A number of sources has grown for higher standards of corrosion protection, their approach to OBM has begun to change. With that change must come a recognition of the need for a properly implemented maintenance plan backed by sound administration, a well-trained crew using correct practices, and, of course, selection of the right paint specification.

This article looks at some of the common problems facing operators who are seeking better value from their on-board maintenance programme, specifically as it relates to deck coating maintenance, and looking to improve the performance of the coating systems being used. It also considers the critical importance of the paint specification.

Maintenance of deck coatings on ships is important not only for protecting the structures against corrosion but also for maintaining the appearance of the vessels and providing a safe environment for the passengers and crew.

Many vessels are at sea much of the time, sometimes stopping only long enough to load and unload passengers or cargo. Therefore, it is not unusual for maintenance of these coatings to be carried out aboard the vessel while en route.

Ship operators are coming to realise the importance of correctly performed on-board maintenance, commonly referred to as simply OBM. Their enthusiasm for such maintenance has been limited in the past, but as pressure from
Background
Traditionally viewed as a means to an end (i.e., a way to achieve the required protection) or, in the worst case, as an activity to keep the crew occupied, on-board maintenance can be an area of neglect within ship operations. OBM has often been governed by an attitude of keeping cost to a minimum. In some cases, this has meant applying the least expensive paint available over minimum surface preparation, often with disastrous results.

Now, however, the changing face of the shipping industry is driving many operators to re-examine this approach. Closer scrutiny of critical areas of ships such as holds and ballast tanks by port state control authorities and classification societies, coupled with ever-present pressures on operating budgets, reduced crews, and the sheer weight of competition in the marketplace, have all forced up the standards of vessel maintenance and overall appearance.

The inadequacies of an on-board maintenance coatings strategy that is not carefully thought through or regularly reviewed show up in many ways. Typically, the problems that can result include a failure to control corrosion and a generally unsatisfactory level of vessel appearance. Other factors that come into play are the wasting of crew time, labour, and ultimately the operating budget.

Despite the fact that OBM paints account for a relatively small part of the overall operating costs of a vessel (typically less than 10% of consumables), the annual seastores bill (i.e., the cost of inventory, specifically the paint needed for OBM) can still be high.

Spending money on a poorly run OBM programme is like pouring money into the ocean. However, as a casual survey of the ships in any busy port might show, the appearance and coating condition of many vessels is lacking, not because the owners are not spending money on maintenance coatings but rather because the money is not being well spent.

Consequently, it often happens that low-cost, low-performance coatings are bought, necessitating more frequent painting, often of the same parts of the ship. The result may be overly thick coating layers that crack and delaminate, thereby exposing the ship to possible corrosion and, at the least, diminishing its appearance.

On the other hand, a well planned maintenance programme that involves evaluation of the entire process, good record-keeping, and use of high-performance coating materials can mean less time and money spent on OBM in the long run—and better results.

The coating system is the bedrock of the on-board maintenance programme and plays a crucial role in the corrosion protection and appearance of the vessel. One of the areas of a vessel where both corrosion protection and appearance are important, and, as noted, one of the areas most commonly involved in on-board maintenance is the deck.

Deck Coatings
Decks are very high-wear areas that require regular maintenance, not only for corrosion protection but also for crew and passenger safety (i.e., anti-slip properties) and for cosmetic reasons. Decks represent a large, highly visible area that says much about the general state of the vessel and the reputation of the owner. In other words, a good-looking deck implies that the ship is well maintained—and vice versa.

Anticorrosive coatings, given their relatively low cost, ease of application, and proven ability to prevent the onset and progression of corrosion for a large part of a ship’s working life, remain the most economic way of protecting seagoing assets.

Over the last 20 years, however, the type and function of anticorrosive coatings has changed dramatically. Pressures to reduce surface preparation costs and advances in coating technology led, first of all, to the introduction of aluminium-containing epoxies, which had a limited degree of surface tolerance. These were followed by a second generation of surface-tolerant, anticorrosive epoxy coatings. They were capable of meeting minimum acceptable surface preparation standards prior to coating application whilst still fulfilling the operator’s demands for corrosion protection. These coatings greatly improved in-service performance over the original surface-tolerant products. They also reduced costs by requiring less downtime and, hence, less loss of revenue than before, both in the repair yard and at sea, and by requiring less surface preparation than conventional anticorrosive coatings.

However, in specifying coatings, it is not just corrosion
control that needs to be considered. Table 1 highlights some of the other important factors, and ranks their priority for use on decks.

The next generation of surface-tolerant epoxy coatings focused on more of these performance properties, including improved durability and resistance to mechanical damage, colour and gloss retention, and abrasion resistance whilst reducing drying times and the levels of volatile organic compounds (VOCs).

These high-solids (typically 80%), two-pack epoxy coatings are specifically designed to meet performance needs in the repair market. They can also be used by operators wishing to extend the life of older vessels as well as by owners faced with second and third special surveys by classification societies. (Such surveys are intended to ensure the structural integrity of the vessels, among other things.)

These modern surface-tolerant coatings can be applied to surfaces prepared to cleaning grade St 2 (thorough hand and power tool cleaning); to hydroblasted surfaces; and directly over existing conventional coatings for simple upgrading without the need for extensive surface preparation.

Typical specifications for major refurbishment or upgrading of a deck coating are as follows.

- Major refurbishment: Clean the complete surface by abrasive blasting to Sa 2 or ultra high-pressure waterjetting to HB2L or HB2M (thorough hydroblast cleaning with light or moderate flash rusting). Then apply two coats of surface-tolerant epoxy at 125 µm dry film thickness (DFT) per coat.
- Upgrade or spot repair: Hand prepare damaged areas to St 2. Apply one coat of surface-tolerant epoxy at 75 µm DFT to cleaned areas. Then apply another coat of surface-tolerant epoxy overall at 150 µm DFT.

### Developing an Effective OBM Strategy

The coating system is only one of several factors that contribute to the success or failure of an OBM strategy for decks or any other parts of a vessel. Common problems associated with a poorly run programme can be divided, for simplicity’s sake, into three main areas: administration, practices on board, and the paint specification. All three factors contribute to the effectiveness of the programme in terms of overall cost, coating performance, vessel appearance, and asset protection.

#### Administration

The budgeting process is one way of opening the debate on how to manage seastores. Most vessels have a seastores budget, although it is not usually broken down by product or vessel area, and it is rarely reviewed annually in detail. Hence, the same amount of paint might easily be ordered each year without any consideration given to how, where, and why the paint is being used.

This practice often disguises excessive use of conventional coatings on easily accessible, high-maintenance areas such as decks, which might benefit from investment in on-board refurbishment or an upgrade to a higher performance system.

A simple review in conjunction with the ship’s staff can quickly identify areas of high paint consumption, which could indicate areas that are being painted repeatedly, whether they need it or not. It also can identify less visible but more critical areas such as ballast tanks that otherwise could be neglected for long periods.

A lack of common records in the operator’s office and

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### Table 1: Features of Anticorrosive Coatings for Decks

<table>
<thead>
<tr>
<th>Feature</th>
<th>Relative Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface tolerance</td>
<td>5</td>
</tr>
<tr>
<td>C/D grade steel, cleaned to St 2</td>
<td>5</td>
</tr>
<tr>
<td>C/D grade steel, flash rusted and cleaned by UHP waterjetting to HB2M</td>
<td>5</td>
</tr>
<tr>
<td>Existing coatings</td>
<td>5</td>
</tr>
<tr>
<td>Adhesion</td>
<td>5</td>
</tr>
<tr>
<td>Corrosion control</td>
<td>5</td>
</tr>
<tr>
<td>Drying time</td>
<td>5</td>
</tr>
<tr>
<td>Durability (wear)</td>
<td>5</td>
</tr>
<tr>
<td>Ease of cleaning</td>
<td>5</td>
</tr>
<tr>
<td>Skid resistance</td>
<td>5</td>
</tr>
<tr>
<td>Colour retention</td>
<td>5</td>
</tr>
<tr>
<td>Abrasion resistance</td>
<td>4</td>
</tr>
<tr>
<td>Pitting resistance</td>
<td>4</td>
</tr>
<tr>
<td>Flexibility (movement)</td>
<td>3</td>
</tr>
<tr>
<td>Surface smoothness</td>
<td>3</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>3</td>
</tr>
<tr>
<td>Light colour</td>
<td>2</td>
</tr>
<tr>
<td>Overcoatability</td>
<td>2</td>
</tr>
<tr>
<td>Immersion capability</td>
<td>1</td>
</tr>
</tbody>
</table>

Relative rating: 5 = extremely important; 1 = of benefit

St 2 = thorough hand tool or power tool cleaning

HB2M = thorough hydroblast cleaning; moderate flash-rusted surface
on board the ship can be a weak link in the ordering process, leading to the requisition of incorrect types or colours of coating products. Keeping a copy of the painting chart or specification in the office as well as on board the ship can help to prevent this problem. It also can prevent the problem of duplication of maintenance work when the vessel’s crew changes, because one crew then can readily determine what a previous crew had done.

In summary, time spent getting the right records in place, either hard copies or electronic files, can go a long way to preserving standards of protection for a ship and ensuring that the correct specification is applied. Equally important, pinpointing areas of high coatings consumption and repeated maintenance can help identify those areas that would benefit from on-board refurbishment or upgrading to a higher performance system.

Practices on Board
The success of any coating system relates directly to the level of care and attention paid to the fundamentals of good painting practice, particularly surface preparation, mixing of coating materials, and, of course, their application. Good painting practice, in turn, depends on the skill of the operator, which relates to training.

During a recent meeting, the technical manager of a London-based ship management company remarked that “maintenance crews use too much paint; they don’t understand the new paint properties.”

This is where training comes into play. For the successful performance of a coating system, the crew must be trained in the properties of the materials being used as well as proper techniques and standards for surface preparation and paint application, climatic condition monitoring, and film thickness. Careful supervision of the maintenance operation will also ensure that standards are met and that time is well spent.

Attention also must be given to equipment and coating materials. Outdated, worn, and poorly maintained equipment for preparation and application can dramatically reduce the success of OBM painting. Furthermore, the paint locker, which is not known for being the tidiest place on board a ship, often reflects the attention paid to the painting process. A paint locker should be well ordered, the racks and shelves clearly labelled by product name, and good stock rotation should be followed.

Here is a simple checklist of good practices for improving on-board maintenance.

- Review the seastores expenditure to determine how much of each product is being bought and used.
- Perform an audit of equipment and invest in new equipment as needed.
- Carry out an inventory of the paint, noting the age, coating type, and condition of the stock.
- Put housekeeping in order, including maintenance of equipment.
- Set up common and simple monitoring and ordering processes that both the on-shore office and the ship’s staff understand.
- Provide for crew training in proper surface preparation and paint application practices.
- Ensure that a copy of the OBM paint specification is kept on board in an easily accessible and well-known place.

Once these steps have been taken, it is time to look at the critical vessel areas and the paint specification.

Paint Specification
If the initial evaluation and subsequent administration of an on-board maintenance programme receive lack of attention, then the same lack of attention will often be given to the paint specification.

Typical coating schemes still include single-pack alkyd and chlorinated rubber/acrylic coatings. Although there are times when these are appropriate coatings to use, there also are times when they are chosen simply because it is expedient to do so. In other words, they might be selected because they are easy to apply with brush and roller by crews without special training, even though other, more sophisticated coatings might be better.

When these single-pack coatings are deliberately chosen, the criteria for their use would be as follows. Surface preparation requirements should be minimal and possible by mechanical means (e.g., power discs). Application should be possible by brush or roller as well as airless spray. Curing and drying times should be rapid enough to minimise disruption of other activities on board.

Coating products that dry or cure at temperatures at or below 0 C and do not soften at high temperatures are normally required for international trading vessels because of the wide range of ambient temperatures to which they are exposed.

Whilst single-pack products may offer advantages of simplicity in many respects, unless specifically designed and properly used, they can account for problems of high paint consumption, wasted crew time, and excessive costs.
For example, highly accessible areas such as decks are regularly recoated, often resulting in a build-up of many layers of paint. Since single-pack coatings are easy to apply, and roller or brush is the usual method of application on board, over application—and, hence, high paint consumption—can result.

Secondly, single-pack coatings generally are not formulated to provide long-term protection for everyday operations in areas where there is heavy wear or mechanical damage. The result can be premature corrosion and the added costs associated with correcting it.

Finally, single-pack coatings do not generally offer the gloss protection and other aesthetic properties that are particularly important for ships that must maintain a high level of appearance. Hence, these coatings would likely be applied more often, increasing the film build-up, wasting crew time, and soaking up the coatings budget.

**Choices: Refurbish or Upgrade**

An on-board painting specification should be selected based on exactly what the coating system needs to do. In other words, the specification should select coatings designed specifically to provide protection against wear, prevent corrosion, enhance the appearance of the vessel, or all of these needs.

To determine these needs, an inspection of not only the ship’s decks but also the holds, hatch covers, ballast tanks, cargo tanks, and superstructure should be performed. This would identify the areas that could benefit from investment in a higher performance coating system either by on-board refurbishment, which could involve removal of existing coatings back to bare steel, or by upgrading (i.e., overcoating) the existing coatings to enhance their performance.

The alternative, of course, would be simply to continue repairing the existing coating system. The decision on which course to follow is normally based on the following criteria: the age of the vessel, the level of investment planned, the condition of the steel substrates, and the type and thickness of the existing coatings.

**On-Board Refurbishment**

Major refurbishment done outside dry dock calls for careful planning of the work to achieve the necessary standards of surface preparation and paint application. It also requires the addition of the necessary products to the ship’s existing seastores range. On-board refurbishment is typically undertaken by commissioned riding crews that perform the work whilst the vessel is at sea or in port.

Advantages of doing the work this way are that the riding crew should be more skilled in some of the more sophisticated methods of surface preparation and coating application. However, accommodating the riding crew on board could be considered a disadvantage, as could the possibility of its work interfering with the normal operations of the vessel.

Doing the work in dry dock, on the other hand, could alleviate these problems and provide ready access to all of the necessary cleaning and painting equipment, but it takes the ship out of service for a period of time, thereby impacting its production of revenue.

**On-Board Upgrading**

If investment in major refurbishment is not commercially feasible, upgrading to a higher performance system (or simply repairing the existing system) is typically undertaken by the ship’s crew.

Most paint manufacturers produce a range of maintenance coatings designed for on-board upgrading to meet the needs of different vessel areas in light of the steel condition, the practicalities of surface preparation, application, and the age and type of existing coatings.

**Conclusion**

The cost and frequency of on-board maintenance painting can be reduced by having an effective painting programme in place that encompasses good record keeping, a well-trained crew, and an appropriate paint specification.

A typical coating system for decks (and hatch covers and coamings) is a high-solids, two-pack epoxy primer/finish that offers good colour retention and resistance to mechanical damage and that can be applied to surfaces prepared to St 2 for control of surface preparation costs. The hard, smooth surface obtained helps resist wear and tear on the deck, and its gloss and colour retention provide improved vessel appearance. This type of product can be applied over existing coatings (i.e., alkyd, chlorinated rubber, epoxy) for simple upgrading without extensive surface preparation.

The OBM can involve complete refurbishment of the coating system using specialised riding crews whilst the vessel is at sea. Alternatively, a simple upgrading of the existing coating system may be all that is required, and this can normally be carried out by the ship’s crew.