MARINE LOG

See p 18, 20

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Cover photo: Kvichak Marine Industries, Seattle, delivered this 34 ft vessel for fast-response duties with Clean Rivers Cooperative of Portland, Ore. (p, 41)

One of a pair of 1 m diameter CLT propeller units fitted to the 34 knot hydrofoil *Barracuda*. Owner Trasmediterranea now intends fitting CLTs to its other hydrofoils (p. 27)

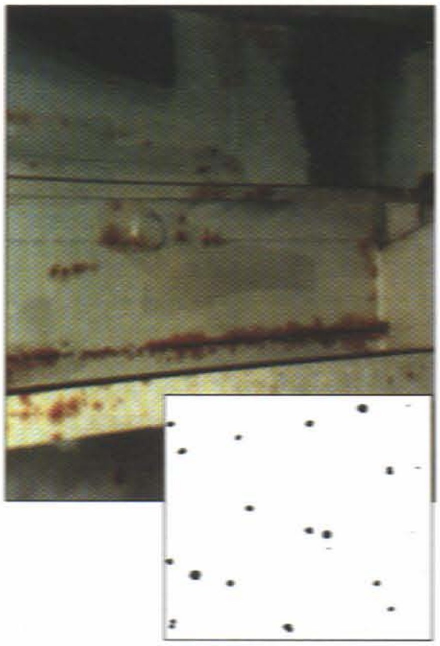
DEPARTMENTS

NEXT MONTH

ANNUAL YEARBOOK ISSUE: FACTS AND FORECASTS

ASSESSING COATINGS CONDITION, BY THE BOOK

Throughout a vessel's life, many areas of its steel structure will be prone to corrosion. Ensuring continued structural integrity of the vessel means that this must be given due regard both at the newbuilding stage and a part of periodic maintenance. The enhanced survey scheme introduced by the leading classification societies puts a new emphasis on coatings and their maintenance. This, along with developments in coatings technology, has prompted the American Bureau of Shipping to provide its field surveyors with a manual on the subject. In fact, *Coating Systems: A Guidance Manual for Field Surveyors* is likely to prove invaluable to anyone involved with marine coatings. The first part gives a general overview of what marine paints consist of, which types are selected for which applications, surface preparation and paint application along with chapters on alternatives to "hard coatings" and on corrosion and cathodic protection.



Coating at left is in "fair" condition, with 0.5% spot rusting, though there is coating breakdown on welds. Coating at right is in "poor" condition with >20% corrosion and discolorations

The second part of the manual deals with the assessment of the condition existing coatings, with the following "ratings" suggested:

- **GOOD**—only minor spot rust.
- **FAIR**—with local breakdown at edges of stiffeners and weld connections and/or light rusting over 20% of areas under consideration, but less than as defined for POOR condition.
- **POOR**—general breakdown of coating over 20% or more of areas or hard scale at 10% or more of areas under consideration.

The table at right shows how the Tanker Structure Cooperative Forum has tabulated these definitions.

The ABS manual includes a visual assessment scale for breakdown and numerous large, four-color photographs, with accompanying notes, that give examples of these conditions. It notes that coating condition should normally be judged over large areas. **Write 119**

TSSC DEFINITIONS

Rating/condition	Good	Fair	Poor
Spot rust	Minor		
Light rust	Minor	<20%	
Edges weld	<20%	>20%	
Hard scale	Minor	<10%	>20%
General breakdown	Minor	<20%	>20%
Other references			
ISO	Ri3	Ri4	Ri5
European rust scale	RE3	RE5	RE7

CALCULATING LIFE CYCLE COSTS, ON THE PC

More than 50% of the world's annual production of iron goes to replacement of material lost through corrosion. Though corrosion costs worldwide are enormous, it is estimated that up to 25% of this loss can be prevented.

To help reduce corrosion costs to a minimum, Jotun A/S has introduced a life cycle cost analysis method for the selection of the right initial coating system. It has developed a simple PC program that makes it easy for any industry to calculate life cycle costs for any given coating system.

In estimating life cycle costs, a key factor is the maintenance interval of a coating system. Significant savings can be made by choosing products with an increased lifetime, since, says Jotun, the cost of maintenance is many times the cost per square meter at the new construction stage.

"The cost of maintenance is decided at the newbuilding stage," notes Jotun, and is "basically a direct result of the chosen system's lifetime and maintenance intervals."

OBJECTIVE FIGURES

In the Jotun PC program, the user's own objective figures are put in. To calculate life cycle costs, the user establishes an expected life time for the coatings system, for example 10, 15, 20 or 25 years. Costs per square meter for construction and maintenance are established next, with the user putting in actual costs for 14 factors that include scaffolding, degreasing, cleaning, steel work, preparation and application as well as the costs of the material. The program also takes into consideration the inflation and interest rate needed to establish net present value and the user's input for repair intervals and percentage of area to be repaired.

"A coating system may be cheaper to install initially, but if it has a shorter life and requires frequent maintenance, the total life cycle cost will be much higher," says Jotun. **Write 120**

THERE'S MORE THAN ONE KIND OF RUST ...

Environmental constraints are compelling more ship repair yards to turn to hydroblasting, or water jetting, as an alternative to grit blasting for surface preparation. One key to successful coating of waterjet-prepared surfaces is the use of "surface tolerant" coatings.

At the recent *Marine Log* Ship Repair & Marine Maintenance conference in Houston, Dr. John Kelly of International/Cortaulds Coatings said that consideration of these coatings must start with an assessment of any surface contaminants present, their acceptability for overcoating and their possible effect on the short and long term performance of coatings to be applied. Questions to ask about surface contaminants, according to Kelly, include:

Are they loose or tightly adherent?

Will the coatings applied to the contaminated surfaces wet them out to give the coatings the best chance to perform by allowing them to properly adhere to the surface?

Oil and grease, water and moisture, chemicals, and dust and grit are all loosely adherent visible surface contaminants. They should be removed from surfaces according to SSPC-SP1 procedures prior to coatings application.

Some available coatings can be applied to damp surfaces, or even under water. If the coating system is to perform as intended, the application method must be such that the water is displaced from the surface, allowing the coating to come into intimate contact with the substrate to allow adhesive bonds to be formed.

Chalk may form on the surfaces of, for instance, epoxy and alkyd coatings as a result of ultraviolet degradation of the binders. It is loosely adherent and should be removed prior to overcoating, using processes such as high pressure water washing or abrading the surface.

Non-visible contaminants, including soluble salts such as chlorides and sulfates should also be removed from surfaces prior to overcoating—especially when the surface is to be put into immersion surface—to prevent osmotic blistering. Levels of non-visible surface contamination are included in a recently-issued SSPC/NACE joint standard on surface preparation by water jetting.

Light flash rusting (above) and moderate flash rusting (right) on surfaces hydroblasted to an Sa2 equivalent

RUST

"There is more than one kind of rust," Kelly told the conference. Heavy rust of any type should not be overcoated unless absolutely necessary since it does not provide a sound substrate. Coatings are available that will penetrate into rust and bind the rust particles together or act as a converter, but their use is "a compromise."

General atmospheric rusting or rusting in immersed conditions is contaminated with chemicals from the environment to which the metal has been exposed, such as chlorides or sulfates. In contrast, flash rust formed after preparing surfaces by water jetting using potable water consists of pure iron oxide, which, noted Kelly, is actually a constituent of some coatings. At low to medium levels, flash rust is suitable for overcoating with many coating systems, since it is tightly adherent and won't react with the metal substrate or the coating applied over it. This fact needs to be appreciated when inspecting surfaces prepared by water jetting.

The story is different with mill scale. This oxide layer, formed during the hot rolling of steel, appears to be hard and tightly adherent. But if it is not removed prior to top coating, corrosion will continue within the layers of mill scale and a stage will be reached when the stresses formed will cause de-lamination. This will result in the removal of any coating applied over the mill scale in the areas of de-lamination. This will also occur if heavy rust scale is overcoated.

After evaluating surface contaminants, the existing coating should be assessed. Factors include its generic type, the number and thickness of coats, the level of adhesion to both the original substrate and to between coats and the age of each coat.

The compatibility of the surface-tolerant coating with the existing substrate must then be considered. It should adhere well to the substrate and contain solvents having no adverse effects on the existing coating system. Shrinking during drying and curing produces internal stresses in coatings; the more coats and the higher the thicknesses, the greater the stress. The internal stresses developed during the aging process of the new coating should not affect the existing system. Thus coatings that develop high internal stresses should not be applied over systems with poor adhesion or low cohesive strength. If there are any doubts about compatibility, it is advisable to apply a test patch of the surface tolerant coating.

RISK FACTORS, SURFACE PREPARATION AND APPLICATION

In choosing the coating to be applied, "risk factors" to be evaluated should include overall performance expectations—the expected service life—and the service conditions: immersed, non-immersed, internal or external exposure, chemical exposure, wet and dry cycling and whether subject to wide temperature fluctuations.

For surface tolerant coatings, the most usual types of surface preparation are:

SSPC-SP1	Solvent cleaning
SSPC-SP2	Hand tool cleaning
SSPC-SP3 or SPA	Power tool cleaning
SSPC-SP7	Sweep blasting
HB2	Hydroblasting to commercial standard
SB2	Slurryblasting to commercial standard

Many generic types of surface tolerant coatings are available. Warns Kelly, "the important thing to remember is that the overall performance of any coating system is dependent upon the actual coating formulation (not all coatings are created equal)."

The method of application should allow the coating to come into intimate contact with the substrate to allow adhesive bonds to be formed. In some cases, this means that brush or roller application is preferable to spray techniques. **Write 121**

UHP WATER JETTING OFFERS ADVANTAGES

"Although a waterblasted surface may look different than a sandblasted surface, it is a better surface for coatings to adhere to," says Mark Swearingen of WOMA Corp., a Seattle, Wash., manufacturer of equipment for Ultra High Pressure water-jetting equipment. "A sandblasted surface tends to have a bright appearance when freshly blasted, hence the term 'white metal'. A waterblasted surface will have a dull gray, possibly mottled appearance. Despite the appearance, the waterblasted surface is far superior. All contaminants, such as chlorides and oils, have been removed. The sandblasting operation tends to trap the contaminants in the valleys of the metal. Another benefit of UHP surface preparation: When the base primer is in good condition, the top coating can be stripped, leaving the primer base. This is not possible with abrasives."

To prepare a surface properly with UHP waterblasting, notes Swearingen, the method by which water strips a coating from a surface must be understood. Abrasive blasting literally wears away the coating, but water at ultra high pressure shatters and lifts the coating from the surface. Because the water loses its energy soon after it exits from the nozzle, it is important that the distance from the nozzle(s) to the surface is optimal. With abrasive blasting, the distance from the gun to the surface can be up to several feet depending upon the power of the system being used, and the type of abrasive. Using water, on the other hand, it is necessary to stay within a few inches.

Technique is critical. Training is important if acceptable production rates are to be performed. There have been cases where blasters working side-by-side on the same surface with identical equipment have had radically different production rates, sometimes varying by 100% or more, says Swearingen

Many variables determine how quickly high pressure water, or UHP water, will prepare a surface, including nozzle and carrier head design, the coating being applied and number of existing coats to be removed. It is thus difficult to quote a specific production rate for waterblasting. It is best to test blast a sample area to get an estimated production rate.

In some applications, high pressure water requires special tools; for instance, when working on an irregular surface, or areas with angles and protrusions and there are UHP carrier heads made specifically for cleaning behind lips and angles that work very well in these applications.

In most cases, claims Swearingen, UHP water is the best choice for surface preparation of steel, but there are some exceptions: water alone will not create a surface profile for coatings to adhere to; it also cannot effectively be used to remove mill scale. But, on a surface that has been previously painted or has rusted, high pressure water excels. UHP water will not only remove rust and all coatings (at pressures greater than 26,500 lb/in^2), it will also remove all chlorides present in the metal. **Write 122**