# Blister Repairs Part II

*The Alchemist Still Hasn't Found the Philosopher's Stone*

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**Over the course of the last several months it almost seems that I've been under siege by used boats with failed blister repair problems, some of which are illustrated by the photos below. Reading the magazines and surfing around the web, you probably get the impression, as I have, that the blister problem is abating. But taking a tour of the boat yards I come away with an altogether different impression: the problem is now worse than ever. Much worse. And so is the problem with the failure of repair efforts.**

During the survey, I'm usually asked by my customer for an interpretation of what we see on the bottom after its hauled. These photos show why its impossible for me to answer the question; there's no way of knowing what's under the bottom paint until you start removing it. As often as not, what we find is an accumulation of years worth of hap-harzard attempts at repair. What we see here is akin to kids trying to do autobody work on their cars with no knowledge about what they are doing. The methods and materials being applied are just a bit of anything and everything.

It is true, of course, that blister repair is now big business for boat yards. With repair costs typically running in the $4,000 - $7,000 range for small boats, for those yards that promote the business, its something of a bonanza for them. Even more so for the manufacturers of materials who are now doing a land office business selling their chemical prescriptions. But from what I can see in just looking around the yards, its clear that more than 50% of the repair work that I see in yards is on a do-it-yourself basis. And what is being done is only making a bad situation worse.

**Another failed repair job. This one looks like the so-called "hot coating" where the bottom paint is applied over a wet barrier coat. At left are two larger blisters to which a grinder was applied. The skin out mat layer is plainly evident, is around 3/16" thick and is completely opaque, in addition to having a faulty bonding surface to the structural layers. Under the white layer, which you might think to be gel coat, is a black layer. We can't even imagine what that might be. What has been done to the bottom of this boat over the years (it is 15 years old) is beyond even guessing, but the one thing that is certain is that it there is no hope of successfully repairing it, even though the owner is going to try again. Applying a new coating over this mess is like painting over dirt.**

Which leads me to the subject of this essay, the growing problem of failed blister repairs. In the last two months, more than half of the boats we have surveyed that have blister problems involving failed repairs. The owners who were selling these boats, as one might expect, were less than forthcoming about what had been done to their bottoms. In fact, NOT ONE was willing to explain to me the procedure or materials that were used. Many feigned ignorance that anything was done at all, even though it was plainly evident by the number of coats of paint on the bottom (which are easy to count) that the repairs had taken place within a year or two. (A 10 year old boat with only one coat of paint and lots of grinder marks on the bottom tends to get my attention.) Clearly they were upset that whatever had been done wasn't working.

Doing it yourself can save a lot of money, at least initially. But it can present a big problem for the seller and the buyer a little further down the road: Many of the failed blister repairs we've seen over the last 60 days involved not complete recoating of the bottom, but spot or patch up repairs. Several more involved applying "barrier coats" over

improperly prepared substrates.  Naturally, we cannot completely reconstruct what was done short of doing a lot of probing to the underlying surfaces. But all we have to do is watch what is being done to so many of the other boats in the very same yards in which we are doing the surveys, to see what the nature of the problem is.

To make a long story short, its amateur repairs, or repairs by commercial yards who don't know what they're doing. Its people attacking boat bottoms with grinders and sandblasters and God knows what other kind of devices (sometimes even torches) and causing more damage than they are fixing. Its people applying an apparently endless variety of glop and goop to the bottom of these hulls in the name of  "fixing it."  But what they are really doing is just making a bad situation worse. They are grinding and sanding and filling and painting and trowling and brushing, patching up the bottoms of their boats with a variety of materials whose colors span most of the spectrum. There is no consistency in what any of them are doing; they use different methods and different materials. We even saw, in a number of cases, boat owners applying fillers and barrier coats directly on top of antifouling paint.

What we are finding on our surveys comports with what we see boat owners doing. They are applying a hodge podge of materials to the bottoms, often year after year, to the point where the boat bottom becomes a veritable chemical stew. I use that phrase "chemical stew" intentionally because what is happening is that the morass of materials being applied to boat bottoms are reacting chemically and erupting into boiling cauldrons of alchemy. Its getting to the point where I don't want to touch a bottom without latex gloves on my hands.

***Top*: What you see here may look like gel coat blisters but actually the white spots are a chemical reaction between a variety of gunk that was smeared on the hull. There was almost no gel coat left. *Below:* This is what it looked like after some kind of machine was used on the bottom. Here we can count four different kinds of filler, in addition to the black stuff that is now being applied on top of all the others, another patch up job. After he's done, he is going to seal all this mess over with a barrier coat. This owner's efforts are a complete waste of time and money.**

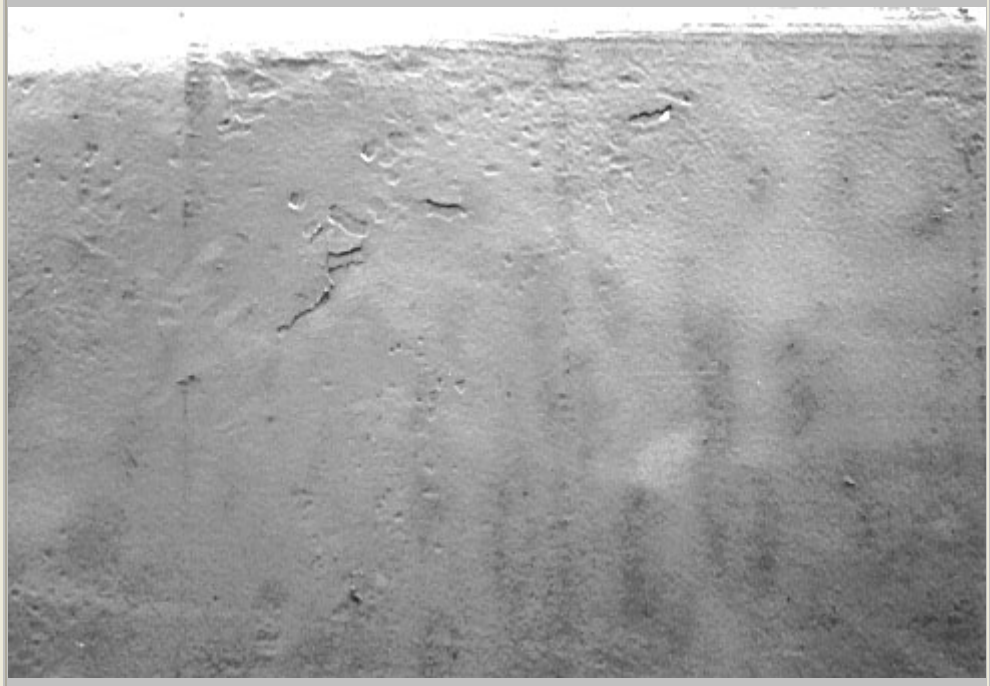
One boat I looked at recently was the real clincher. There was only one coat of anti fouling paint on the bottom, which indicated that whatever had been done most recently was probably only a year ago. Cutting into some of the bottom layers, I found six different colored materials under the antifouling. SIX! In some areas material had been applied over the antifouling. And it was clear, by this variety of multicolored materials, that blister repair had been an on-going patch up process. The fact that the bottom had broken out, not in thousands, but millions of tiny blisters on the surface, just under the paint, is what caught my attention. But what held my attention was that these bottom coatings had turned to mush. Virtually all of the materials applied to the bottom were as soft as day-old paint. Moreover, the stuff was saturated with water and styrene, which has a strong vinegar-like smell. Pick any spot on the bottom and prick it with a sharp knife and this styrene based fluid would start to seep out. Anywhere.

What's happening here is that boat owners are reading stuff in magazines and on the web and then attempting to repair the blisters themselves, either taking advice from people who don't know what they're talking about, or they're just winging it. Whatever the case, they're just making a bad situation worse. Often much worse. They would have been much better off had they just left well enough alone. For instead of blisters, what they end up with is a festering wound.

While there's no way for us to know exactly what's been done and why it went wrong, I have found some common factors.

- The bottom had been sandblasted, attacked with a grinder, or some other method employed that eroded the gelcoat, leaving a pock-marked surface like the face of the moon.
- Materials were used that were either incompatible or inappropriate, particularly fillers or fairing material.
- The materials hawked as being water resistant are not styrene or acid resistant, and were softened or partially dissolved.
- Heavy layers of poorly saturated chopped strand mat continues to be one of the predominant factors in both initial and secondary blistering. The worst cases invariably involve heavy layers of mat on the exterior, as revealed in the top right photo where two ground out blisters reveal a mat nearly 1/4" thick.


**The effects of rotary pressure stripping. This process does not remove the gel coat but merely errodes it, leaving it in worse condition than ever. A barrier coating applied to a surface like this is an exercise in futility and a waste of money. This is not the first time around for this boat: notice the prior repaired area at right. This is the third time around for this boat.**



**This bottom was barrier coated after sand blasting. The craters in the gel coat still remain and the surface is now more porous than ever. The blisters returned with a vengence. They didn't even bother to fair out the craters. Unfortunately, this kind of repair work has become common.**

**Advice for Buyers** Once a blister repair job has been botched, it only gets worse from there. For now the owner has introduced a witches' brew of new chemicals into the equation with all the additional layers he's added. Even worse, he's probably made the hull more porous than it was before, meaning that the poorly saturated mat is going to absorb water faster than ever. There's no way what you see illustrated in these photos can be "sealed." Its like trying to seal a sponge. At this point, the only thing left to do is to strip the entire bottom right down to the structural laminate, which is what should have been done in the first place.

The problem that this poses for the used boat buyer is that the botched repair job is far worse than a boat that merely has blisters. This is not the kind of situation that you want to buy into; in many cases, the botched repair job now will no longer even hold antifouling paint on the bottom because it, too, is reacting chemically and bubbling off. And if you can't keep the bottom paint on, you really do have a problem, one that's a lot worse than just blisters.

This situation is becoming so commonplace that the best advice we can give used boat buyers is to not even consider buying such a boat. And you might just as well inform the broker or seller in advance, before you go the trouble of signing a contract and getting a survey, that you will reject the boat if it has a failed repair job. You should also be aware that the boats built in the orient are the absolute worst for these kinds of problems, with many of the other imports following as close seconds. Moreover, there is a direct correlation to the amount of chopped strand mat on the exterior and where it was built. Its

not unusual to find Chinese boats where the mat is 1/4" thick and over. We are happy to report that the incidence of severe blistering with US built boats is considerably less, although far from non existant.

**Is There a Right Way?** The first thing you have to understand (and accept) is that some boats are not repairable. That's because the quality of materials and workmanship used to build the boat is so bad that what you have is an unstable hull laminate. Adding a barrier coating is not going to prevent the chemical reactions from continuing to occur. You can coat the bottom, but its going to absorb water above the water line and from the interior.

The relationship between boats with severe blistering and boats with excessive chopped strand mat on the exterior can be proven beyond any reasonable doubt. So, too is the problem of hulls where the gel coat is not thoroughly bonded to the mat. Add to that the fact that blisters always occur under the gel coat or with the mat, but almost never within the structural laminates (such as roving or other woven fabrics), and we know for certain that the problem lies within these two outer layers. It stands to reason, then, that if it is possible to remove these offending materials, its is possible to solve the problem. Unfortunately, if the hull has 1/4" of chopped strand mat on the exterior, that mat comprises so much of the thickness of the hull that removing it means removing half the hull. If that's the case, then removing it is no longer an option, so that the hull is then essentially unrepairable.

If the mat layer is thin, say 1/8" - 3/16" then it can be removed without significantly reducing the hull thickness. Of course, there is always the option of stripping a heavy mat layer, and relaminating with a heavy fabric, bearing in mind that fabrics are too strong to allow blisters to form. But that would be rather costly.

We draw a distinction between a bottom that had thousands of pimples and those that have larger blisters. Pimpling is a different phenomenon than a hull that develops just a few larger blisters. While we do not know what the cause is, we can say that it is often associated with solvent softening of the gelcoat. In many cases of pimpling we find the gel coat to be soft and pliable. With larger blisters the gel coat is usually brittle.

Boats with a relatively small number of larger blisters (1" for example) are amenable to spot repairs, which are often successful. If the bottom of your boat has, say, 100 blisters on the bottom, we would recommend spot repairs over stripping and recoating the bottom. We would not recommend barrier coating after spot repairs. Spot repairs are inexpensive, and if they do fail, at least you won't be out a lot of money.

**Repair Tips** We continue to recommend that the best way to solve the problem of extensive blistering is with complete removal of the chopped strand mat. This material is the primary source of the problem. The most badly blistered boats continue to be those with heavy external layers of mat, and it is our opinion that the blistering cannot be stopped until the material is removed.

- Under no circumstances should you ever sand blast or sand sweep a bottom. Sandblasting shatters the plastic and exposes the fibers far more than they already

are. In addition, it craters the gel coat with millions of craters that only worsens the problem when it is sand swept.

- Virtually the same result occurs when these rotary water pressure strippers are used. The end result is as bad as sandblasting. It pocks the gel coat and shreds the exposed fiber bundles, opening up more channels for water ingress.

- The recommended method for removal of gel coat and mat is the planing machine with carbide cutters. This machine will cut off gel coat and mat with minimal damage to the plastic or shredding of the fiber bundles, leaving a clean, smooth surface suitable for recoating. Yes, its more expensive, but it does the job right.

- For spot repairing blisters, we recommend the use of two part epoxy paste ONLY. Do NOT use microballons or fairing material of any kind. You should purchase only the highest quality epoxy, which means the most expensive, and usually one with a recognizable name brand.

- If you do not know how to use a grinder to grind out blisters, DO NOT DO IT. Either learn how or get some one who does. The odds are very high that you will only make matters worse. This is not a job for amatuers. Very few professional yards even know how to do it right.

- Before considering whether to engage a yard to make repairs, determine how thick the skin out mat is. If it is more than 1/8" the odds of success are slim. You will be applying your epoxy or vinylester on top of a sponge.

- Determine how porous the mat is. The better the saturation of the mat with resin, the higher the odds of success. The mat should appear translucent, NOT OPAQUE. If it is opaque or whitish looking, the chance of success if slim. If the mat shows numerous small voids, these are the propagation points for new blisters and the repair is likely to fail.

- If you see blister voids deep within the mat (small, round, opaque areas), the mat has to come off. Coat over this kind of surface and the blisters will come right back again.

- If you are unwilling to pay the cost of stripping off heavy layers of mat, consider whether the blister repair is really necessary. You may be better off just leaving it alone.

Finally, the situation has become so severe that we can only counsel against buying a boat with a botched blister repair job. The ulcers on the bottom of the boat are likely to end up in your stomach.

**Here's a 22 year old Bertram with about 100 blisters on the bottom. It has never had any kind of repairs. Is it worth tearing up the bottom and risking making the situation worse? Or would the owner just be better off leaving it alone? We'd opt for the later.**

**About Barrier Coating** The idea of barrier coating is to replace porous gel coat with a more water resistent material such as vinylester or epoxy resin. In theory, its a good idea; in reality it doesn't always work out that way, for the problem is WHAT you are applying that coating to, and whether the coating can be made thick enough to really keep the water out.

For some answers we looked to Hatteras Yachts which, as many of us know, has had enormous blistering problems in the past, and which dealt with it by repairing many of their boats under warranty. So we started wondering how did those repairs hold up? As near as we can tell, by checking on the number of boats built in the 1980's, the answer is fairly well. Its very easy to determine whether a hull has been repaired just by scratching the surface to see if there's gel coat under the paint. If not, then you know its been recoated. The number of Hatterases we see with reemerging blisters is very few. But bear in mind that these are very expensive, larger yachts (50, 60, 70 footers) where the job was probably done right. Usually with the outer layers being removed by hand grinding. The other factor we see is that these coatings are usually quite thick and don't involve any fairing material (like microballons) at all. In other words, the repair is a combination of epoxy paste filler and epoxy or vinylester coating. And nothing else.

The chopped strand substrate on a Hatteras is usually quite thick and porous, but when we see the jobs done at yards like Derector-Gunnell and other high end yards, (I'm talking here over a period of a decade or more) we usually see most of the mat removed and the roving showing through in many places. For the most part, these repair jobs are either completely successful, or fail completely. Very rarely do we see reemergence of only a

few blisters. Contrast this with the massive failures that are found on smaller boats. Obviously, with high the cost of a repair job on a million dollar yacht, there is considerable motivation to do it right, as the cost of failure could seriously hurt a yard.

Considering these factors, its hard not to draw some conclusions about the relationship between the dollar value of the repair versus the success rate. The bigger the yacht, the greater the success rate. So what's going on here? Is barrier coating working? Or when it fails, why does it fail? Well, I think the answer has already been given in what has been said so far. The answer is in knowing what works, and the knowledge of how to do it right. But ultimately that boils down to an issue of COST. Successful blister repair is expensive. Barrier coating only works up to a point. That point is predicated on applying the coating to a surface that is not highly porous, such as with a heavy layer of mat. Barrier coatings are not completely water proof, nor can all the water in the hull laminate be eliminated, or prevented from returning. Water can be absorbed from above the water line, and from the hull interior. To be successful, the voids where blisters propagate have to be eliminated. And that usually means removing the chopped strand mat.

**Why Are There No Absolute Answers?** I am often asked this question, but the answer is difficult to comprehend if you don't understand the nature of boat building. It goes back to the fact that boats are hand made items, usually by companies that are quite small and are sorely lacking in resources and production controls. One day they use this kind of material, the next day something else. In other words, most boat hulls are different, even among the same models by the same builder.

Because there are tens of thousands of different boats all built somewhat differently, no one has even bothered to attempt to study the problem. Besides, how could anyone go around chopping up peoples boat's to study the problem? Even if someone were willing to invest the millions that such a research study would require, the resulting answers would probably be very unsatisfying. It would likely end up with dozens of explanations and mitigating factors that would leave us just as confused as ever. In fact, some of the chemical companies have done some in-house research, including the one I was involved with back in the early 1980's (Uniflite). While I never saw the entire results of that research, I do know that a large number of factors were identified, far more than are common knowledge today. If a complete dissertation on the subject were published, it would be so complex that no one would want to read it. It would just make your head swim with possibilities. It may be just as well that that research, utilized in the Uniflite class action lawsuit, was ultimately sealed in the court settlement, never to be revealed.

The only thing we know for sure is that it is quite possible to build boats that don't blister by using quality materials and methods. As long as the boating public is willing to foot the bill for this terribly expensive problem, without holding the builders feet to the fire, then we'll just have to suffer with it.

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