

Recovering MARINE COATINGS MARKET

Prepares for New Challenges

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The commercial marine market in 2011 is showing signs of recovery, even in the more mature EU and U.S. sectors. Asia, particularly China, now dominates both new building and maintenance and repair (M&R) activities and consequently is experiencing the fastest growth. With the largest fleet of in-service vessels ever seen, marine coating manufacturers anticipate improved demand in the coming years. At the same time, they face many challenges ranging from rising raw material costs to declines in new build orders to new country-based regulations and international standards for performance. Coating producers are responding with the development of novel technologies aimed at not only improving coating performance, but also increasing ease of use and reducing environmental impact.

The economic downturn hit the commercial marine industry in 2009, largely impacting the M&R sector as ship owners and operators faced increased competition and lower freight rates. As a result, many looked to delay maintenance activities or elected to use less expensive coating options to reduce expenses, according to Martin Porsbjerg, Hempel's Group marine product manager. This trend began to reverse itself in 2010 as the general economic recovery took hold, and Steve Dickey, market director for the Global Marine business at Sherwin-Williams Protective & Marine Coatings, expects continued improvement going forward. Global new building remained strong during this period but is expected to decline from 2011 to 2013 as reduced order rates work their way through the system. Industry experts predict, however, that it will recover in 2014.



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Further complicating the situation is the mixed outlook for the global marine market. "Analysts are bullish on container trade, but are less confident about the dry bulk market, which has started the year very poorly," notes Jim Brown, marketing development manager for International Paint's Worldwide Marine business. He adds that geographical mix also plays a part; Asian economies are already returning to strong growth, while the U.S. is recovering gradually and European growth remains weak.

Over 75% of new building and M&R activity, in fact, takes place in Asia. In 2010, China overtook South Korea as the leading new build country and now tops this segment as well as the M&R category. Brazil is also experiencing significant growth in response to increasing activity in the petrochemical, oil, and mining sectors, according to Dickey. U.S. activity largely stems from government-based demand.

This increased demand is welcome news for coating producers but does not guarantee increased profitability. Raw material costs continue to rise. Copper prices, for instance, are currently at record highs. Suppliers of other ingredients from titanium dioxide to basic resins are also passing on price increases to coating manufacturers. "We have seen significant price increases for most ingredients used in our marine coating formulations and expect more to come for the foreseeable future," states Porsbjerg. "At the same time," he adds, "our customers are not seeing peak freight rates so they are very focused on keeping expenses low." The result, according to Brown, has been the decline of margins to below 2009 levels.

Coatings manufacturers are also faced with increasing regulatory pressures, including new performance standards developed for protective anti-corrosion coatings by the International Maritime Organization (IMO) and many country or region specific requirements for reduced VOCs. The International Paint and Priming Ink Council (IPPIC) is actively involved in the IMO's efforts revolving around the important role of antifouling coatings in preventing invasive species and performance stan-

dards for anti-corrosion coatings for critical ship areas such as ballast tanks and crude oil cargo tanks where weakening by corrosion can lead to catastrophic ship breakups. "The primary focus of the international effort is to achieve uniformity and reasonableness in the global regulation of marine coatings, and IPPIC strongly supports this goal," notes Jim Sell, senior counsel of the American Coatings Association (ACA) and counsel to IPPIC. (ACA serves as secretariat for IPPIC.)

Compliance, however, does add to the cost of doing business for coating manufacturers. Often times, the regulatory concerns can be interactive and even competing. "For example," says Sell, "the increased concern at the IMO and in individual countries about better shipping fuel efficiency, in its own right, but also because of its impact on clean air, can be affected by efforts to reduce biocides in hull antifouling coatings. Effective antifoulings prevent hull drag which in turn greatly affects fuel efficiency. Further, effective antifouling coatings are needed to prevent invasive species. Thus, because of their desire to reduce the environmental impact of their biocide leachate, they must consider those potential impacts as well." Sell continues, "One of our chief challenges is to ensure that these problems are viewed and addressed comprehensively on a global basis. Reducing VOC and HAP emissions or biocide content should not compromise the anti-corrosion performance of protective coatings or antifouling coating performance, which could lead to increased hull drag, loss fuel efficiency, and clean air problems. And all of these issues must be sorted out in a globally uniform way because the industry's products are applied worldwide and must comply with regulations in various countries and regions."

IPPIC's European member CEPE (the coating industry association in Europe) is resisting an EU effort to regulate VOC emissions from shipyards with specific coatings VOC limits rather than maintaining a program that regulates them with an overall emission limit for the entire shipyard. In the U.S., the ACA is addressing issues such as the development



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by the Environmental Protection Agency (EPA) of a potentially more stringent HAP coatings standard for shipyards and the revision of a recent EPA guidance to states on the development of VOC emission standards for pleasure craft coatings used at boat yards, which did not examine the technical performance requirements for these coatings and relied on excessively stringent California standards, according to Sell. Separately, ACA's Marine Coatings Committee is also lobbying for enactment of federal legislation that will implement the IMO Convention of Antifouling Systems to ensure that the U.S. will be a full participant in the Convention as additional antifouling systems are reviewed under it for elimination or regulation in the future.

Fortunately, the desire of owners and operators to reduce costs has also led to growing interest in coatings that contribute to fuel savings, lowered dry docking expenses, and improved regulatory compliance, providing opportunities for coating manufacturers despite these other difficulties. “The current situation in the marine market, while presenting challenges, also creates opportunities for coating manufacturers to develop solutions that help ship owners and operators maximize the efficiency of their operations through longer coating service life, reduced maintenance requirements, shorter return to service times, easier application processes, reduced VOCs through higher volume solids formulations, and much more,” observes Porsbjerg. Dickey agrees that coating producers have a real opportunity to help their customers address the challenges they face by developing advanced products that provide a measurable economic benefit.

FOULING CONTROL SOLUTIONS

Significant advances have been made in antifouling technology, including self-polishing silyl acrylates containing copper, copper-free antifoulants containing organic biocides, and completely biocide-free silicone and fluoropolymer-based

foul-release systems. Regardless of the type of technology, the elimination of fouling on ship hulls leads to increased fuel efficiency and reduced CO₂ emissions, which adds up to significant savings for owners and operators. “The cleaner and smoother the hull, the lower the friction through the water and the greater the potential for increased fuel efficiency,” explains Porsbjerg. Furthermore, transmission of marine organisms, a problem of growing concern, can also be reduced or possibly avoided.

Silyl acrylate polymers contain bound cuprous oxide, which is effective for preventing hard biofouling. The coatings prepared from these resins are also formulated with a co-biocide such as copper or zinc pyrithione for prevention of soft fouling. As the coating is exposed to seawater, the top layer of bound cuprous oxide is released into the water. The remaining top polymeric layer is then soluble and dissolves, releasing the co-biocide and also exposing the next layer of bound copper species. Companies have developed proprietary versions of the technology, enabling a range of service lives. “Silyl polymer technology has for more than a decade produced the most advanced and controlled delivery of copper and co-biocides in antifouling,” states Eivind A. Berg, regulatory affairs manager for antifouling with Jotun. “Silyl based antifouling has the additional benefit of providing a self-smoothing paint film and does not require any cleaning, which can lead to rougher surfaces.”

New advances in this area include Hempel's Dynamic range of antifouling coatings that provide possible service intervals of up to 90 months and are optimized in terms of a very controlled and stable polishing with a very controlled release of the active materials, according to Porsbjerg. Meanwhile, International Paint expanded its range of antifouling coatings with higher volume solids products that provide reduced coats per scheme, lower levels of overspray, and reduced VOC emissions, according to Brown. Intersmooth IIS SPC features the company's copper acrylate self-polishing copolymer antifouling technology that delivers controlled chemical dissolu-

tion of the paint film, ensuring continued smoothing over long drydocking intervals. "Predictable polishing enables specifications to be tailored to specific ship types and operational profiles, while thin leached layers allow simple cleaning and recoating at drydockings," Brown states. The new range also features the company's economical rosin-based Interspeed controlled depletion polymers (CDP) that offer 36 months of service. In addition, new Interswift products blend self-polishing and controlled depletion technology for surface tolerance, high volume solids, and an attractive cost base combined with polishing rate control, reduced leached layer size, and control of biocide release.

Copper-free antifoulants containing organic biocides have been drawing attention as questions have been raised about the potential negative impact that copper might have on the marine environment. This is a particular concern for marinas where copper concentrations can build up over time. Although a recent study has shown that when formulated appropriately, biocidal copper ingredients are safe and effective (see *related article on Biocides on page 28—Ed.*), certain groups

continue to pursue legislation to reduce or eliminate their use. Thus, paint manufacturers are now offering antifouling coatings formulated solely with organic biocides.

SeaVoyage Copper Free from Sherwin Williams is a non-copper antifoulant coating designed for long-term service (three to five years compared to the typical one to two years for currently available systems). The solvent-based ablative coating deters both soft and hard fouling, according to Dickey. "A further advantage of copper-free coatings is the reduced weight of these systems, which can weigh as much as one third less than traditional copper-based antifoulants," he remarks.

A third choice is completely biocide-free foul-release coatings that rely on silicone or fluoropolymer resins. These coatings create a smooth, "slippery" surface that exhibits non-stick properties, making it difficult for marine organisms to attach to the hull. If they do settle, they can easily be removed. There has been some resistance by operators to switching from an anti-foulant to a foul-release system, though, due to the time consuming and expensive procedures which often include full blast cleaning of the underwater hull to remove the existing coatings and application of two intermediate tie or linking coats. Coating manufacturers have recently introduced new systems that eliminate the need for much of this work.

"Continued research and development, particularly in the area of adhesion mechanics, has resulted in these latest innovations," observes Brown. International Paint's Intersleek 7180 Linkcoat is designed for use with the company's fluoropolymer-based Intersleek 900 and silicone-based Intersleek 700 foul release technologies and enables switching without the need and expense of full underwater hull blast cleaning. Hempasil Nexus X-SEAL also seals antifouling coating systems in one coat without blasting. It is designed for use with Hempasil X3, Hempel's third generation foul-release coating that works by creating a hydrogel layer on the surface and making it appear to be a liquid, according to Porsbjerg. Hempasil Nexus X-Tend, meanwhile, is a new tie-coat designed to increase the efficiency of maintenance and re-coating procedures when a vessel with a fouling release coating comes into drydock for hull maintenance.

Hempel estimates that Nexus X-Seal can save shipping companies up to \$400,000 in surface preparation, application expenses, dock rent, and vessel inactivity compared to a solution which requires fully blasting the hull and applying the X3 system from scratch. (This estimate is based on a vessel with a 15,000 m² hull and a daily hire rate of \$85,000.) With Nexus X-Tend, the company estimates that vessels spend a half day to a full-day less in drydock, saving shipping companies up to



Photo courtesy of Hempel



Photo: courtesy of International Paint

\$100,000 in dock rental fees, surface preparation time, and vessel inactivity.

With these developments, interest in foul-release coatings is expected to grow. Studies on the fuel savings of these coatings are also attracting attention. Most recently, Professor James Corbett's Energy and Environmental Research Associates found that the eco-efficiency benefits of fluoropolymer foul-release coatings from International

Paint when applied to tanker, bulk cargo, and other vessel types can reduce greenhouse gas (GHG) and other emissions by an average of 9% and that these reductions are achieved while also saving due to reduced fuel consumption. Silicone-based foul-release coatings have shown CO₂ emission reductions of 4–6%, according to various manufacturers.

Not surprisingly, all of the leading marine coating suppliers offer at least one foul-release coating. Sherwin Williams has introduced SeaGuard Surface Coat, a silicon-based topcoat in the Sher-Release System that, according to Dickey, is designed for long term service (60 months). Based on technology developed by the U.S. Navy, SeaGuard Surface Coat combines an epoxy anti-corrosive system and a tough, protective silicone surface coat interlocked by a unique elastomeric formula that provides steady long-term performance that is less prone to mechanical damages that can cause problems for "softer" silicone systems.

Nanotechnology has also been employed in a new foul-release coating. Jotun's SeaLion Repulse utilized the company's Nanorepellent Technology. Nano silicon structures extend into the water and act as nano-scale springs. When the spring-like structures are compressed, a counter force is developed, providing both release and repellent properties. The result, according to the company, is a smoother surface than what is achieved with conventional fouling-release coatings and up to 10 year's lifetime of the coating system under normal conditions.

With regard to regulatory/standard development activities for antifoulant/foul-release coatings, IPPIC's Antifouling Work Group (AFWG) is coordinating input from the coatings industry into ISO Technical Committee 8 (TC8), which is developing the International Standard Organization (ISO) standard for risk assessment of antifouling biocides and antifouling products. "The goal of the AFWG is to provide expertise during development of the standard and support for the standard when it is

considered by the TC8," explains John Hopewell, ACA assistant director of environmental and international programs as well as secretary to IPPIC's Antifouling Work Group. The ISO standard will be key for countries wishing to develop new rules for antifouling based on risk assessment, namely Japan and China. China is in fact actively developing rules and IPPIC is participating in the process to ensure that adopted programs are based on reasonable risk assessment criteria. The AFWG is working closely with the China National Coatings Industry Association (CNCIA) by providing antifouling expertise in discussions with the Chinese Ministry of Environmental Protection (MEP).

COMBATING CORROSION

In addition to fuel economy and GHG emission reduction, corrosion control ranks very high in importance for ship owners and operators. Coatings serve as a front line defense and help prevent damage by protecting metal surfaces from water. In the marine environment, and particularly in sea water ballast tanks, corrosion control can be challenging due to the harsh conditions to which the metals are subjected.

The new Performance Standard for Protective Coatings (PSPC) from the International Maritime Organization now requires that all coatings designated for use in sea water ballast tanks meet certain minimum standards. Coating producers have invested significantly in the testing of their products to ensure that they comply with these criteria. They have also trained yard and ship owners and operators on the proper application techniques and the expected appearance of quality coating systems, according to Dickey. "Ballast tanks are complex structures exposed to constant stress from structural flexing, vibrations, wet/dry cycles, thermal variation, and loading/unloading activity during vessel service, and they are difficult to access for both inspection and maintenance. Therefore the highest possible safety level against corrosion and its possible consequences is very important in these areas," observes Porsbjerg.

At the same time, however, ship owners must meet the requirements of the IMO Ballast Water Management Convention for development of Ballast Water Management Systems (BWMSs) designed to prevent transmigration of marine organisms through discharged ballast water. The resolution affects both new builds and existing ships. Unfortunately, the PSPC standard was developed separately. Therefore, there is the possibility that water treatment systems (especially those using chemical treatments such as hypochlorite) might be selected that damage the ballast tank coatings required to provide corrosion protection. "We are

working closely with both ship owners and ballast water treatment system suppliers, of which there are now probably around 40-50 active vendors, and participating in industry forums to come up with effective solutions," Porsbjerg says. He notes that IPPIC has addressed this issue as well.

Fortunately, coating manufacturers have been making progress on new coating technologies for ballast tanks. "There have been real advances made in the area of ultra high-solids coatings for sea water ballast tanks that address problems previously experienced with solvent-based systems, notably edge retention on the edges inside the tanks, reduced turnaround time, and improved conditions for workers applying the coatings," Dickey says. Sherwin-Williams has introduced Fast Clad ER Epoxy, an ultra high-solids epoxy amine coating engineered for immersion service in sea water ballast tanks, fuel/sea water ballast tanks, and petroleum storage tanks. It provides greater than 70% edge build retention, is low VOC and low odor, requires only one coat, and can be walked on in just four hours.

International Paint received good news at the end of 2010 when a Lloyd's Register Class Surveyor confirmed that the 15-year-old Intershiel 300 double bottom tank coatings on the panamax bulk carrier m.v. Eleranta were in "good condition." The results are believed to be the first real-life evidence of anticorrosive coating performance over a 15-year period, according to the company. This achievement is noteworthy because the PSPC now requires that anticorrosive coatings used in water ballast tanks remain "in good condition" for at least 15 years.

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In 2010, the company added to its product line with the launch of a new range of universal primers for the new building market to address the productivity, regulatory, performance, and commercial needs of shipyards and ship owners and Intershiel 803Plus, a new cargo hold coating specifically designed to address the key issue of impact damage from the loading of dry bulk cargoes. "Without excellent coating protection, the structural integrity of holds can be compromised, jeopardizing continuing vessel profitability and safe operation," notes Brown. Intershiel 803Plus is VOC-compliant with 75% volume solids, offers fast drying times, and is designed to protect against "shooting damage" during loading as well as provide abrasion and corrosion resistance, according to Brown.

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Hempel also recently introduced coatings for both seawater ballast tanks and cargo holds. Hempadur Quattro Fibre 47604 is a new IMO PSPC ballast tank compliant universal epoxy primer with incorporated synthetic fibers that increase its tensile strength, flexibility, and fatigue properties compared with standard epoxy coatings. It is less prone to suffer from cracking of the coating layer and therefore damage and subsequent corrosion are minimized, according to Porsbjerg. Also for ballast tanks, Hempadur EM 35740 is a new ultra high-solids (96%) easy maintenance solution for use while at sea that tolerates minimal surface preparation and application on moist/damp surfaces. It is designed to help keep tanks in "good" condition but also reduces the work required when drydocking. Hempadur Ultra Strength 47500, for which it won an IBI 2010 Innovative Technology Award, is an advanced cargo hold coating that extends repair intervals up to 10 years instead of the normal two to five years for conventional coatings.

Another crucial area of performance standards for protective coatings addressed by the IMO recently are those for crude oil tanks and the development of testing procedures for such coatings which will go into effect in 2013. Sell notes, "The IPPIC PSPC Work Group headed up the development of this unprecedented test for one of nature's most complex substances in a very tight time frame. The WG involved all of the affected parties, including testing labs, ship owner representatives, and key classification societies that will implement the coatings certification procedures."

Unfortunately, according to Sell, some of the WG's recommendations concerning components of the test which were unrepresentatively too aggressive and caused coatings with long successful track records to fail were not accepted. "We will be pursuing these matters until they are resolved," he adds. Even though the implementation details still need to be worked out, he stresses that the effort to date has been outstanding. "I am very proud of the effort of the IPPIC members that began, ran, and drove this effort to meet an almost impossible IMO deadline for such a complex undertaking." 