Optimization of Bonded UHMW for Improved Performance and Reduced Costs of Boats and Marine Structures

Introduction

Advancements in technology come in many varieties. While a few have been obvious "game changers," most technology breakthroughs have traveled a long road of development before evolving into revolutionary products. In fact, revolutionary products are often discovered by combining new technologies, designs, and methods.

Resistance to change in technology is understandable. In some cases, people do not perceive the need for change. Other times a change is deemed risky and not worth the cost to validate. If a new technology is meant to immediately replace the old technology, this can lead to poor results; typically a new technology must be worked into a problem over time to realize its true potential.

Such has been the case for LinkTech's new OceaPoly® technology for applying Ultra High Molecular Weight Polyethylene (UHMW) to boat hulls and other marine structures.

Development of OceaPoly

UHMW is well known for its toughness and slick surface — qualities that make it an ideal material for marine applications where contact abrasion is a problem. However, its "bolt-on" construction creates cost and reliability issues. Early attempts to bond this extremely slick material were unsuccessful.

LinkTech's OceaPoly® is a breakthrough technology that enables reliable bonding of UHMW. However, it hasn't always been obvious how to use OceaPoly to replace the "old way" or traditional materials.

OceaPoly's long road started back in 1992, when food processing was looking for better ways to handle sticky foods. UHMW seemed like an obvious solution. The first hurdle was how to deal with seams where food could become trapped. That's when LinkTech developed its UHMW welding process.

Success in solving food processing problems led to other ideas for applying UHMW; if only it could be bonded to steel or other materials. So, LinkTech developed a

Figure 1 - LinkTech fabricated, and Red Cedar Technology designed, the first ever food vibratory conveyor pan with carbon fiber bonded to UHMW.

patented method for manufacturing UHMW with a bondable surface. This advancement continued to improve applications in food processing, but it also led LinkTech to consider applications in other industries.

Regardless of the application, however, the process was never as simple as replacing one material for another. While the properties of UHMW had their benefits, each application required a redesign to account for different properties and assembly techniques. At this point, LinkTech teamed with Red Cedar Technology, who applied the HEEDS® design optimization technology to ensure that each new solution provided maximum performance at minimum total cost.

Red Cedar Technology provides design optimization software and consulting services. The HEEDS® optimization search technology, SHERPA, is a hybrid and adaptive technology that breaks the barriers in optimization. It has been successfully applied in the automotive, defense, biomedical, aerospace and marine industries, among others, to find optimum designs when experience, intuition and other methods have failed.

Marine Applications of OceaPoly

Marine applications seemed to be a natural fit for the new bonded-UHMW technology. There were several existing applications in which UHMW had been bolted to docks and the inside of ships as bumper material to reduce abrasion damage. However, the bolts created

high installation costs, reduced the effective thickness of the UHMW, induced stress risers and fatigue points to the substructure, and allowed the UHMW to warp.

Landing craft bays

LinkTech's OceaPoly solved these issues for the M80 Shipco Stiletto in the landing craft bay, resulting in a lower-cost installation with no stress risers or water collection points; a stronger, stiffer floor; and easier maintenance.

Boat hulls

With its successful application in landing craft bays, it seemed logical to apply OceaPoly directly to a boat hull in damage-prone areas. The first application was to the Christensen Yachts Bulbous Bow Plates where damage was common. OceaPoly was thermo-formed for a clean, tight and permanent fit over the existing structure. As anticipated, it created a protective surface from anchor- and chain-strike damage. A remarkable, but not surprising, reduction in drag was an unexpected bonus.

Anchor Innovation, a Virginia Beach company, realized the potential of OceaPoly and has teamed with LinkTech to help foster and realize more game-changing marine applications. The next frontier for the bonded UHMW is the hull surface for boats to reduce drag and surface damage. However, straight application of UHMW to an existing hull design will add undesirable weight. The bonded nature of OceaPoly increases strength, and the UHMW is lighter and more buoyant than aluminum or fiberglass; therefore, less base aluminum or fiberglass is required.

Again, LinkTech is working with Red Cedar Technology to apply HEEDS design optimization technology to the problem to find an optimum solution that not only reduces drag and damage, but also provides a total lower-cost solution with reduced overall weight.

Adding OceaPoly to an existing boat design is a challenge that requires advanced analyses of a multi-ply structure with multiple load cases, competing requirements and many variables. As with most new technologies, this application will require development to realize a revolutionary advancement in boat design, performance and cost.

Conclusion

Innovation is a team game involving new technologies, engineering development, validation, and a vision of new applications. LinkTech, Anchor Innovations, and Red Cedar Technology have formed such a team, working together to realize new levels of performance and cost reduction in boat and marine applications.

Figure 2 - Stiletto landing craft bay.

Figure 3 - Bulbous bow with thermo-formed OceaPoly protective surface.

Figure 4 - Common damage to aluminum boat hulls due to normal use.

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