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Top Stories

## Making The Splash Zone Less Vulnerable

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As the owner of approximately 816 million square feet of waterfront bulkheads, the Navy is employing a novel technique to protect a particularly vulnerable section of these steel and concrete structures—the splash zone.



*Sea water immersion and splash, pollution, and ultraviolet light exposure corrode the steel and concrete bulkheads at Naval Air Station in Pensacola (above), and the Naval Station on the eastern shore of San Diego Bay (below). Photos courtesy of Naval Facilities Engineering Command (NAVFAC).*



Spanning from the lowest tidal mark in a given year to as many as 10 feet above the year's highest tidal mark, the splash zone easily falls prey to corrosion. In fact, the corrosion rate of unprotected steel in this area of bulkhead can exceed 30 mils per year. Not surprisingly, the splash zone frequently requires expensive maintenance or even replacement.

Traditionally, the Navy has protected the splash zone with coating systems comprising either three coats of epoxy-polyamide or two coats of coal tar pitch epoxy-polyamide. Either coating system is applied during the initial painting of steel placed in seawater immersion/splash zones. Between five to eight years of service, the coatings are in need of maintenance. However, because of the high cost and environmental requirements, it is more typical that steel members (sheet pile or support members) are left in place until replacement is required.

When maintenance is carried out, the structures are stripped to bare metal and recoated with a splash zone maintenance coating. This second application is usually good for another three years.

Given the amount of bulkhead under the Navy's purview, one can appreciate the great cost and effort needed to maintain these vital facilities. Notwithstanding these demands on Navy resources, the conventional coating systems also release pollution-generation volatile organic compounds (VOCs) and hazardous components during application when coal tar epoxies are used.

### ***A Longer-Lasting, Greener Alternative***

In 2002 the Navy launched a program to develop alternative high-performance coatings that would be suitable for initial and in-service splash zone applications. The initiative led to the "Polysulfide Modified Epoxy Novolac Cladding for Steel Immersion/Splash Zone Service" program, which ultimately yielded a sprayable, fast-cure, self-priming cladding formulated to withstand harsh splash zone conditions.

PolySpec Corporation, of Houston, Texas, and POLYMERright, of Fremont, California, developed the self-priming cladding under contract with the Naval Facilities Engineering Command (NAVFAC) through its Small Business Innovative Research program.

The Navy initially tested the polysulfide-modified epoxy novolac self-priming claddings in small-scale application trials under actual field conditions. Results of the tests were promising, indicating that the self-priming claddings formulated under phases one and two of the research program would offer protection lasting more than twice as long as the previously used coatings systems.

"The primary objective was to develop a coating system that could be used for in situ maintenance of steel sheet pile," recalled Daniel Zarate, Research Chemist and Paints & Coatings expert with the NAVFAC Engineering Service Center in Port Hueneme, California. "This is to help extend the life of the sheet pile, thereby reducing long-term costs."

Indications to date suggest that NAVFAC will accomplish this goal. "We anticipate a doubling of the life cycle of the sheet pile, at a minimum, but what the actual life cycle could be is still an unknown," Zarate said.

Illustrating how the self-priming cladding could help the Navy reduce bulkhead maintenance costs, Zarate said the cost of installing or replacing sheet pile is approximately \$30 per square foot. "A common installation size is around 1,000 feet by 20 feet deep, or approximately \$600,000 to install," he said. "We anticipate doubling the life of the sheet pile in place, which would avoid the typical replacement cost at least once in the new life-cycle mode."

Zarate also noted that the self-priming cladding should greatly reduce if not altogether eliminate the need for maintenance early in the bulkhead's life cycle. "At a cost of \$23 per square foot, this cost is eliminated and impacts on operations are also eliminated," he explained.

From an environmental standpoint, self-priming cladding eliminates VOCs as well as the carcinogenic compounds present in coal tar epoxy systems. "For a 1,000-foot-by-20-foot wall, this translates to 597 pounds of VOCs and 847 pounds of coal tar pitch," he said.

Zarate pointed out that the coating system was developed to be more flexible and more resistant to the splash zone environment than the current systems used in similar applications. "The component that provides the flexibility is attached to the resin so there would be no loss in flexibility due to component migration," he explained. "This also has an environmental impact in that there is no leaching of possibly toxic compounds."

### ***Coating Application Requires Skill***

Although the self-priming cladding coating is more surface-tolerant than earlier coating systems, a well-prepared surface obviously will help to optimize its performance. Zarate notes that self-priming cladding sets rapidly so that it can be applied in a single coat to a thickness of up to 60 mils. "This is three times the typical 20 mils for coal-tar epoxy systems," he says. "With a heavier coating we expect longer in-place service and also lower maintenance requirements."

Properly applying the coating system demands a skilled applicator. The technician must ensure that the spray equipment provides tighter or more accurate mixing controls. Given this particular requirement, the overall application cost for self-priming cladding will be higher than that of more established coating systems. The need for greater mixing control stems from the fact that the reaction of two or more components occurs at or near the spray gun in a plural-component system such as self-priming cladding. In contrast, a conventional coating system is combined and then applied using a single hose and simpler spray gun design.

Zarate noted that a product standard for self-priming cladding under the Master Painters Institute is being developed. Subsequently, the system will be incorporated into the updated/draft UFGS (United Facilities Guide Specification) construction standards for splash zone applications and sent forward for publication.



*Pictured (top) is typical corrosion on steel piling at Naval Air Station Pensacola. A technician (bottom) applies a high-performance coating to the piling in order to protect the splash zone.*

