Will Polyester Based Material Bond With Epoxy?

(Lets Find Out!)

In short, the answer is yes! Providing a high quality epoxy such as West System is used and proper steps are taken throughout the repair process, I have not encountered any issues (short or long term).

It's been a long held belief that polyester based materials such as gelcoat do not achieve proper bonding strengths when applied over epoxy. While there are a number of variables that effect bonding in general, all of the limiting factors are very easy to address.

When looking at this closer, the key points are to make sure you are working with a fully cured epoxy surface that is clean and well scuffed to allow a good 'tooth' for secondary / mechanical bonding.

So why use epoxy at all if there may be issues? ~

Epoxy has a lot of benefits over other resins for marine repair; Longer working times, higher bonding strengths to a substrate, it's less porous (meaning better water proofing ability) and it provides a more stable surface for finishing (less shrinkage over the cure cycle).

Key points when working with epoxy~

* Proper ratio's of resin to hardener are VIP. Too much or too little can result in un-uncured epoxy. A bond is only as good as the surface that you're bonding to, if it's not fully cured you're going to run into problems. Using the metered pumps available through West System is a great way to ensure correct ratio's.

* Presuming the mix ratio's are correct, having everything properly mixed is another important step. Scrape the sides of the mix cup, scrape the bottom; repeat, repeat, repeat!. You want to make sure that all of the hardener is incorporated into the resin. I will typically stir for a minimum of 1 – 2 minutes for small batches. If you really want to cover your bases, transfer the mixed epoxy to a clean cup and stir a bit more. This will ensure that all the hardener is well incorporated.

* Cure time and temp. Depending on the temps you're working in, epoxy can take a few days to fully cure. It is advised that you allow your epoxy to cure for at least 3-4 days before moving forward.

* A natural by-product of epoxies curing process is something called amine (or amine blush). This is a film that forms on the top layer of epoxy that will inhibit the cure of polyester material as well as create bonding issues. How do you take care of this? Warm water and a scotch-bright pad. Amine is water soluble and is easily removed. Simply scrub the surface with warm water, wipe dry with a clean papertowel and this detail is taken care of.

* Clean, Clean, Clean Make sure that the surface you're bonding to is very clean. A wipe-down with acetone and / or a wax remover both before AND after sanding will ensure there are no surface contaminates.

* Lastly, the bonding surface needs to be well scuffed with sandpaper to ensure a good mechanical bond. I will generally use 60 or 80 grit paper and sand the surface until it is uniformly dull in appearance.

***** Something that I want to emphasize is that the above steps are not only geared to epoxy. These are good general rules when working with composites; either polyester, vinylester or epoxy.***

Real World Testing

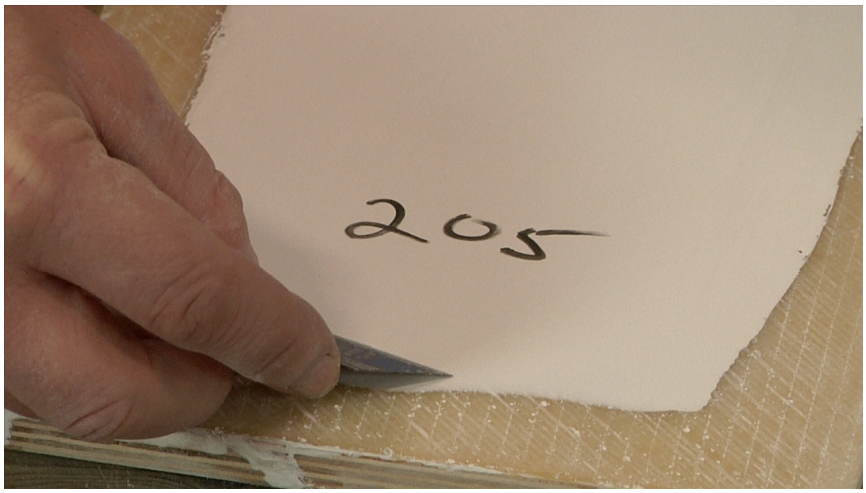
For my experiment I decided to focus on 3 common factors that come into play when doing repair work; Fine edge bonding, flexing stress, and shear strengths. All of these tests were done comparing the three West System hardeners I commonly use with their 105 resin; 205 fast hardener, 206 slow hardener and 207 special clear hardener. The glass used for all the tests was 1708 Bi-axial.

* Fine edge bonding: This is a situation that is faced when finishing off a gelcoat repair. As the gelcoat is sanded down and feathered into the surrounding area, the perimeter of the patch becomes very thin; almost translucent depending on the color you're working with. What I'm looking for here is to see how well this fine edge stays intact. When gelcoat gets this thin it can have a tendency to lift / chip back if it does not have a solid bond to it's substrate.

* Flexing stress: Boats flex while in use. In order to prevent stress cracks in the gelcoat, this material needs to be able to move with the boat without delaminating / peeling apart from it's substrate. I used a single layer of 1708 wetted out with each of the 3 West System hardeners and top-coated with a general purpose laminating gelcoat. The gelcoat was sealed with PVA and allowed to fully cure.

* Shear strengths: While it's nice to have analytical data (numbers, charts, graphs, etc) associated with shearing strengths, I often feel that a lot of these results can be simplified into a more 'black and white' presentation. For my experiment I took a sample piece from each of the three hardeners mentioned above and bonded it to a polyester based sample using gelcoat as the bonding medium. After a full cure, I manually ripped them apart giving me a clear pass / fail on the bonding strength. Whichever side breaks free from the gelcoat, comparatively did not have as strong of a bond.

The Results



Fine Edge Bonding:

All three of the epoxy samples performed equal to that of the polyester sample. When sanded to a fine edge and picked at with a razor blade, no lifting or separation of the gelcoat was noticed.

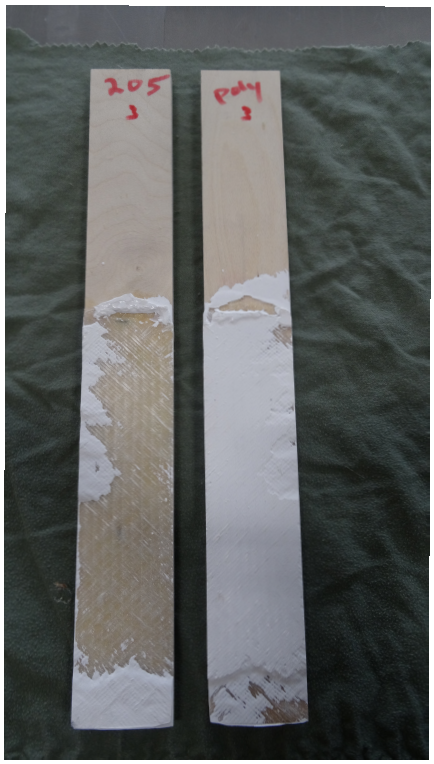
Flexing Stress:

Here again, all of the epoxy samples performed equal to that of the polyester sample. Each of the samples were bent and twisted to varying degrees far beyond what would be encountered through normal activity on a boat. There was no lifting or separation of the gelcoat from the epoxy substrate. Stress cracks were noticed as I intentionally broke the fiberglass sample in half looking for bonding failure along the fracture point. None were found on any of the samples.

Shear Strengths: This was the test that was of most interest to me, and the results were somewhat surprising.

* When separating the 205 / poly sample, the gelcoat did bond well to both surfaces, but overall the failure happened on the epoxy side. Chunks of gelcoat did stay secured to the epoxy sample, but more than 90% of the gelcoat pulled away and remained intact to the polyester panel.

* Both the 206 and 207 samples really impressed me. Not only did the gelcoat remain 100% intact to the epoxy panels, it pulled the fiberglass apart from the polyester based side! Compared to the 205 sample, these samples proved to be clear winners on bonding strength.



Conclusion~

While I can't ensure the same results would be had using other brands of epoxy, based on my personal testing and experience I am confident saying West System Epoxy as a substrate for polyester based material such as gelcoat will provide a more than capable bond (if not better than that of a poly to poly layup) providing proper steps are followed throughout the repair process.

For full details of this test, please visit my website http://BoatworksToday.com for a video documentation of the process performed.

About Boatworks Today

Boatworks Today is a video podcast dedicated to the education and entertainment of the DIY boat owner through professional HD instruction. Andy Miller, the creator of the show has over 15 years of professional marine repair experience; 10 of those years working independently as Miller Boatworks, Ltd. along the South Shore of Lake Superior. http://Facebook.com/BoatworksToday