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{BARRIER BUILDING}

What Protects Your Hull?

By Bob Anderson

One of the greatest challenges of boat manufacturers is to maintain the aesthetic integrity of the hull throughout the manufacturing process.Inherent in hull construction are chemical reactions that can cause a finish to distort,bubble,and even crack over time.Some major boat manufacturers have begun to apply a barrier coat during construction in order to protect the hull exterior and preserve the boat's aesthetic appeal.

As the resin layers in a laminate cure,they produce an exothermic reaction,and the continuous shrink that occurs can distort gel coat, causing it to appear bubbled or ridged.This effect is referred to as "print through." In a closed molding environment,the added pressure required in the process can exacerbate the effects of heat, causing even more significant print through.

After production is complete,as the boat is exposed to climatic changes like temperature variations,the effects of continuous shrink are amplified by the post-cure process,which makes imperfections on the hull's surface profile increasingly more pronounced.These additional imperfections may require repair.Often these repairs fall under the boat's warranty and,therefore,cost the manufacturer time and money.

While the print through alone does not significantly affect a boat hull 's mechanical function, it reduces the aesthetic value of the boat. In the past,many boat manufacturers removed the effects of print-through by sanding down the hull and buffing imperfections in the gel coat to obtain the desired shine.However, this re-work is costly in time and materials.In addition, as they are exposed to sunlight and the elements, re-worked areas can create even more cosmetic imperfections via potential "yellowing." As a result,,many forward-thinking boat manufacturers began to look for ways to improve the laminate 's surface profile during the manufacturing process.

Filled barriers

To address the concern of the manufacturers,several chemical companies researched and developed a concept now known as barrier coats.These barrier coats were specifically designed to protect the surface gel coats from the exothermal reaction produced by curing resin.Shiraz Sidi, Director of Materials for VEC Technology, a subsidiary of Genmar Industries, is responsible for testing all materials for building laminates at each Genmar plant.

Severe print through effect in the vacuum infused panel constructed of gel coat,96 oz.skin and 1-inch balsa wood.

"The primary function of the barrier coat is to enhance the blister resistance in the gel coat," Sidi,who has become a strong advocate of barrier coats,says."It also acts as a print blocker,giving us much better cosmetics."

During production,after the gel coat is applied to the hull mold, the barrier coat is sprayed to a thickness of 25-35 mils.After reaching the necessary cure stage,resin layers are added.As the resin cures,the barrier blocks the heat of the reaction and protects the gel coat against any distortion.

Interplastic Corporation was one of the first companies to pioneer the field with a non-filled barrier coat resin.By 1994, sprayable filled barriers were introduced on a large commercial scale by Magnum Venus Products and ITW SprayCore.In the past few years,large resin suppliers, including Cook Composites, Reichhold and Ashland,have followed suit and started introducing their own spray barrier systems. These sprayable barrier coats are now being used in the production of such well-known boat brands as Crownline, Four Winns,Larson, Stratos and Mastercraft.But,what 's the secret behind barrier coats?

Anatomy of a filled barrier coat

The effectiveness of a barrier coat lies in its chemical properties.The filled barrier coats currently on the market are made from a premium vinyl ester and high quality isophthalic resins.Then,non-wicking fillers are added to prevent water from finding a direct route to permeate the laminate,which makes filled barriers highly effective in providing water permeation protection.Additionally,by way of osmotic pressure,the vinyl ester resins that are added to the barrier coat formula also minimize the amount of water that migrates into the laminate.

Vinyl esters,by resisting cracking,also contribute to improved physical properties such as flex and elongation.In a vinyl ester,when the very active carbon-to-carbon double bonds react,their terminal cross-linking allows the entire length of the molecular chain to elongate under stress and therefore absorb mechanical shock.

When a filled barrier coat is added to a laminate,the physical properties of the laminate as a whole change.It is a common miscon- ception that these changes to the laminate produce negative results. And,while adding a filled barrier behind the gel coat does increase the percentage of the unreinforced material in the total laminate, thereby reducing the strength of the laminate,the reduction is very slight.Tests demonstrate that the structural integrity is still well within the accepted range of performance metrics.

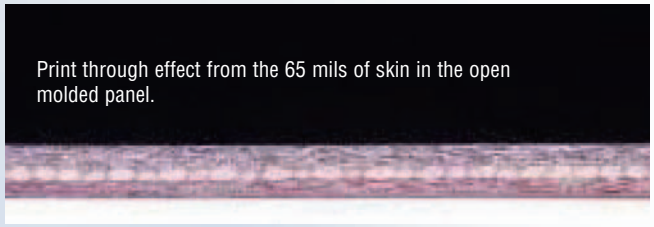
In applying a barrier to a laminate,pin air is essentially eliminated during the manufacturing process.Since the barrier coat is applied as a liquid,it conforms exactly to both the gel coat and to the resin layers, filling in any pockets that may form as a result of the fibers in the resin. This perfect fit eliminates any air bubbles that could develop into holes or cracks.

Testing

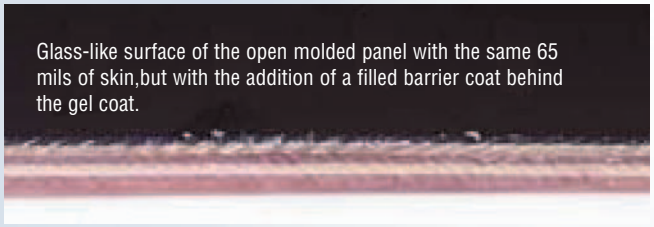
Before making the investment in equipment and changing the flow of the manufacturing process to accommodate a barrier coat operation,boat ma ufacturers must feel that the benefits of a barrier coat far outweigh the investment.Extensive testing by independent laboratories using both closed and open molding manufacturing approaches has demonstrated the filled barrier coat's effectiveness in greatly increasing a laminate's osmotic protection, ability to maintain its strength, and flexibility.

Surface profile of the vacuum infused pane;constructed of gel coat, filled barrier coat, 96 oz.skin and 1-inch balsa wood.

Print through effect from the 65 mils of skin in the open molded panel.



Glass-like surface of the open molded panel with the same 65 mils of skin,but with the addition of a filled barrier coat behind the gel coat.



All photos courtesy of ITW SprayCore

The addition of a barrier coat to a laminate increases the osmotic protection of the laminate.When subjected to a boil test,a laminate that included a barrier coat sprayed at 25 mils showed no signs of blistering after 100 hours at 212 degrees Fahrenheit and after 200 hours at 150 degrees Fahrenheit.In fact, tests show that even if the gel coat cracks, the barrier coat behind it continues to provide water protection to the laminate layers, reducing damage to the hull.

Flexural testing using an ASTM D790 test (3-point bending,gel coat face in tension) yielded equally positive results.Two panels were tested:one that had been constructed with a barrier coat and one constructed without the additional layer. As expected,the addition of the barrier coat initially reduced the laminate's strength, but after immersing both panels in water for 28 days at 35 degrees Celsius,the panel without the barrier coat absorbed a significant amount of water,which reduced its strength by 16.5 percent.The strength of the panel with a barrier coat was reduced only by 1.9 percent.

Current filled barrier coats available on the market have higher elongation than typical gel coats and most skins,which greatly reduces the risk of gel coat cracking.The elongation of a standard gel coat is 1.4 to 1.8 percent and, similarly,the elongation of most skins (constructed with laminating resin and 35 percent glass) is 1.6 to 1.8 percent. However, the elongation of syntactic barrier coats has been shown to be 2.4 percent and greater, providing greater protection to the laminate than a gel coat alone can.

Advantages

While it adds an extra step to boat production, applying a barrier coat has significant benefits to boat manufacturers.The most significant include:

- **Improved cosmetic appearance of finished hull surface:** Applying a sprayable syntactic barrier coat eliminates print through,pinned air instances, and other cosmetic problems associated with the cure process while improving the entire laminate surface profile;
- **Reduced time refinishing print through on boat hulls:** According to the recent studies, the detailing department production time decreased 30 percent when a syntactic barrier coat was used behind the gel coat (figures are based on 30 ' pleasure boat));
- **Extended mold life:** When used in a mold- making process,barrier coats can extend the life of the mold and increase the number of pulls.The syntactic barrier coat works as a heat sink, which reduces the thermo shock cycle. The barrier coat also cuts down on mold repair by preventing the print-through in the mold itself;
- **Increased water resistance:** In addition to providing a buffer against the heat of the curing resin,the barrier coat prevents water from permeating the layers of the laminate; and
- **Greater flexibility:** Filled barrier coats currently available on the market have higher elongation than a gel coat alone, providing greater flexibility,which reduces the risk of the gel coat cracking.

These significant advantages of using a filled barrier coat have lead many savvy boat manufacturers to change the way they do business. Barriers provide a viable solution to issues that have plagued these businesses for decades.

With the introduction of new regulations and initiatives to reduce emissions leading more facilities to use a closed molding environment, concerns about heat distortion and print through will become even more significant for manufacturers.Fortunately, there are proven barrier options available to help boat manufacturers to provide quality products with longer-lasting aesthetic appeal to their clients. CF

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