

Scraping the Bottom – From Plutarch to Polymers



Association of Average Adjusters of the US & Canada Chairman's Presentation October 7, 2021

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Content

- A brief background of bottom coating systems
- Current legislation governing antifouling
- Bottom coating technologies – not all are equal
- Types of damages requiring repainting of vessel bottoms
- Clauses and rules of practice regarding painting and scraping of vessels bottoms
- Cost and time considerations of bottom coatings in repair scenarios

A Brief Background....



“A vessel glides lightly, and as long as it is clean, easily cuts the waves; but when it is thoroughly soaked, when weeds, ooze, and filth stick upon its sides, the stroke of the ship is more obtuse and weak; and the water, coming upon this clammy matter, doth not so easily part from it; and this is the reason why they usually scrape the sides of their ships”

Plutarch, 1st Century AD



“The echeneis (Remora) is a small fish that is often found on rocks. It has the ability to slow the passage of ships by clinging to their hulls. It is also the source of a love-charm and a spell to slow litigation in courts”

Pliny the Elder alleges that the Roman Empires defeat at Acticum in 30 BC was due to marine growth!

Historical Technology

- 1500 – 300 BC Phoenician Vessels – lead and copper sheathing of wooden hulls to prevent fouling
- Iron (latterly steel) ships developed in the early 1800's – could not be “sheathed” due to galvanic corrosion
- 1850's - Development of anti corrosive paint barriers and copper sulphide antifouling paints for iron hulls
- 1950's - Tributyltin (TBT) found to be very effective in combating biological growth on ships hulls
- 1974 – Self Polishing Copolymer Paint introduced by International
- 2000's - Cuprous Oxide / Copper Acrylate based coating systems replaced TBT's as a biocide– now in the spotlight
- 2010's - Biocide Free Paints Low Surface Energy Coatings Developed – Some based on hydrophobic anti-thrombogenic polymers (PDMS) from artificial hearts!
- Non-stick fouling release coatings – ultra smooth surface (high speed vessels)
- Hydrogels (copper silyl acrylate copolymer), traps boundary layer of water - 90 month life

Historical Regulation

- 1960's - Studies find that TBT bioaccumulation & biomagnification are occurring in marine species
- 1980's – Efforts by several nations to ban the use of TBT coatings / US Congress 1988
- 1989 - IMO MEPC Committee meets / adopts 1990 resolution to eliminate TBT in marine coatings
- 1992 – Rio Conference on Environment and Development calls on Flag States to reduce TBT pollution
- 2003 - IMO MEPC Treaty to ban application of TBT based coatings – total ban by 2008
- 2021 – IMO MEPC Prohibits Cybutryne application from 2023

As with most international legislation, things move slowly!

Marine - aggressive environments

Cargo Hold & Tanks

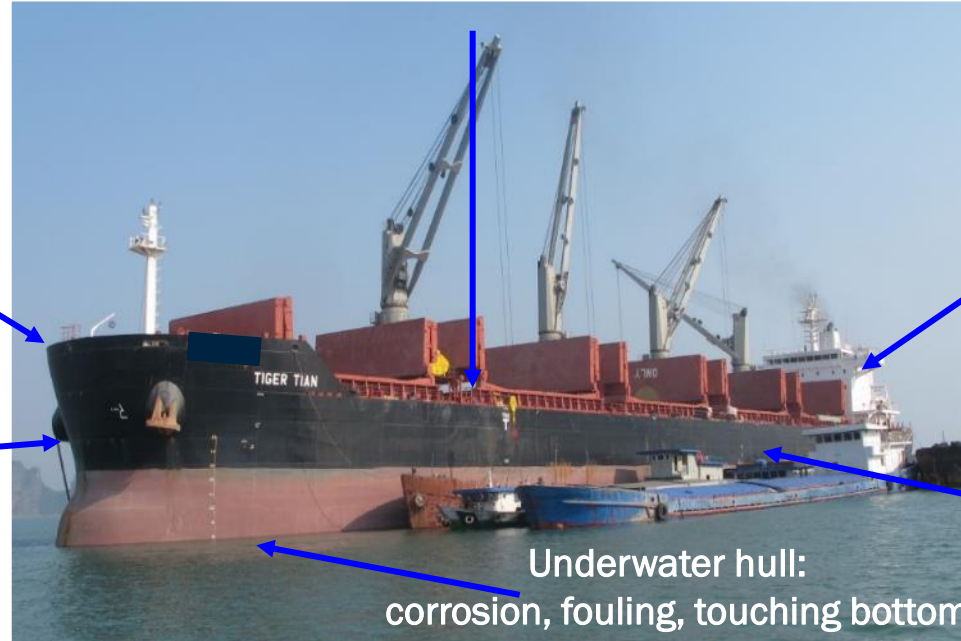
abrasion, chemicals, corrosion

Decks

corrosion, UV,
heat, chemicals

Hull

corrosion, impact,
abrasion



Superstructures

corrosion, UV, heat

Ballast Tanks

corrosion

Underwater hull:

corrosion, fouling, touching bottom

Owners Considerations

- Cost of initial application / ease of application
- Effectiveness of product – does it work to protect their asset (eliminate corrosion) and maintain hull efficiency
- Speed of ship / mileage underway / operating environment
- Time between reapplication – Drydocking required every 5 years or greater
- Surface friction (hull efficiency) incorrect product can adversely affect drag up to 23% compared to optimal product application
- Compliance with current and upcoming legislation / environmental cost



- Bottom coating removal, preparation and application of a typical Panamax bulk carrier drydocked in Asia is around **USD 1m.**

What makes up a modern bottom coating system?

Layers:

- Steel plate / shop primer
- Primer keys into steel below
- Anti-corrosion layers
- Tie coat
- Biocide or Foul Release Layers

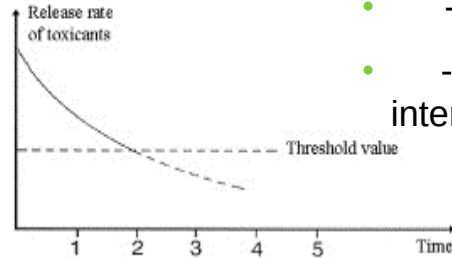
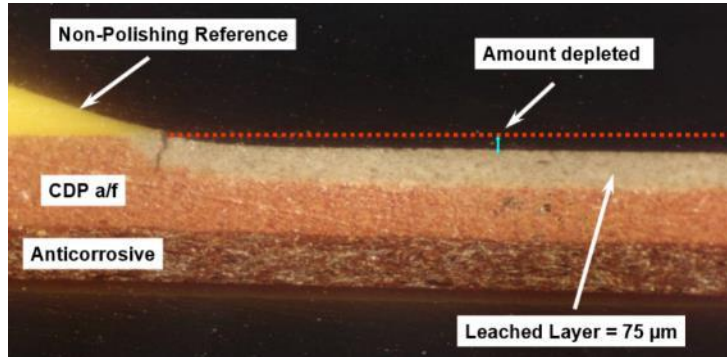
Table 13.5 Estimated typical paint and painting costs for biocidal antifouling and foul release coatings [97].

Technology	Assumed paint lifetime (years)	Relative paint cost, (TBT-SPC = 1)	Estimated overall application cost	
			\$ m ⁻²	\$ m ⁻² year ⁻¹
CDP	3	1.5	50	15.2
Hybrid	5	1.75	50	10
Tin-free SPC	5	2–3	75	15
Foul release	10	4–6	116	11.6

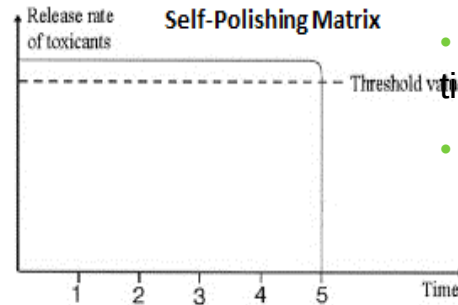
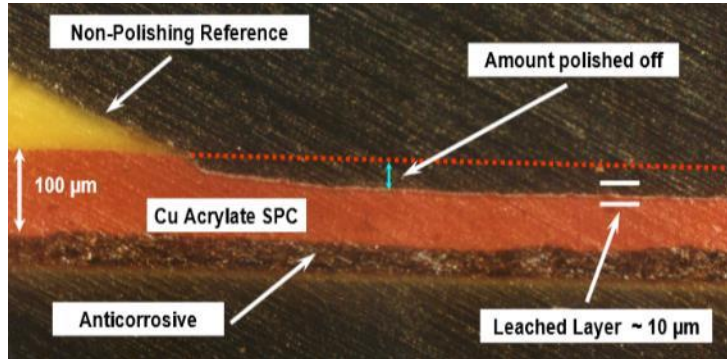
Main technology used in commercial shipping:

- CPD – Controlled Depletion Polymer – Cheaper but lower interval between docking <3 years
- SPC – Self Polishing Copolymers – More expensive application but can last 5 or more years before reapplication
- Foul Release Coatings

Antifouling coatings: biocide-based paints



- **Controlled Depletion Polymer (CPD)**
 - - AF performance decreases over time
 - - cheap, suitable for short dry-dock intervals

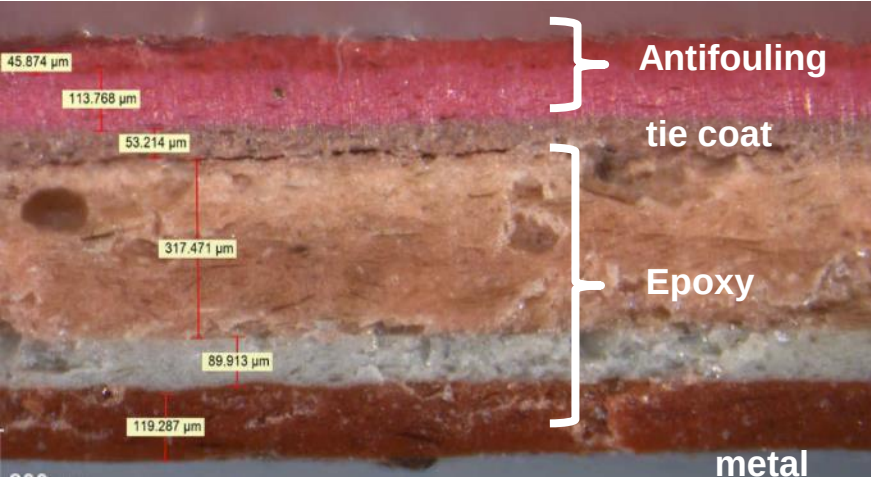


- **Self-Polishing Copolymer (SPC)**
 - - controlled release of biocide over time
 - - expensive and lasting 60 months

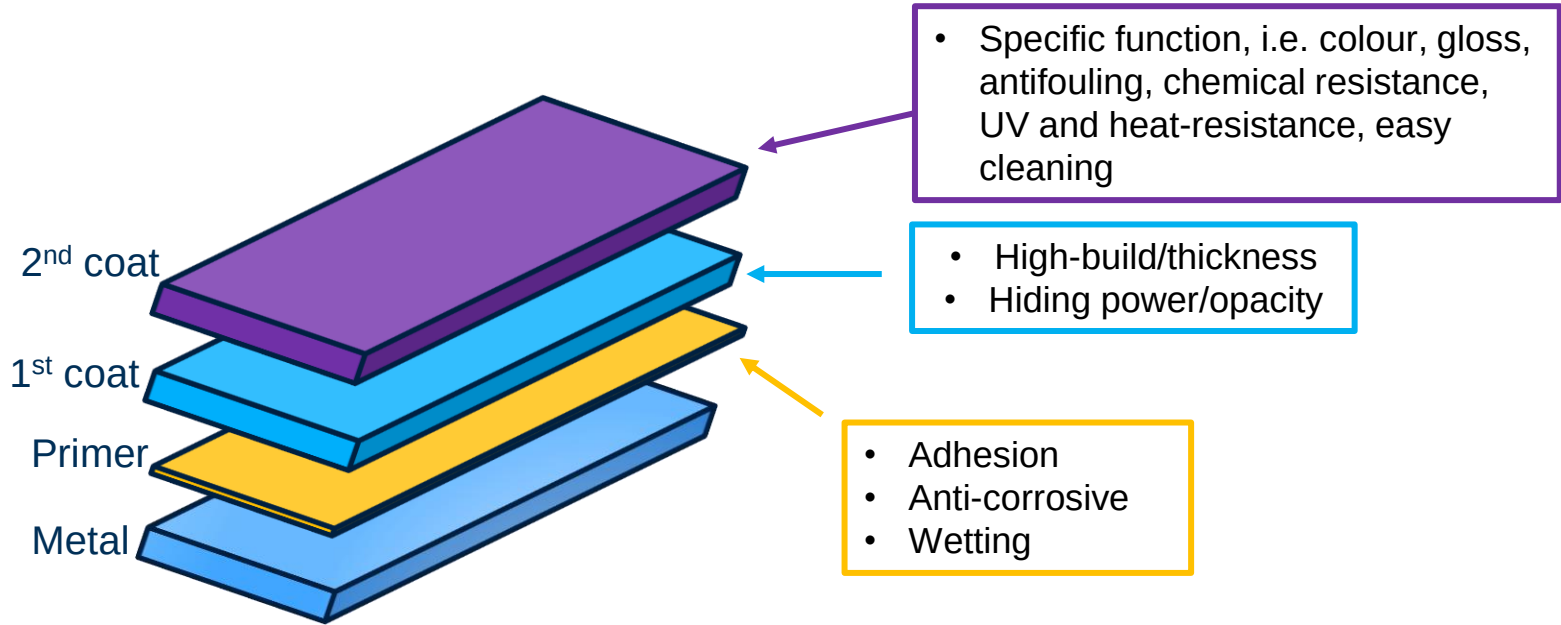
Example of a coating system



Intersleek _® Finish (150 µm)	Intersleek _® Finish (150 µm)	Intersleek _® Finish (150 µm)
Intersleek _® Tiecoat (100 µm)	Intersleek _® Tiecoat (100 µm)	Intersleek _® Tiecoat (100 µm)
	Intershield _® 300 (125 µm)	
Anticorrosive (125 µm)		
Anticorrosive (125 µm)		
Steel substrate		



Multi-coating system



Corrosion protection via physical barrier to impede transport of water, oxygen, ions

Marine fouling on a ship's hull: issues



Marine fouling

- Unwanted growth of organisms on submerged structures
- Increased hull roughness and drag
- Speed reduction
- Increased fuel consumption up to 40%
- Maintenance & Repair
- Higher CO₂, SO_x and NO_x emissions
- Translocation of invasive species

Damages to Bottom Coatings

DIRECT

- Heavy Groundings
- Collision / Allision
- Contact with a submerged object
- Structural failure of the hull / heavy weather
- Soft Grounding (Touching bottom) due to insufficient water at berth during maneuvering or cargo operations
- Mechanical Abrasion from tugs, fendering systems, wave action

Damages to Bottom Coatings

INDIRECT / CONSEQUENTIAL

- Contamination (e.g. oil spill)
- Slow steaming due to engine failure
- Location – berthed for extended period next to outfall
- Impingement of cavitation bubbles (following propeller / appendage or hull damage)
- Vessel inoperable for period of time awaiting permanent repairs – heavy growth in 3 weeks
- Cropping of hull plating to allow removal of damaged machinery or repair of cargo spaces
- Lack of initial preparation / poor application and curing during prior repair
- Aggressive cleaning of hull in drydock or by underwater cleaning machine
- Time out of water (CDP ablative antifouling can become ineffective after time on drydock)

What if plating is not “damaged” and only the coatings are?

Consideration for Repair of Bottom Damage / Coatings

- Hull must be cleaned off in areas of plating damage and perimeter (350 bar wash)
- Coating system needs to be renewed from base steel up – grit blasting steel to Sa 2 to 2.5 (thorough blast cleaning)
- Time awaiting drydocking / under tow at slow speeds to repair yard
- Compatibility of repaired area coating system with existing coating
- General rule of thumb is 15 to 20% area in addition to the plating damage will require recoating (due to areas of heat / blasting / cleaning)

Hull Clauses

- **Institute Time Clauses Hull**

The Underwriters shall not be liable in respect of scraping, gritblasting and/or other surface preparation or painting of the vessel's bottom except that

17.1 gritblasting and/or other surface preparation of new bottom plates ashore and supplying and applying any "shop" primer thereto

17.2 gritblasting and/or other surface preparation of

17.2.1 the butts or area of plating immediately adjacent to any renewed or refitted plating damaged during the course of welding and/or repairs

17.2.2 areas of plating damaged during the course of fairing, either in place or ashore

17.3 supplying and applying the first coat of primer/anti-corrosive to those particular areas mentioned in Clauses 17.1 and 17.2

*17.4 supplying and applying anti-fouling coatings to those particular areas mentioned in Clauses 17.1 and 17.2, shall be included as part of the reasonable cost of repairs in respect of damage to bottom plating caused by a peril insured under this insurance. * ITC 2003 Addition*

- **American Institute Hull Clause 1977**

No claim shall in any case be allowed in respect of scraping or painting the Vessel's bottom.

Average Adjusters Rules of Practice

- Association of Average Adjusters US and Canada Rules of Practice

C4 - Where the Policy includes a Clause to the effect that:

“No claim shall in any case be allowed in respect of scraping or painting the vessel’s bottom”

(1) Gritblasting and/or other surface preparation and recoating as original of new bottom plating;

(2) Gritblasting and/or other surface preparation of:

(i) the butts or areas of plating immediately adjacent to any renewed or refitted plating damaged during the course of welding and/or repairs;

(ii) areas of plating damaged during the course of fairing, either in place or ashore;

The surface preparation and recoating as original to those particular areas mentioned in (i) and (ii) above shall be allowed as part of the reasonable cost of repairs in respect of bottom plating damaged by an insured peril and shall be deemed not to be excluded by the wording of this Clause.

The gritblasting and/or other surface preparation and the painting of all other areas of the bottom is excluded by the Clause

- *B16 “The costs of cleaning, painting or coating of bottom shall not be allowed in General Average unless the bottom has been painted or coated within the **twelve months** preceding the date of the General Average act in which case one half of such costs shall be allowed*

York Antwerp Rules 2016

*Rule XIII.(c): “The costs of cleaning, painting or coating of bottom shall not be allowed in general average unless the bottom has been painted or coated within the **24 months** preceding the date of the general average act in which case one half of such costs shall be allowed.”*

Nordic Plan 2013 Version 2019 - Practical Changes

“The provisions relating to bottom painting in sub-clause (d) and Cefor I.16 and PIC Cl. 5.18 are impractical and have therefore been deleted. This means that bottom painting in hull insurance for ocean-going vessels must henceforth be treated in the same way as other painting, and that the insurer shall always cover bottom painting in the damaged area”

The Nordic Marine Insurance Plan - Commentary Part 2

Concluding Remarks

- Coating systems have evolved significantly in the last 20 years
- They are a critical and material part of a ship that requires maintaining and proper repair
- Expected life span of coatings is increasing from 5 to 10 years
- There are major costs involved in recoating damaged hulls
- If not repaired correctly, then future coating failure, hull corrosion, trading and vessel value will be affected (along with environmental costs)
- Consequential damages can and do occur to hull coatings
- The current American Institute, ITC Hull clauses do not appear to account for the importance of hull coatings, technological developments or loss scenarios

Acknowledgements

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- Adam Rolland, Braden Marine



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Chairman's Address – Association of Average Adjusters US & Canada

October 7, 2021

Slide 1

Good morning, ladies and gentlemen. The title of my chairman's address is

“Scraping the Bottom, from Plutarch to Polymers”

In my years as a marine surveyor, I've had many interesting discussions with Average Adjusters, Underwriters, Brokers and other surveyors on the subject of bottom painting and where the line is drawn between maintenance of the vessel and repair.

Today I will mainly focus on the technical aspects of hull coatings technology and damages, but I understand that there are some quite restrictive provisions in hull clauses and how the established Rules of Practice apply to these claims.

Slide 2

As such, I will give a brief overview of bottom coating systems, what the current regulation and legislation looks like, as that is an important consideration when it comes to selection and application, coating technologies, the types of damages requiring repainting of vessel bottoms, current hull clause provisions, cost and timeline considerations during repairs.

Slide 3

Now it appears that these discussions on bottom coatings have been going on for quite some years.

Back in the first century AD, the Greek philosopher Plutarch noted that ship owners needed to keep their hulls scraped. Pliny, at around the same time penned his The Natural History (Naturalis Historia). It appears he was quite vocal on the problems of the Remora fish and their ability to slow ships, leading to the defeat of Marc Antony at Actium, the assassination of Caligula and slowing up the court system. Some of those issues persist to this day!

The need for bottom coatings and keeping ships efficient and seaworthy has been a central part of marine transportation for quite some time.

Slide 4

Back in the Phoenician times, they started to sheath vessels with lead and copper to prevent biofouling. This worked well and remained a method used on wooden vessels of the 1800's.

The construction of iron ships meant that due to galvanic corrosion, sheathing of hulls in this way was not possible. Paint systems were developed around 1850 as an anti-corrosive barrier. By adding copper, it also acted as an antifouling.

By the 1950s tributyltin, TBT was noted to be a very effective antifouling due to its toxicity.

To increase the efficiency of the hull and biocide dosing, self-polishing copolymers were introduced around 1974.

Due to the environmental impact of TBT, a replacement had to be found. Various compounds were tried and marketed, with the majority being a copper-based coating system.

Since copper has now come under the environmental pollutants spotlight, other solutions are being tried and tested. For higher speed vessels, the latest generations of nonstick fouling release coatings are used, which work by having an ultra-smooth surface that bio-organisms cannot adhere to.

Other coatings with long life expectancy include hydrogels, which trap a boundary layer of water, creating a turbulence at the ship's side to restrict growth. These latest technologies require very controlled application and are an initial higher cost to the vessel owner.

Slide 5

As technologies developed, adverse environmental consequences became clear. Despite knowing about the harmful effects of TBT's as early as the 1950s and 1960s, it took many years for them to finally be phased out in 2008. Vessels are required to carry certification for their hull coating systems showing that it is compliant with the IMO legislation. Any significant repair or renewal would require revalidation of this certification.

Slide 6

A ship will be designed and built with many different types of coatings, each with its own unique properties. The hull market has recently experienced many well publicized cargo tank coating failure claims, likely not subject to the same exclusions that bottom coatings would be.

Slide 7

What aspects will an owner consider for hull bottom coating? There are many variables but the main one would be cost, in terms of initial application, time between application and hydrodynamic efficiency.

As in water survey technology advances, scheduled dry docking periods have been extended to 5 years for most vessels, with some classification societies piloting 7.5-year interval haul outs. Specific bottom coating systems are now designed to go to 10 years to meet these changes.

The main limiting factors in granting longer periods between scheduled dockings has been coating systems, something the latest technologies are addressing, along with improved in water cleaning and survey equipment (remote operated vehicles, hull scanning, and vessel condition monitoring systems).

Time in drydock is costly to shipowners, who would always prefer to have a vessel trading than sitting on the blocks.

Slide 8

Hull coatings are applied as a system, rather than as just a few coats of the same product. While each paint manufacturer will have a different specification, most systems will rely on a multi-product approach of primer, anticorrosion layers, tie coat and biocide / foul release coating¹.

The longer the life of the coating the more expensive the initial application generally is. However, it can be seen that the overall cost on a “per year” basis trends down significantly until the more expensive and longest lasting “foul release” coating is on par with the other technologies, and ends up significantly lower than controlled depletion polymers.

Slide 9

Self-polishing paints will provide a more controlled release of biocide and a longer lasting smooth finish when compared to a controlled depletion polymer paint.

Slide 10

It is important to note that in a scheduled drydocking reapplication the hull is rarely taken down to bare steel.

Normally any marine growth and chlorides are removed by pressure washing, at which point the coating is inspected. If the antifouling paint system appears depleted but intact, then fresh antifouling layers are added on top.

If corrosion is noted or paint appears blistered, then grit blasting may be required back to the steel. This can be localized (most cases) or on occasion whole areas of the hull require taking back.

A well applied and effective bottom coating will normally not exceed 5% of the area requiring blasting back to the steel at the scheduled five year drydocking. Boot tops and belt areas will normally require more intensive blasting work due to the constant wet then dry environment and abrasion.

Comparatively, a repair should essentially be dealt with as if the steel were bare plate. The recommendations given by the manufacturer for steel preparation, priming, application of tie coats and anticorrosion must all be strictly adhered to, or the repair will be considered improper.

Slide 11 No Comment

Slide 12

In summary the antifouling layer will prevent the growth of marine organisms on the submerged surfaces. A failure to have an effective antifouling has both economic and environmental consequences.

¹ Some more recent products (for example, EcoSpeed) being only two layers being applied directly onto the steel

Slide 13

When we think about hull damages in the context of bottom coatings, we are normally talking about a physical grounding or contact that has set in or disrupted the steel plating and structure of the vessel. It is then the cropping and renewal of the steel that causes the bottom coating to require reapplication.

However bottom coatings can be damaged significantly without any perceivable disruption of the hull plating or structure. In many instances, a soft grounding will result in the hull coating being removed but no deformation of the plating. The ship's hull is then exposed to corrosion and attack from bio-organisms.

Slide 14

There are other damages to bottom coatings I've noted as indirect or consequential.

With modern coatings designed for the vessel to be making a certain speed on passage, any disruption that would cause the vessel to slow steam or be stopped for a considerable time (for example awaiting permanent repairs in drydock) can have a detrimental effect on the hull coating.

In tropical locations heavy growth heavy things from the ships hull in around three weeks

Following the Deepwater Horizon explosion and oil spill, we saw numerous claims for hull cleaning painting due to contamination.

Also, to be considered if a vessel has set in plating from a grounding or damage to a propeller this will disrupt the normal hydrodynamic flow, causing cavitation. Downstream of the cavitation the impingement will affect the hull coating.

Most commercial vessel antifouling can be allowed to be dry for several months. Some specific soft products, particularly for yachts, only allow a short period of hauling before reapplication is necessary to activate the biocide layers.

Slide 15

When considering repair of hull plating it is normally necessary to grit blast the steel down to Sa 2 or 2.5. This should be achievable in most major ship repair yards.

Location of the yard (cost, quality and availability) and potential time waiting to go into dry dock (buildup of growth) will need to be considered due to the effect on the paint repairs.

It is not only the direct area of plating damage that requires recoating. Normally a margin of around 15% to 20% additional area would potentially be affected.

Slide 16

And now to some of the disparities I've noted between hull clauses, adjusters' rules of practice and the York Antwerp Rules, many of which do not, in my opinion, consider the current coating technologies employed on commercial vessels and the extended periods between scheduled drydocking.

The ITC 2003 addition appears to somewhat address application of antifouling coatings, but only in cases where steel plating requires renewal or refitting. It does not account for some of the indirect damages I previously noted.

the American Institute clause is even more restrictive allowing no claim for scraping or painting of the bottom.

Slide 17

The current Average Adjusters rules of practice reflect the ITC clauses with the noted exception of application of antifouling coatings, only primer and anti-corrosive being allowed.

In the case of General Average, the cost of painting or coating the bottom shall not be allowed unless it has been coated in the previous 12 months, in which case half of the costs would be allowed.

Slide 18

The York Antwerp rules how a little less restrictive regarding General Average, allowing 24 months

Given that the standard period between drydocking's is five years, and bottom coating systems at that point do not due to normal wear and tear require the same remedial actions as a significant hull damage, I would venture that an arbitrary time frame or limitation on coating application, such as those outlined above, is not particularly relevant in today's shipping industry.

Slide 19

The Nordic Plan appears to have realized this and no longer excludes or restricts bottom painting. from a practical surveyor's point of view this makes sense.

Slide 20

In conclusion, hull coating technology has moved forward significantly in the last 60 years and particularly in the last 20 years with respect to increased time between drydockings and lifespan of paint systems.

The bottom coating system is a critical part of a ship. While it requires ongoing maintenance it is also subject to fortuitous damages and requires proper repair.

One of the major costs during a drydocking is the maintenance or repair of the underwater coating system. Ship owners plan the maintenance aspect into their operating budgets, it is unlikely they would expect to budget for hull damages and the associated repairs.

From a surveyor's perspective it appears that hull policies, rules of practice and the York Antwerp rules require a more consistent approach in line with the industry and have got a little way to go to catch up with today's technology.

Respectfully Submitted

John M. Walker

Chairman