PRO-SET®

REPORT
2008/1

News about

EPOXY CHEMISTRY

COMPOSITE PROCESSES

FABRICATORS

Introducing PRO-SET M1018 and M1019 Epoxy Gel Coat Resins

The M1018 and M1019 epoxy gel coat resins are now available. You can mix these resins with several PRO-SET hardeners to provide a range of working times. We formulated these resins for use as a mold surface coat or a sandable base for part manufacturing.

M1018 is a white resin while the M1019 is a black resin. Chemically these resins are identical with the difference being the choice of black or white to fit your requirements for the part or tool. Most laminators prefer a black mold surface. The white M1018 is more commonly used as a surface coat on a part. The formulations are hard and tough and can be wet sanded and buffed to a glossy finish or sanded to provide a great base for a high-quality topcoat system.

These systems are not UV stable, so in the case of a finished part, they will need topcoat protection. The UV stability is fine for a mold surface as long as the mold is not left in the sun between uses.

M1018 and M1019 are easily applied with a roller or brush and have good flow and leveling. Application of one coat will provide an 8 to 12 mil coating. They have good hiding capability and will hide the underlying surface with one coat. For a quick film build up you can apply multiple coats wet on tacky. We recommend a minimum of two coats on molds and plugs, while one coat may be sufficient on a composite part.

For additional information about these gel coat resins, or any of the other fine PRO-SET Epoxy product combinations, see our web site at www.prosetepoxy.com or call our technical support staff at 888-377-6738. ■

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Quality Control in the Shop

Occasionally, we receive a call from a customer who has had some sort of hiccup in his shop that resulted in an uncured or under-cured part. Most fabricators are astute enough to know that a drum of resin and hardener which built a good part yesterday should build a good part today. They call for help to figure out what went wrong during their manufacturing process. Sometimes the answers come easily, but other times it takes in-depth analysis of the part and the situation. Invariably, our technical support folks will ask questions to try to get to the root cause. This sometimes lead to an "ah-ha" moment when the customer knows exactly what went wrong before we go any further.

For many years we have used our manufacturing experience to help customers define and implement a quality control system that will prevent the need for those uncomfortable phone calls and emails. Here are a number of issues to consider when developing your in-house QC program.

Check the pump ratio

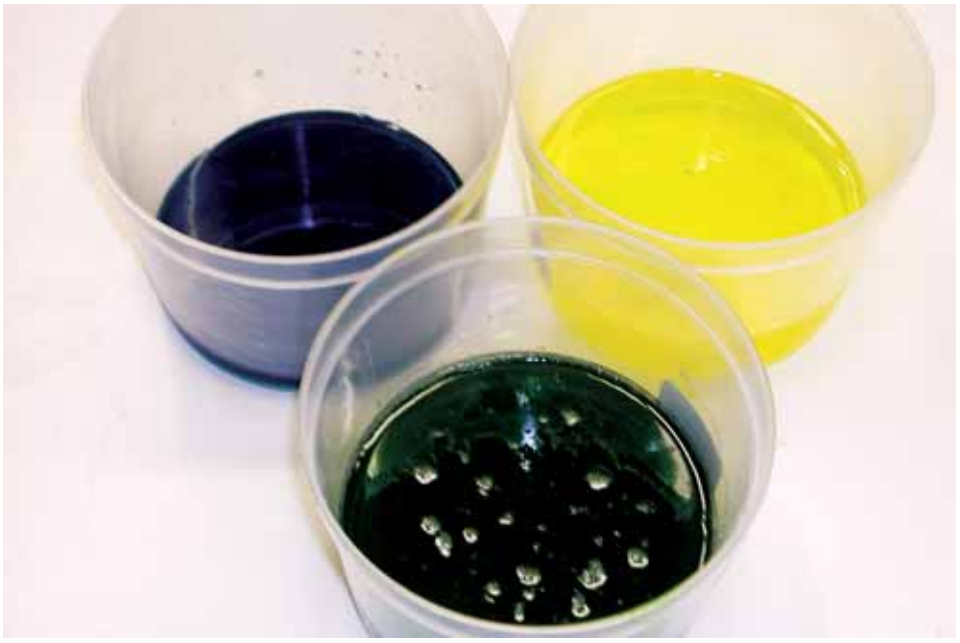
We all understand the importance of using PRO-SET Epoxy at the correct resin/hardener ratio. Many shops go as far as using large mechanical pumps to dispense the epoxy resin and hardener at the correct ratio. This is great idea. However, there is one flaw in this plan: if the pump should go off-ratio, you can dispense a lot of off-ratio epoxy very quickly. We recommend the pump be checked for ratio at least daily, and certainly before any large part lay-up. There should be at least two folks on the shop floor who know how to do this ratio check, and they should have the acceptable range information at their finger-

Typical 309-P Gear Pump station. Check the ratio daily.

tips. It is critical to keep the data sheet or a summary of ratios for all resin and hardener combinations readily available. Most importantly, these "pump experts" need to have the responsibility and authority to stop fabrication until the situation is resolved. It is much more expensive to make scrap than to not make a part. They also need to know what to look for if a pump should go off ratio so they can get it back on track quickly.

Use tinted resin and hardener

There have been instances when the customer used all hardener or all resin. In the heat of the moment doing batch mixing while in a big lay-up project, it is easy to forget to add the hardener to the resin. One way to provide the shop floor personnel with a visual indication that epoxy is properly metered and mixed is to use tinted resin and hardener. We tint resin and hardener on request for any customer and provide tints for those who want to do the tinting in their own shop. We use a yellow tint in the resin and a blue tint in the hardener. When the resin and hardener are mixed, it creates a nice uniform green color. A color difference this distinct will also show streaks if the epoxy is not fully mixed.



Blue tinted hardener (left) and yellow tinted resin (right), when properly mixed, make a uniformly green colored epoxy.

Record your lay-up data

We also recommend recording any critical processing data. We have included a copy of a form that can be used on the shop floor and includes a list of items we would record in our mold shop (*Page 3*). Some shops record all of this data, and some choose to record portions of it. When fabricators ask which variable is most important, we tell them the one that has affected the part (most of the time this is the information not recorded). One important aspect of a documentation record is that it shows the shop floor personnel that the management team thinks these details are important to the success of the part, and therefore to the company.

The shop temperature is a critical piece of information to record. A change in temperature will dramatically affect the cure rate of any epoxy formulation. With a 18°F (10°C) change in temperature, the rate of reaction will either be cut in half or doubled, depending on whether the temperature went up or down. This is a linear change. Imagine the situation where the shop temperature goes from 72°F on one day to 90°F the next. The pot life, working time and cure time will be half of what it was the day before. This is a 100% change. Even a 9 degree change will alter the cure rate by 50%. A resin and hardener combination that provided a four-hour working time at 72°F will have a two-hour working time at 90°F and a three-hour working time at 81°F. Conversely, when the temperature goes down the cure times increase just as dramatically. At 63°F the working time will be six hours and at 54°F it will be eight hours.

Temperature can also dramatically affect viscosity. For most hand wet out or impregnator wet out, the viscosity change will not be especially noticeable. However, in higher temperatures resin drain out may be more of a problem.

Sample Laminate QC Log

Part ID	SB 082	**Date**	8/12/2008	**Shop Temp**	79°F
		Recorded By	JOE PARKER	**Shop Humidity**	71%

Task	Result	Comment
Gel coat date / time	6:00 AM	
Gel and batch #	M1019	#08-131-33A
Gel catalyst and %	1224 HARDENER	@ 27 PHR
Gel thickness	10 MILS	
Tie coat date / time		
Tie and batch #		
Tie catalyst and %		
Catalyst and batch #		
Tie coat thickness		
Skin coat date / time	8/12/08, 8:30 AM	
Resin and batch #	5/14/1900	#13139A
Hardener and batch #	8/11/1900	#80108A
Mix ratio	27 PHR	
Pounds / volume per mix	5.08 LB	
Number of mixed batches	2	
Putty filler and %		
Fiber outer skin	1-12 OZ, 2-DB1808	LAMINATE STARTED @ 10:45 AM
Core material	H-80 FOAM	
Core bedding		
Fiber inner skin	1-12 OZ, 1-DB1808	
Peel Ply	WHITE W/ RED TRACER	
Breather	4 OZ	
Perf film		
Bag film	YELLOW NYLON	
Time before bag on	1.25 HR	
Vacuum level @ pump	27" HG	
Vacuum level @ valve	26.5" HG	
Vacuum gauge #1 on mold	18 HG	IN LINE VACUUM THROTTLE USED
Vacuum gauge #2 on mold		
Vacuum gauge #3 on mold		
Vacuum duration	2.5 HR	
Post cure date	8/13/2008	
Post cure schedule	16 X RT + 8 X 140°F	BLUE OVEN - TYP RAMP + SOAK SCHED.

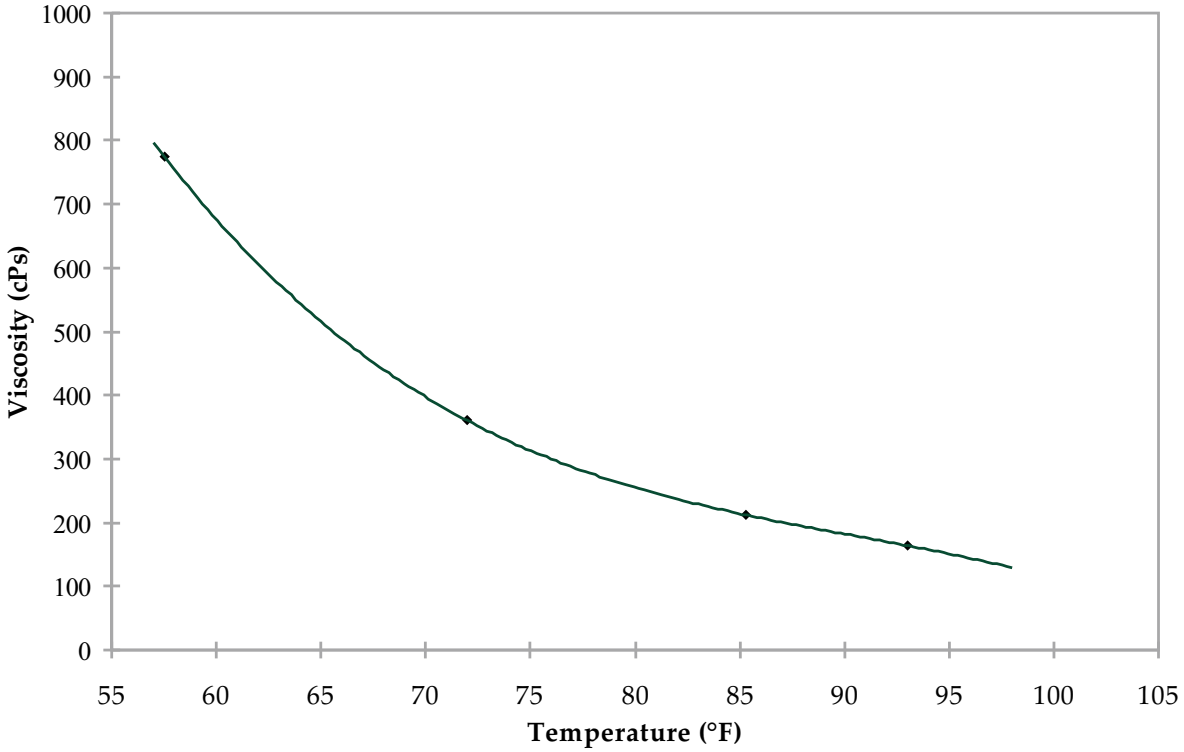
Equipment calibration		**Pump**		**Spray Rig**	
		Impregnator		**Vac. Pump & gauges**	

Comments

RANDY Z ASSISTED WITH LAYUP

BREATHER OVER SATURATED @ TOP OF PANEL

Mixed Viscosity and Temperature PRO-SET 117LV / 237



Higher temperatures are okay up to a point for infusion applications, but lower temperature may cause enough of an increase in viscosity to prevent proper processing of the part. I have included a graph for our PRO-SET 117LV resin and 237 hardener that shows the viscosity difference as related to temperature (*above*).

Recording the temperature for each part may seem like overkill, but a simple solution is to spend a few hundred dollars to purchase a data logger that will record any environmental conditions you specify. This can port directly to an Excel file or database file, giving you a permanent record of the conditions in the shop for any part, assuming of course that you recorded the day you made a specific part. You can also set up the record sheet so it can be completed for each part in a Excel or database file. Then you have a complete record for each part. It is a good idea to keep track of the storage conditions for the resin and hardener. If you're planning an infusion operation and the resin was stored in a cold building, the viscosity will be high and the infusion may not go as planned.

Take an epoxy sample

When we were building wind turbine blades, we cast a sample of resin and hardener for each blade in pucks about 3" in diameter and about ¼" thick. We labeled these with the part number and date, cured them with the part and checked for hardness once they were cured. This is a good way to ensure that the epoxy used in a specific part is properly metered, mixed and cured before the part moves farther into the manufacturing process. We use a Shore D meter to determine the hardness of the material. The technical data sheet has the hardness for the resin and hardener combination at several cure schedules. These meters can be purchased from Shore Instruments™ (www.instron.us/wa/acc_catalog) and are reasonably priced. They are used much like a Barcol meter is used on a polyester laminate, but they are much more sensitive and should be used on neat epoxy castings only.

In the next issue of the *PRO-SET REPORT* we will examine several other quality assurance topics and provide suggestions to continue to improve shop cleanliness and productivity. ■

The Shore D Meter

Preventing surface contamination

By Tom Pawlak

Advancements in chemical engineering have improved our lives in a variety of ways. Some of the advancements involve surface treatments that make fabrics softer and less prone to static cling. Some make surfaces shinier and others make sandpaper last longer by not allowing particles to be trapped between abrasive grit. These advancements all come at a price if you fail to appreciate their potential for contaminating the surfaces you plan to adhere to or apply coatings to. We will discuss potential contaminants, make recommendations for their removal and provide a foolproof way of verifying surfaces are clean.

Car wax and mold release

Car wax provides wonderful non-stick surfaces that allow dried bugs and bird droppings to easily be removed at the car wash. Molded fiberglass parts like boat hulls and decks often arrive at the showroom with mold release residue still on their surfaces. The painting and FRP repair industries are aware of these contaminants and provide wax and silicone removers like DuPont's Prep-Sol™ #3919S. Years ago, you could apply these solvent-based removers with clean rags, but this is no longer a good idea. Fabric softeners used in our laundry cycles today are made with proprietary blends of silicones, stearic acid, fatty acids, fatty alcohols and perfumes. These combine to do a wonderful job of eliminating static cling, making our clothes smell great and feel soft. Unfortunately, these ingredients leach out when exposed to solvents and can leave surface contaminants behind.

Another strike against using rags is they are often made of something other than pure cotton. The manmade fibers can dissolve when exposed to certain solvents, leaving more contaminants behind that act like mold release. You can't tell the fibers are dissolving because the fabric may be 85% cotton and only 15% manmade fiber. To be safe, you need to use contaminant-free towels to apply cleaning solvents. Guaranteed contaminant-free towels are available but expensive to use on an everyday basis. In our shop we've solved the problem by using generic white paper towels for applying solvents. Cheap white paper towels are not likely to have special treatments that would add significantly to the cost of the end product. So far, this logic has worked. We haven't had any adhesion problems or blemishes when gluing or painting over surfaces cleaned with solvent and generic white paper towels. We avoid paper towels that have colored prints or advertise being soft and absorbent. The inks may transfer and the softeners may pose contaminant issues similar to laundered rags.

When cleaning surfaces we suspect are contaminated with solvent, we use the "wipe-on and wipe-off" method: apply the solvent and before it evaporates, wipe it off with dry paper towel. This way the contaminant is not redeposited onto the surface when the solvent evaporates.

Non-clogging sandpaper

Like fabric softener formulas, surface treatments for non-clogging sandpaper are guarded secrets. I became concerned some years ago when a customer asked if we had heard of stearate coated sandpaper. His sandpaper had a warning label that said adhesion to surfaces abraded with it may be affected. I asked a sandpaper rep at IBEX whether these treated sandpapers might contaminate surfaces. He said, "There could be an issue but it is unlikely to be a problem if the sandpaper was changed out before it got dull." He acknowledged that some car manufacturers will not allow sandpaper into their facilities if it is treated with non-clogging coatings—at least not plants where parts are painted. I asked, "How do you determine if sandpaper has been treated?" He said, "If the sandpaper's product description hints at being non-clogging, as in non-loading, resists loading, no fill or non-plugging it likely has been treated and could potentially interfere with adhesion, especially if you run the sandpaper until much of the abrasive is worn away."

I asked him what to use in place of no-fill sandpaper. He said, "Car companies use untreated aluminum oxide sandpaper to avoid adhesion issues posed by no-fill paper." He also recommended sanding with wet/dry sandpaper as a safe bet for preparing contaminant-free surfaces. "Many people use no-fill sandpaper in course grits to do the majority of their grinding and shaping, and then switch to the untreated aluminum oxide sandpaper when they get close to their final shape," he said.

Other contaminants

Car manufacturers have spent millions of dollars researching potential surface contaminates to prevent paint adhesion problems and surface imperfections. They've identified hundreds of crater-causing contaminants that include the obvious and not so obvious. These include sweat, deodorants, hair spray, hand lotion, cologne, sealants, cutting oil, rust inhibitor oil and grease on your hands from fast food eaten at lunch. Even the dead skin cells all people shed can cause imperfections in paint's final finish.

Others we would add to the list include tack rags and amine blush. An alternative to tack rags is a static wipe like those for household dusting, sold alongside cleaning products at the grocery store. Amine blush forms on many epoxy formulations when the epoxy cures in humid conditions. It is best removed with water and an abrasive pad.

With all the potential contaminants out there, how do you know if a surface is clean? Here is an easy way to tell: if the surface can tolerate getting wet, we apply clean water and watch to see if it flows and sheets out without fish-eying or pulling back in places. If the water lays there like a coat of perfectly applied varnish without surface imperfections, you can assume that when it dries the surface will be ready for gluing or painting. If water beads up or otherwise leaves a visual distortion on the water's reflection, the surface needs additional cleaning. ■

New Volatile Content Data

New tests show the volatile organic compound (VOC) content of some PRO-SET® Epoxies is lower than previously reported. This is good news for businesses faced with government restrictions on their facilities VOC emissions and for commercial and large residential contractors pursuing "green" building certification. Green certification is based in part on low vapor emissions during construction and upon initial building occupancy. Choosing products with low VOC content helps to meet both manufacturing emissions limits and green building certification requirements. Like other coatings manufacturers, we publish product VOC information in our literature and on our product containers.

Recent testing of PRO-SET Epoxy resins to specific American Society for Testing and Materials (ASTM) standards showed that some of our products have a lower VOC content than what we'd published earlier. This was revealed when these products underwent the ASTM Standard 2369-07 test as part of the Environmental Protection Agency's (EPA) Test Method 24. Test Method 24 is a compilation of individual ASTM tests to collectively define the VOC content of a coating product.

ASTM Standard 2369-07 recognizes and incorporates procedures for determining volatile content of multi-part systems that undergo a chemical reaction after the parts are mixed. This test applies to our two-part epoxy systems. When tested to this standard, PRO-SET shows a reduction in volatile content compared to what we've reported in the past. While we've always reported our standard PRO-SET Epoxy resins have a relatively low level of volatile content, the table below compares the new VOC data to our previously published data.

PRO-SET Epoxy system	Volatile Content (Method 24)	Volatile Content (ASTM 2369-07)
PRO-SET 125 with: 224 Hardener	14.0 g/L (0.12 lb/gal	1.21 g/L (0.01 lb/gal)
226 Hardener	13.3 g/L (0.11 lb/gal)	2.61 g/L (0.02 lb/gal)
229 Hardener	14.6 g/L (0.12 lb/gal)	4.45 g/L (0.04 lb/gal)
PRO-SET 175 with: 273 Hardener	11.9 g/L (0.09 lb/gal)	8.65 g/L (0.07 lb/gal)
275 Hardener	9.94 g/L (0.08 lb/gal)	9.43 g/L (0.08 lb/gal)
277 Hardener	9.41 g/L (0.07 lb/gal)	11.4 g/L (0.10 lb/gal)

The data table represents laminating resins and adhesive resins in the PRO-SET product line. For additional information on the volatile content of specific PRO-SET Epoxy products, please call us at 888-377-6738 or visit www.prosetepoxy.com to review updated Material Safety Data Sheets. ■

—Glenn House

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