similar non-ionic character to 2-HEMA includes a longer side chain that can provide a lower Tg, softer polymer, and may lead to inconsistent properties if the amount of DEGMA varies from one batch to another. MEHQ is commonly used to inhibit the polymerization of 2-HEMA when it is being prepared and purified. This radical inhibitor, while usually required at some level to stabilize 2-HEMA, can also lead to inconsistent polymer properties if the quantity varies significantly from batch-to-batch. **Polysciences' cGMP processes offer the necessary controls and analytical testing to minimize the quantities of undesirable impurities and quantify levels present.**

Table 2. Potential impact of impurities

Impurity	Source	Potential Impact
MAA (Methacrylic acid)	Incomplete esterification	Changes polymer physical properties Varying amounts provide inconsistent properties Increases the acid content of the polymer
EGDMA (Ethylene glycol dimethacrylate)	Over-esterification / transesterification	Increase polymer molecular weights Crosslinking causes formation of gelled products
DEGMA (Diethylene glycol methacrylate)	Side reaction Impurity in ethylene glycol starting material	Changes polymer physical properties Varying amounts provide inconsistent properties
MEHQ (Hydroquinone monomethyl ether)	Required to minimize polymerization	Inhibits polymerization and provide inconsistent properties with varying amounts present
Other inhibitors	May be included to minimize polymerization	Inhibit polymerization and provide inconsistent properties with varying amounts present

ORDERING INFORMATION

Cat. #	Description	Unit Size
03699-100	2-Hydroxyethyl methacrylate, Low Acid Grade	100g
03699-500	2-Hydroxyethyl methacrylate, Low Acid Grade	500g
03699-1	2-Hydroxyethyl methacrylate, Low Acid Grade	1kg
00227-1	2-Hydroxyethyl methacrylate, Technical Grade	1kg
04675-100	2-Hydroxyethyl methacrylate, Ophthalmic Grade	100g
04675-500	2-Hydroxyethyl methacrylate, Ophthalmic Grade	500g
Inquire	2-Hydroxyethyl methacrylate, Ultra High Purity cGMP Grade	

Visit [Polysciences.com](https://www.polysciences.com) anytime to place an order or inquire about custom formulations.