Fiberglass Blisters – Effective prevention and treatment

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Boating World

http://www.boats.com/news-reviews/article/fiberglass-blisters

Fiberglass blistering seems to have become an increasingly common problem in the past several years. For most boats, it has been primarily a cosmetic problem, albeit a vexing one, but there have also been instances of hulls so damaged by blisters as to be rendered unseaworthy, which is the reason the Coast Guard funded a study of the problem. The American Boat Builders and Repairers Association also provided a grant, and the Department of Chemical engineering at the University of Rhode Island was selected to conduct the research, which began in 1985.

An initial report from URI, issued in 1986, identified the principle cause of blisters as the presence of water soluble materials in the hull laminate — from chemicals in the resin or from dust, dirt or sawdust — that set the stage. As water molecules penetrate the laminate they combine with these materials to form a droplet of solution. Because of osmotic pressure, more water molecules combine with this droplet, eventually expanding enough to cause a blister.

The solution formed by water mixing with the water soluble materials in the laminate is acidic, and more concentrated than pure water. Osmosis is the tendency of two liquids of different concentration, when separated by a semipermeable membrane, to mix. Thus water molecules pass through the membrane to combine with the more concentrated liquid. (The semipermeable membrane in this case is the fiberglass laminate). The new mixture attracts more water, expands, and causes the blister.

Stress, whether from water absorption in the gel coat or from the rigors of the sea, was also found to be a culprit, with water soluble materials concentrating in microscopic cracks or at interfaces between layers of laminate. A third kind of blister was also deemed possible: the long-term effect of water saturation of the laminating resin. Most of us don't think of our fiberglass hulls as having the characteristics of a sponge, but the URI study has demonstrated that fiberglass laminates do indeed absorb water.

The most recent report from URI has proven to be controversial within the marine industry, and it breaks with the traditionally accepted methods of both preventing and repairing blisters.

A "barrier coat" generally has been considered to be the best preventive medicine against boat pox, and most major paint manufacturers have a "high build" epoxy coating that offers a high level of resistance to water penetration. These high build coatings, which add about 5 mils of thickness

per coat, are usually used in two or sometimes three coats below the waterline, followed by the normal application of bottom paints.

Most modern gel coats use an isophthalic resin base, which has shown to be more water resistant than the orthophtalic resin used in the hull lamination. Care must be taken to keep from damaging the gel coat surface when prepping the surface because, though it is known to be fragile and water permeable, it is still far more protection than the primary laminates of the hull. Don't gouge or chip the gelcoat, and rely on an even sanding to provide adhesion for the barrier coat.

The URI study indicates that most fiberglass hulls are vulnerable to blistering or internal water damage as a result of long periods of immersion. It suggests that the hull should be sanded and coated below the waterline every one to three years, depending on water temperature and the length of time afloat each year. If the boat is in cold water for only six months per year and the bottom is carefully inspected every year, renewing the bottom coating every three years may do the job. If the boat is afloat in warm water 12 months per year, the coating should probably be renewed annually.

The process of re-coating the hull involves sanding off all previously applied paint (but not the gel coat!), and then allowing the hull to dry for two or three days to reduce the moisture content of the gel coat. The drying is so important that the URI report suggests that the sanding be done in the fall and the recoating in the spring, if possible.

The URI study mentions the traditional epoxy barrier coat but, in a finding that is a bone of contention within the industry, also suggests that a common alkyd-urethane-silicone marine paint — such as is used on topsides — is a better protection because there is a chemical interaction with the gel coat.

The report also indicated that epoxy coatings do a good job as a water barrier, but "may result in more severe blistering once it starts". Why this occurs is unclear, but the researchers suspect that curing agents in the epoxy may be the culprit.

Whichever prevention method is chosen, all blisters must first be repaired, and three degrees of blistering have been defined by the report:

Type I: Near-surface blisters. Type II: Deeper blisters and cracks extending through resin rich surface layers but not reaching half the hull thickness. Type III: Severe, deep-seated blistering, cracking and delamination that extends through most of the hull thickness and jeopardizes the structural integrity of the hull.

For Type I damage, the first step is to open and drain all blisters, then dig out the damaged fiberglass. The gel coat should be removed from the entire bottom by careful sandblasting or using a power sander with 20 grit aluminum oxide or silicon carbide paper. The URI report emphatically urges

frequent changes of sandpaper, to avoid moving the dirt around.

The entire bottom and the damaged areas must then be washed with a stiff nylon brush and fresh water. If you have access to a high-pressure washer, that's even better.

Following this, it's a good idea to inspect the surface (and particularly the damaged areas) with a magnifying glass, to be certain all the dirt and debris has been removed. These impurities can quickly cause reblistering.

The hull must then be dried, to get the saturation of the laminate below 50 percent, which can take considerable time, as reflected by the following table:

Temperature	50% Relative Humidity	25% Relative Humidity
100 F	l6 days	9 days
83 F	32 days	18 days
65 F	64 days	36 days
47 F	128 days	72 days

One of the best ways to be certain that the hull has fully dried is to use a moisture-meter, available at many major boatyards which handle blister repairs.

The URI report recommends repairing the pitting with a compound made up of polyester resin, chopped glass, and colloidal silica. The report also mentions that it's best to do as much fairing as possible while the filler is in the liquid state, because sanding will be difficult. It will indeed: colloidal silica is actually fine sand, and it rapidly destroys sandpaper.

The generally accepted industry method of blister repairs has been to use epoxy resins mixed with chopped glass or powder, after first making sure that the epoxy is compatible with the polyester used in the hull laminates.

For Type II damage, an additional step is necessary before final coating an extensively blistered hull. The entire bottom must be covered with a 1/8-inch layer of fiberglass, which can be done by rolling or spraying isophtalic resin into one or two layers of E-glass "veil mat," a light reinforcement. This must be done in one continuous operation and, when cured, the bottom must be carefully washed, sanded, and washed again before the final coatings.

The good news about Type III damage is that it is quite rare, but the bad news is that the hull is useless and irreparable.

There is a clear message for anyone intending to buy a fiberglass boat. With a new boat, the bottom should be sanded and washed as for Type I blistering, and then a barrier coat of either epoxy or the URI-recommended

finish should be applied.

Anyone buying a used boat should certainly have a careful survey, including an assessment of the amount of water absorbed into the hull laminate.

Most boat builders have faced the blistering crisis in varying ways, and Beneteau is an outstanding example of a company responding quickly and honestly to the problem. In the mid-1980s, it was discovered that some boats from one of their four plants were developing blisters, which set off a massive research effort to discover the cause. The culprit turned out to be an unannounced change by a supplier to a water soluble catalyst.

Beneteau corrected the problem and then directly contacted all owners of flawed yachts to have the underwater gelcoat removed and replaced. The process is neither simple nor inexpensive, but the result for each Beneteau owner has been a completely blister-free yacht and a renewed faith in the company.

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