

STYPOL[®]

ArmorStar[®] VMC High Performance-VE Laminating Resin

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Type

ArmorStar[®] VMC contains less than 35% styrene and complies with EPA's NESHAP MACT requirement for both Marine Manufacturing and Reinforced Composites.

Uses

ArmorStar[®] VMC is a high performance, low styrene, 100% vinyl ester laminating resin designed for open mold processes where hand lay-up and spray up applications are used. ArmorStar[®] VMC is an excellent skin coat resin for boat hulls and other applications where long-term immersion in water is required. ArmorStar[®] VMC also provides increased mechanical properties in applications where added toughness is needed.

Distinguishing Characteristics

ArmorStar VMC offers the following features:

- Excellent mechanical properties
- High elongation (an indicator of toughness)
- Superior cosmetics, superior blister resistance
- Low HAP content
- Rapid cure and Barcol development in a thin laminate
- Reduced cycle times
- Compatible with standard catalysts
- Also compatible with low-exotherm MEKP/CHP catalyst blends for thicker cross-sections.

Typical Liquid Properties (at 77°F)

These values may or may not be manufacturing control criteria. They are listed for a reference guide only. Particular batches will not conform exactly to the numbers listed because storage conditions, temperature changes, age, testing equipment (type and procedure) can have a significant effect on the testing. Products with properties outside of these readings can perform acceptably. Final suitability of this product is in the end use performance.

Test	VMC
Viscosity, Brookfield RVT #2 spindle @ 50 rpm	550 cps
Thixotropic Index	2.0



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Non-Volatile Material	65%
HAP*	
1.50 % by weight ARKEMA Luperox® DDM-9	<35%
• Gel Time in Minutes	22
• Gel to Peak	10
• Peak Exotherm	335°F

*Hazardous Air Pollutants (HAP) listed in EPA's NESHAP MACT Standard (which includes styrene and methyl methacrylate).

Physical Properties

The physical properties of thermoset resins evolve as the resin cures. The time required for ArmorStar® VMC to achieve complete cure will depend upon the thermal history and peroxide usage during the cure process. Heat to facilitate cure may come from the exotherm of the laminate, or from external sources. The use of too little or too much catalyst will result in permanent under cure that cannot be overcome. Properly catalyzed thin laminates that do not receive external heat may not reach complete cure and therefore good physical property development. These properties are typical values and are provided for reference only.

Test	Casting ¹	Laminate ³	Test Method
Barcol Hardness	40	45	ASTM D-2583
Tensile Strength	12,500 psi	16,600 psi	ASTM D-638
Tensile Modulus	0.540 x 10 ⁶ psi	1.420 x 10 ⁶ ps	ASTM D-638
Tensile Elongation	3.5%	1.80%	ASTM D-638
Flexural Strength	21,000 psi	34,000 psi	ASTM D-790
Flexural Modulus	0.580 x 10 ⁶ psi	1.320 x 10 ⁶ psi	ASTM D-790
Heat Distortion @ 264 psi	122°C(252°F) ²	N/A	ASTM D-648
Glass Transition Temperature, Tg	139°C(282°F) ²	N/A	DMA 1 Hertz

¹Clear casting and laminate cured overnight at room temperature and post-cured at 150°F for 4 hours.

²HDT and glass transition temperature for 1/8 clear casting post-cured for 4 hours at 120°C.

³Laminate construction: 2 ply of 1.5 oz. CSM at 36% glass to resin ratio.

Cure

It is recommended that gel time be checked in the customer's plant, as age, temperature, humidity and



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catalyst will produce varied gel times. The peroxide level should not exceed 2.5% or fall below 0.75% for proper cure. This product should not be used when temperature conditions are below 60°F, as curing may be adversely affected.

Laminate construction and shop conditions should be considered when selecting a peroxide and specifying the level. To aid in these decisions, CCP has investigated the effects of laminate thickness and temperature on cure of ArmorStar® VMC laminates. The results of this investigation are presented in Table 1 (next page). All catalyst recommendations are based on the following criteria:

- Laminate peak exotherm of 150°F maximum
- Laminate Barcol hardness of 20 in less than 2 hours
- Laminate gel time of 25 to 45 minutes.

Recommended Initiators

Success in using CCP laminating products relies on use of the appropriate initiator for the type of process and working conditions. CCP’s standard laminating products have been formulated and proven to perform well with many different types of initiators, including MEKP’s and MEKP/CHP blends. Following is a catalyst guide based on laminate lay-up thickness and shop temperatures.

ArmorStar® VMC Catalyst Chart

	Catalyst	Laminate Thickness		Temperature Range, °F
		(<0.250")	(>0.250")	
Straight MEKPs	Luperox® DHD-9	1.2 - 2.25	NR	60 - 95
	Chemtura HP-90	1.2 - 2.25	NR	60 - 95
Low CHP Blends	Luperox® KC-70	NR	1.25-2.0	75+
	Luperox® Cat 730	NR	1.25-2.0	75+
	Norac MCP 75	NR	1.25-2.0	75+
Higher CHP	Luperox® KC-50	NR	1.8-3.5	95+
Blends	Luperox® Cat 11	NR	1.8-3.5	95+
	Norac MCP	NR	1.8-3.5	95+

Caution

Do not over-mix. Over-mixing can break down a resin system, increasing its tendency to sag. Material should be mixed once a day for 10 minutes. The resin should be mixing to the sides of the container with the least amount of turbulence possible. Air bubbling should not be used for mixing; it is not effective and only serves

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as a potential for water or oil contamination.

Do not add any material, other than the recommended fillers and methyl ethyl ketone peroxide, to this product without the advice of a representative of CCP Composites US.

Storage

Uncatalyzed, standard cure polyester products have a usage life of 90 days from date of shipment from CCP when stored at 73°F or below in a closed, factory-sealed, opaque container, and out of direct sunlight.

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COMPOSITES SAFETY INFORMATION (October 2011)

All sales of products manufactured by CCP Composites US (CCP), and described herein, are made solely on condition that CCP's customers comply with applicable health and safety laws, regulations and orders relating to the handling of our products in the workplace. Before using, read the following information, and both the product label, and Material Safety Data Sheet pertaining to each product.

Most products contain styrene. Styrene can cause eye, skin and respiratory tract irritation. Avoid contact with eyes, skin and clothing. Impermeable gloves, safety eyewear and protective clothing should be worn during use to avoid skin and eye contact. Wash thoroughly after use.

Styrene is a solvent and may be harmful if inhaled. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Extended exposure to styrene at concentrations above the recommended exposure limits may cause central nervous system depression causing dizziness, headaches or nausea and, if overexposure is continued indefinitely, loss of consciousness, liver and kidney damage.

Do not ingest or breathe vapor, spray mists or dusts caused by applying, sanding, grinding and sawing products. Wear an appropriate NIOSH/MSHA approved and properly fitted respirator during application and use of these products until vapors, mists and dusts are exhausted, unless air monitoring demonstrates vapors, mists and dusts are below applicable exposure limits. Follow respirator manufacturer's directions for respirator use.

The International Agency for Research on Cancer (IARC) reclassified styrene as Group 2B, "possibly carcinogenic to humans." This revised classification was not based on new health data relating to either humans or animals, but on a change in the IARC classification system. The Styrene Information and Research Center does not agree with the reclassification and published the following statement: Recently published studies tracing 50,000 workers exposed to high occupational levels of styrene over a period of 45 years showed no association between styrene and cancer, no increase in cancer among styrene workers (as opposed to the average among all workers), and no increase in mortality related to styrene.

Styrene is classified by OSHA and the Department of Transportation as a flammable liquid. Flammable products should be kept away from heat, sparks, and flame. Lighting and other electrical systems in the work place should be vapor-proof and protected from breakage.

Vapors from styrene may cause flash fire. Styrene vapors are heavier than air and may concentrate in the lower levels of molds and the work area. General clean air dilution or local exhaust ventilation should be provided in volume and pattern to keep vapors well below the lower explosion limit and all air contaminants (vapor, mists and dusts) below the current permissible exposure limits in the mixing, application, curing and repair areas.

Some products may contain additional hazardous ingredients. To determine the hazardous ingredients present, their applicable exposure limits and other safety information, read the Material Safety Data Sheet for each product (identified by product number) before using. If unavailable, these can be obtained, free of charge, from your CCP representative or from: CCP Composites US, P.O. Box 419389, Kansas City, MO 64141-6389; 816-391-6053.

FIRST AID: In case of eye contact, flush immediately with plenty of water for at least 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If affected by inhalation of vapors or spray mist, remove to fresh air. If swallowed, get medical attention.

Those products have at least two components that must be mixed before use. Any mixture of components will have hazards of all components. Before opening the packages read all warning labels. Observe all precautions.

Keep containers closed when not in use. In case of spillage, absorb with inert material and dispose of in accordance with applicable regulations. Emptied containers may retain hazardous residue. Do not cut, puncture or weld on or near these containers. Follow container label warnings until containers are thoroughly cleaned or destroyed.

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