



Congresso Internacional de  
Corrosão, Integridade,  
Pintura e Revestimentos  
Anticorrosivos



# Do you have a plan for Fouling Control?

Michael Hindmarsh

Safinah Group

[michael.hindmarsh@safinah-group.com](mailto:michael.hindmarsh@safinah-group.com)

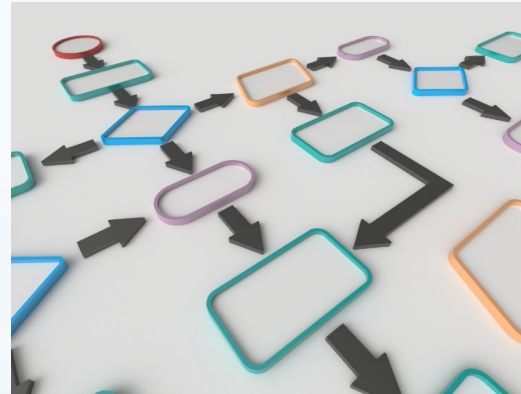


## Safinah Group

360° Coating & Engineering Experts

# Agenda

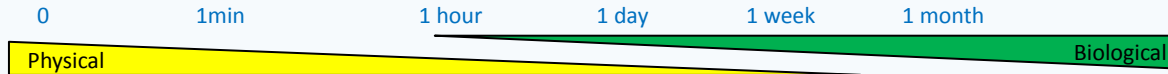
- The biofouling problem
- The solutions
- The questions
- Your strategy
- Process for choosing the best solution



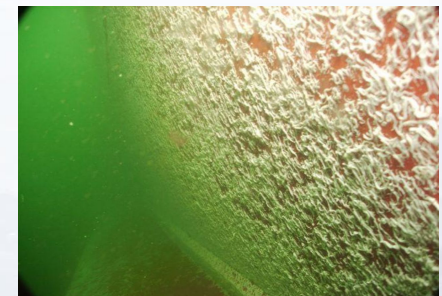
# The problems

- The vast majority of 'things' placed in (sea) water if left unprotected will foul

Bacteria → Diatoms → Slime (EPC) (micro) → Weed (macro) → Animal (macro)



- Problem depends on what it is you want to protect. Moving structure, slow-moving structure, low activity moving structure, static structure etc.
- What is making biofouling a problem for you?



# The problems

## Static structures

- Structural stability
  - Could fouling affect stability?
    - FPSO North Sea, 65months, no AFS, 100% fouling - 225 tonnes of mussels (IMO presentation)
- Asset integrity
  - Inspecting structure integrity
  - FRU or FPSO, class requires the underwater surfaces to be inspected every 5 years. UWILD (Underwater inspection in-lieu of Dry Dock)



### 3.11 Underwater Conditions

- i) The vessel's underwater body is to be sufficiently clean and the sea water is clear enough to permit meaningful examination and photography by the diver. "Sufficiently clean" is taken to mean that sections of the underwater body, including flat keel plating forward, amidships and aft, are cleaned to the extent that the Surveyor can determine the condition of the plating, the welding and the coating. Additional cleaning may be necessary. Overall or spot cleaning may be required at the discretion of the attending Surveyor.

Source: Underwater inspection in lieu of Drydocking (UWILD) – Guide for class notation, ABS, April 2007

# The problems

## Dynamic structures

- If you have a moving vessel and you are responsible for the fuel or scheduling, you want a **smooth hull to reduce drag**
  - Hull performance
    - Reduce Fuel consumption
      - operational costs
      - emissions regulations
    - Maintain speed
  - Environmental or operational
    - Translocation of invasive aquatic species (Biofouling Management Planning) - Also important long term for FPSO's
    - EEXI and CII

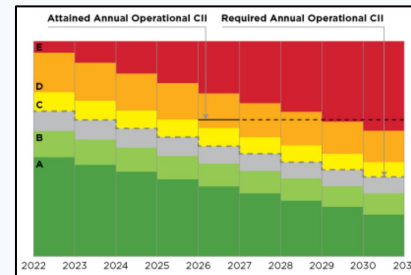


# The problems

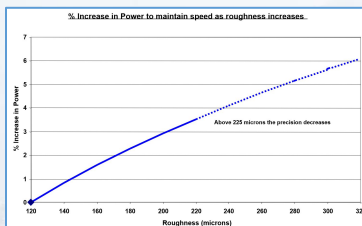
## Smoothness of underwater hull

Smoothness of underwater hulls - reducing drag

- EEXI is dependent on engine, hull shape, smoothness of hull, propeller etc
- Complex formula but conceptually,  $EEXI = \frac{ME \text{ and } AE \text{ CO}_2 \text{ emissions} - \text{Energy savings}}{DWT * Speed}$ 
  - Fouling control influences EEXI (Speed) but coatings are not directly certified to improve EEXI - IACS
- $CII = \frac{\text{Total CO}_2 \text{ emission during year (in tons)}}{DWT * \text{Nautical miles sailed}}$
- Maintain the smoothness of the hull from when the vessel enters in-service period.
  - IMO requires CII, but shipowners are not keen - 'laden' DWT)
- But how smooth is the hull in the first place?



**Total ship resistance**  
Hullform 10-40%  
Residual ~2%+  
Frictional resistance 50-90%



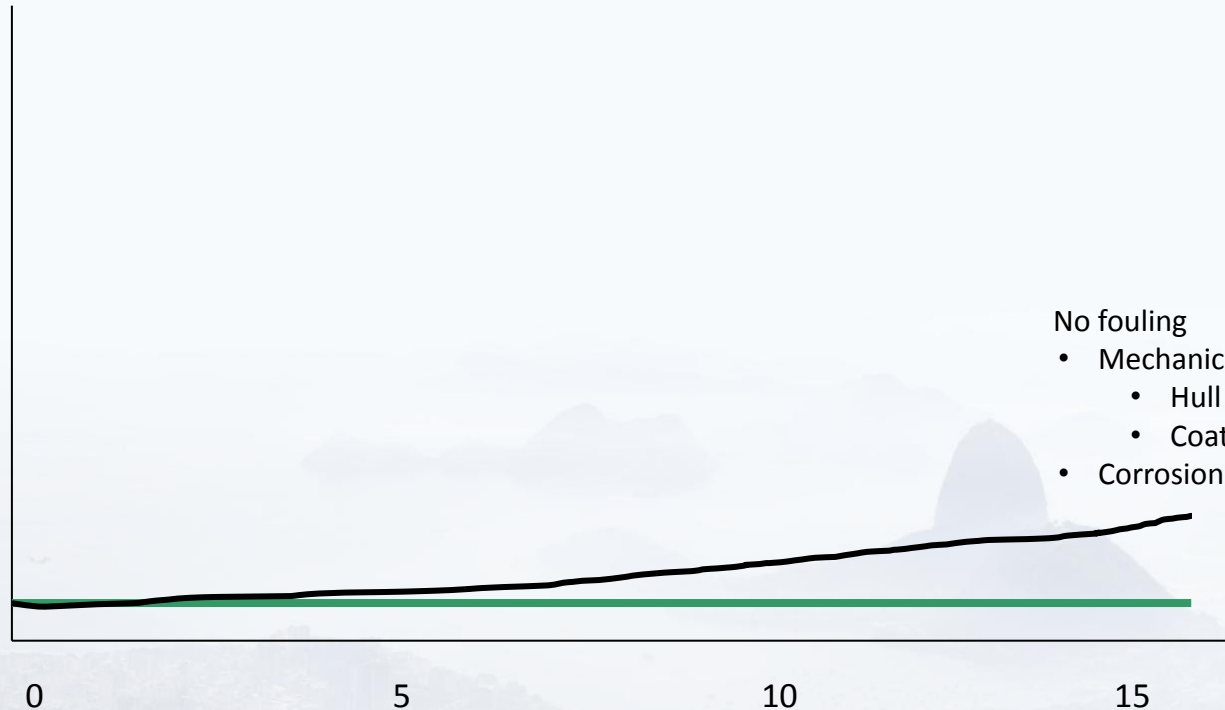
R. Townsin  
Every 25µm increase in AHR  
there is a 1% increase in  
power



# The problems

## Hull roughness - No Fouling

Roughness or drag

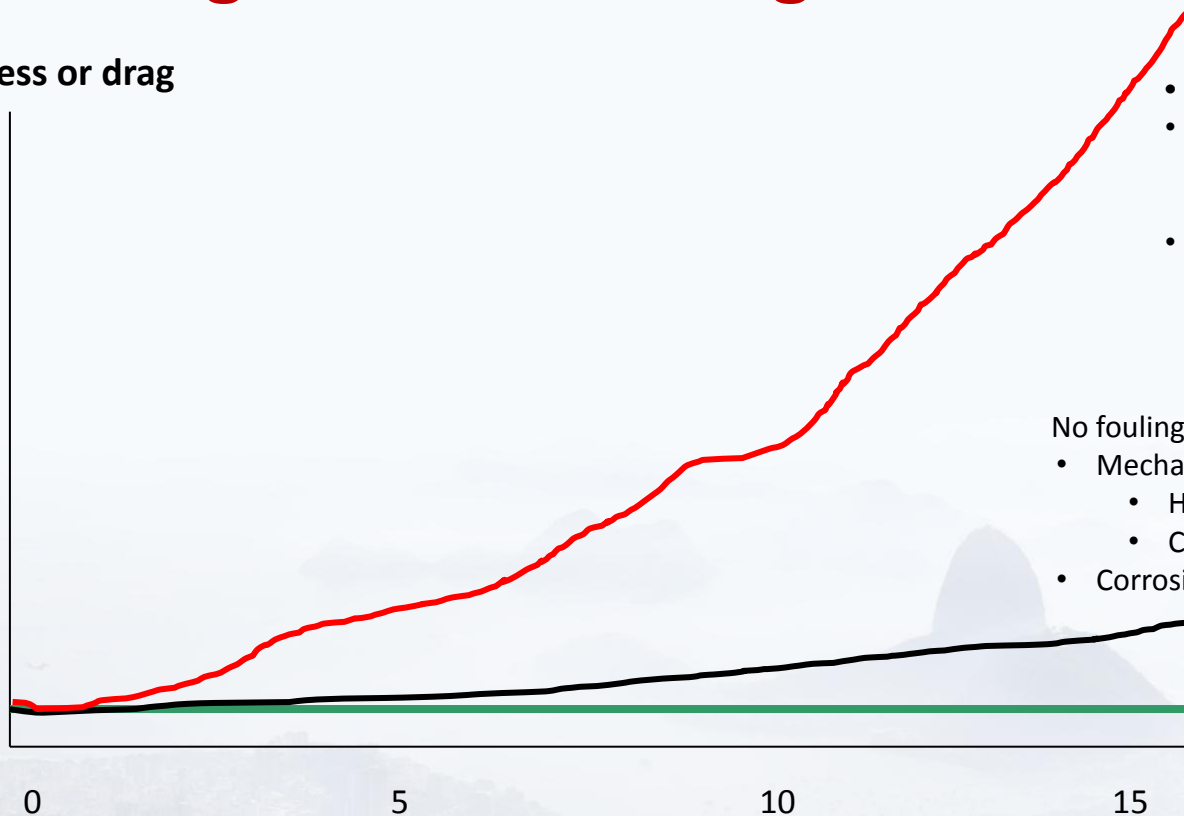


- No fouling
- Mechanical damage only
    - Hull
    - Coating
  - Corrosion

# The problems

## Hull roughness - Fouling vs No Fouling

Roughness or drag



- **Fouling**
- Mechanical damage
  - Hull
  - Coating
- Corrosion

- **No fouling**
- Mechanical damage only
  - Hull
  - Coating
- Corrosion

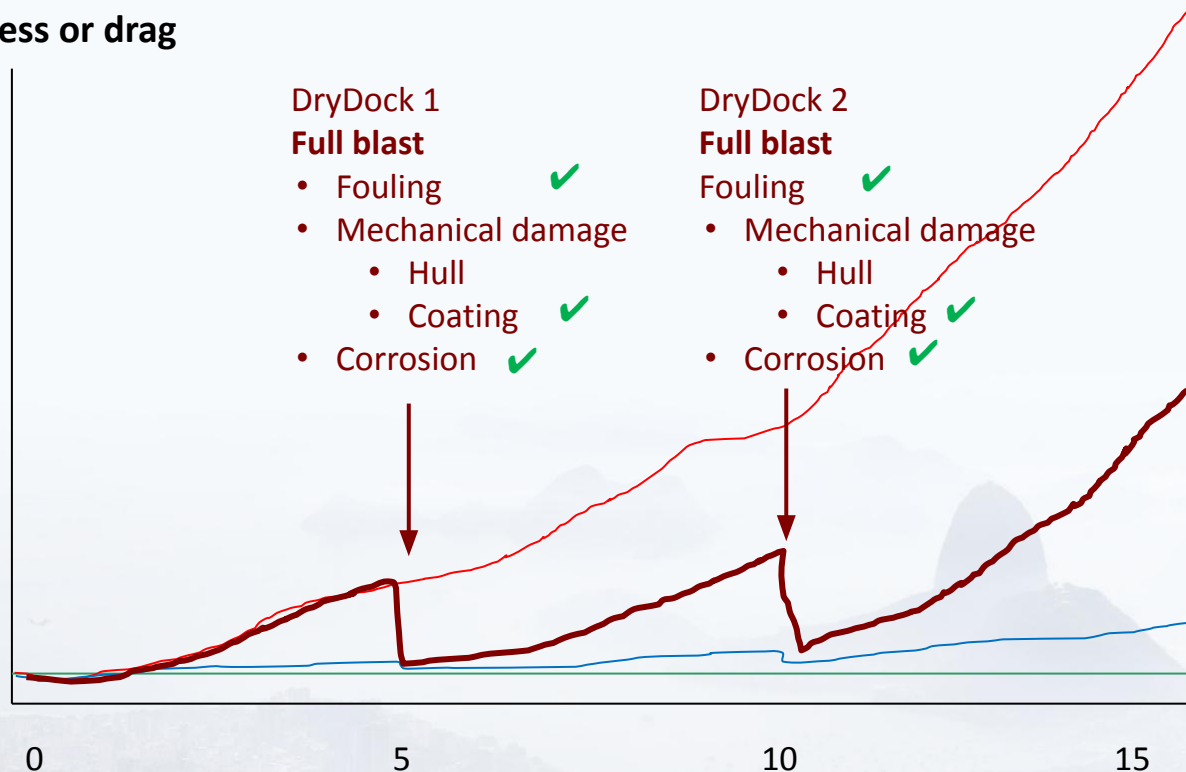


# The problems

## Hull roughness – Fouling, full blast

- Fouling
- Mechanical damage
  - Hull
  - Coating
- Corrosion

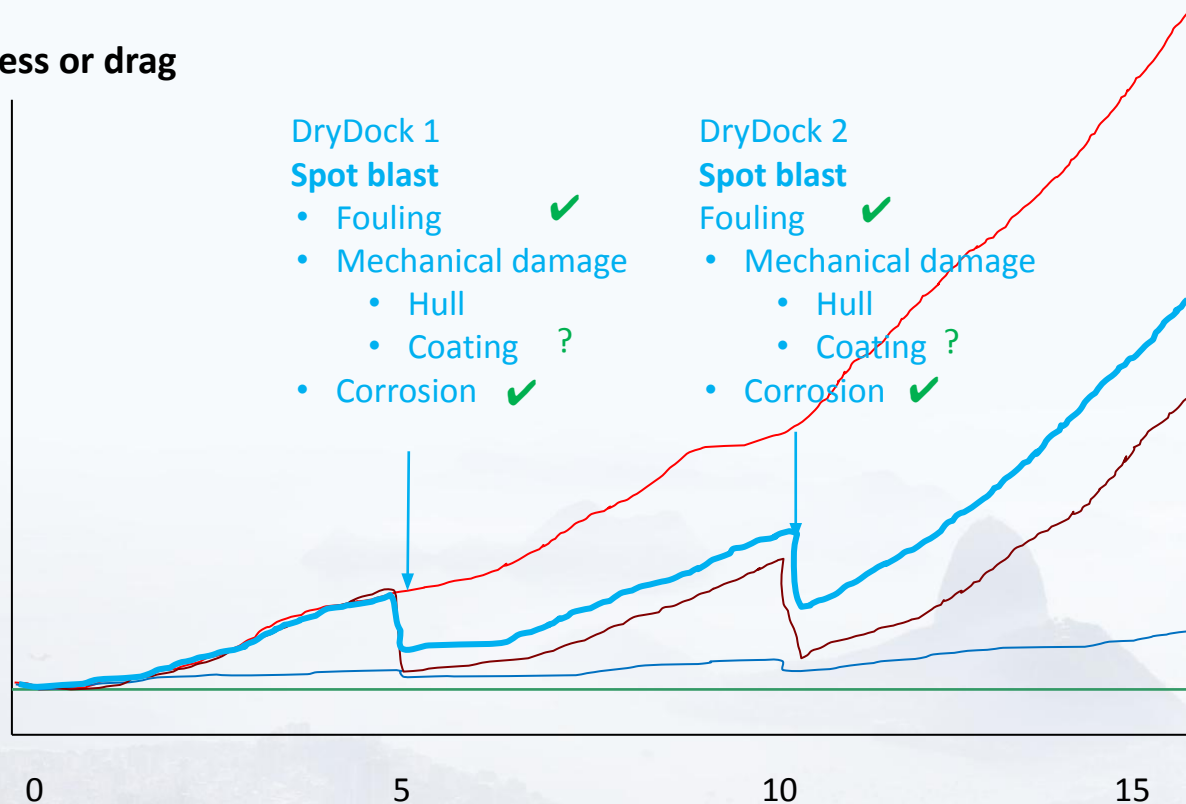
Roughness or drag



# The problems

## Hull roughness – Fouling, spot blast

Roughness or drag



- Fouling
- Mechanical damage
  - Hull
  - Coating
- Corrosion

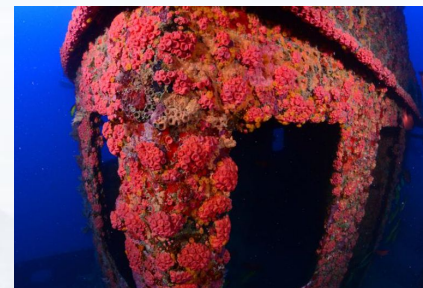


# The problems

## Environmental – Invasive species

- **Aquatic Invasive Species**

- BWM Convention
- 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species
  - Effect on coating selection and potentially scheme life
- “My structure doesn't move, so why care?”



# The solutions Fouling Control

- Coatings (prevention)
  - Biocidal antifouling - A range of delivery mechanisms and a range of biocides
  - Biocide free coatings - Range
  - Polishing and Non-polishing
  - Surface functionality (Hydrophilic, Hydrophobic, Amphiphilic)
  - Non-stick (Silicone, Fluoropolymer, hydrogel)
  - 'Furry' systems
  - Hard scrubbable\*

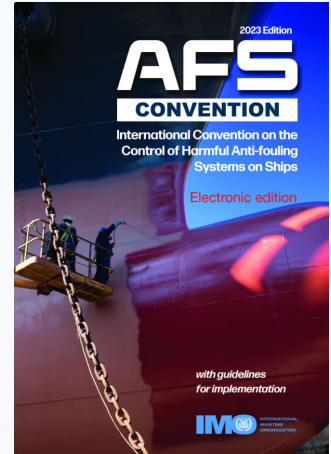
\* with cleaning

# The solutions Fouling Control

- Non coating technologies (prevention)
  - MGPS niche areas (production of copper ions)
  - Ultrasonics
  - UV-C sterilisation (LED technology)
  - Air lubrication systems (not primarily for fouling control)
- Underwater cleaning (reacting)
  - Proactive
  - Reactive

# The solutions ..... IMO

- International Convention on the Control of Harmful Antifouling Systems on Ships (2001) - **AFS Convention**
  - The convention responsible for banning the use of TBT
  - Now cybutryne (irgarol) from Jan 2023
  - Which biocide is next?



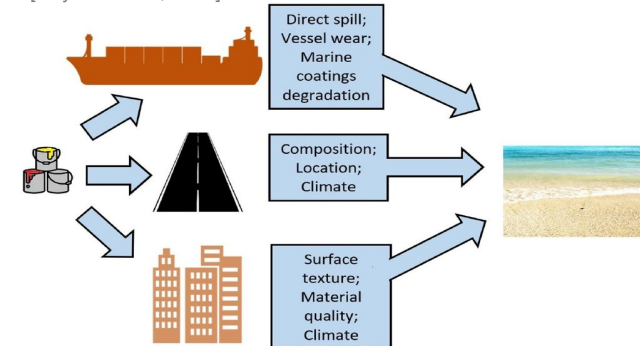
# The solutions ....and new pressures

- Microplastics
  - **IMO**
    - Proposal for the formal investigation of microplastics from paints and anti-fouling coatings and their effect
  - **Other:**
    - UN Member States agreed to negotiate a legally binding global plastics treaty (March 2022)

Graphical summary of results by Dibke et al (2021) on main sources of microplastics in the German Bight



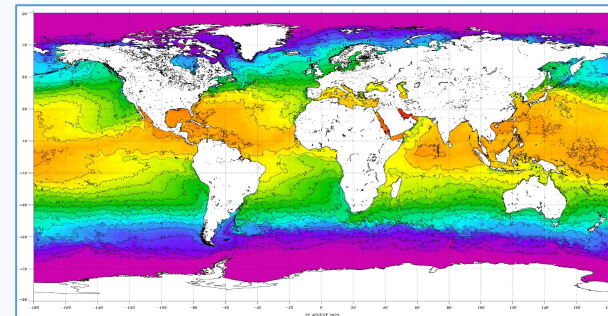
Major Sources of Paint Microplastics in the Oceans  
[Gaylarde et al, 2021]



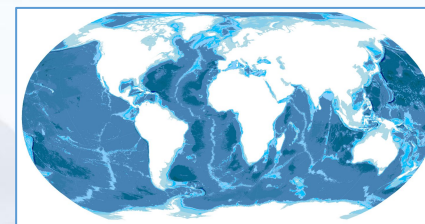
# The questions

## Fouling abundance trend?

- Several factors will affect the fouling abundance/risk
  - Global location
    - Water temperature
    - Salinity
    - Abundance of nutrients
  - Structure specifics
    - How far offshore
    - Water depth
    - Presence and intensity of sunlight on the underwater structure



Source: NOAA



Source: Databayou.com

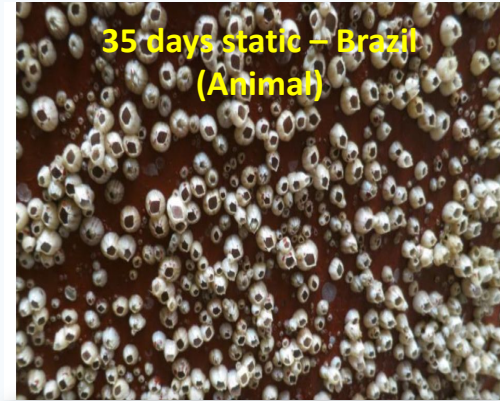


# The questions

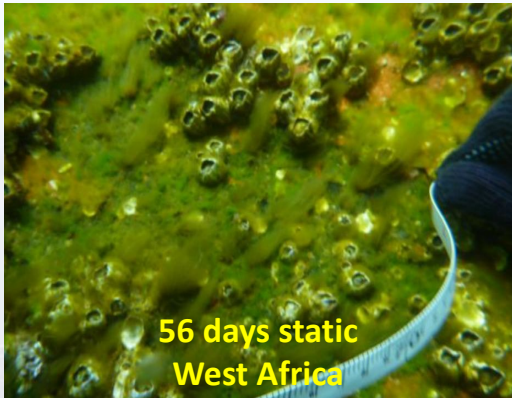
## Scheme considerations

- Strong sustainability stance of Owner/Operator? **Biocide or Biocide free for example.**
- Invasive species consideration? **CA, Aus, NZ waters for example**
- In-service period?
  - 30 – 60month schemes most common for ships
  - Static structures (FPSO's etc could be 15 – 20years)
- Opportunity to maintain the system? Dry Dock or In-water cleaning?
- Stationary or dynamically trading?
  - What do we mean by dynamic? **Offshore structure or Ship**

# Fouling occurring when idling



35 days static – Brazil  
(Animal)



56 days static  
West Africa



25 days static  
Gulf of Mexico



60 days Brazil  
(weed & animal)

# The questions

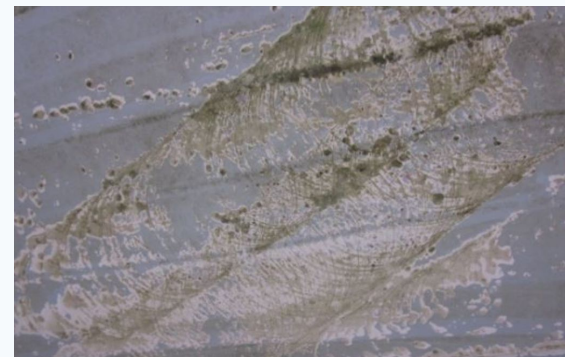
## Scheme considerations

- AFS compliant?
- Why do coating suppliers have so many products for fouling control?
  - No 'one solution' for all floating structures in all locations
  - Antifouling specification criteria: performance expectation, customer preference, in-service period, vessel activity, fouling abundance, through life costs etc
  - Commercial flexibility and different types of end-users
- Who can give you best advice for a suitable solution?
- Selection criteria for decision making?
- Who is going to make your decision?
  - Technical, Operations, Design engineers, Procurement,
- Is cleaning allowed/acceptable/desirable?

Segment	AF Products	Total AF Products
Marine	378	512
Yacht	134	

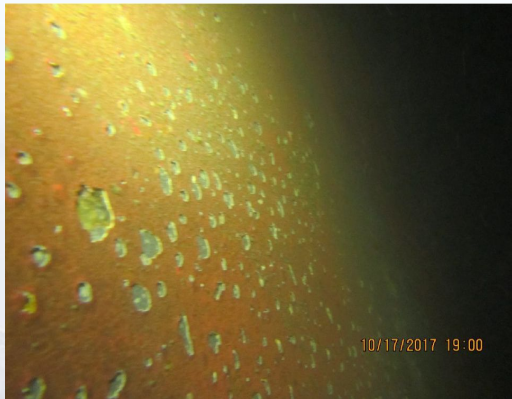
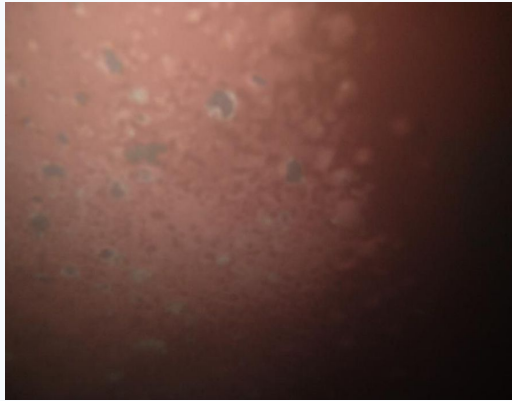
# The questions Cleaning

- Cleaning can remove fouling from the underwater hull - Great
- It can also completely remove the fouling control coating system!



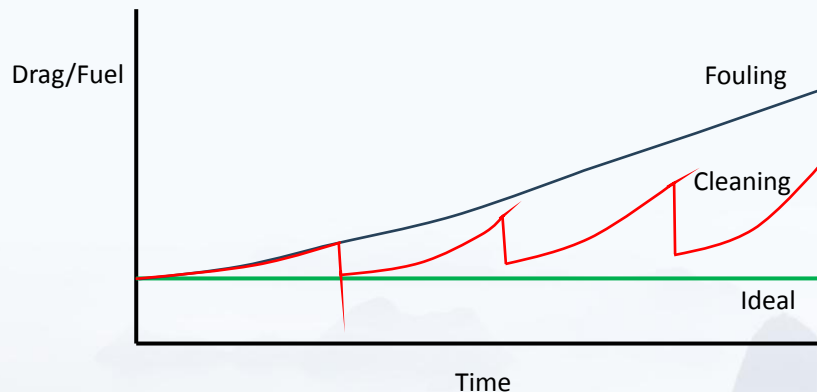
Source: EC Hokinson. Images used for illustration only, no endorsement expressed or implied.

# Hull coating damage from removing fouling



# The questions To clean or not to clean

- Why clean?
  - Fouling increases drag on a moving asset (increasing operational cost)
  - Economic sense? - Cost/Benefit decision

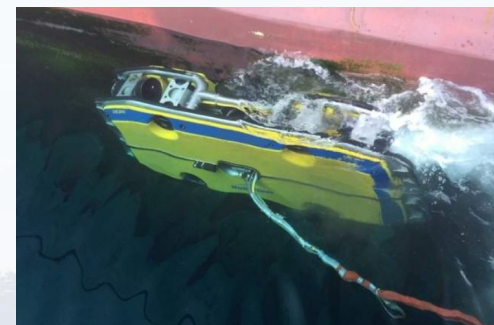


You never get back to initial performance!

# The questions

## Viability of cleaning

- Cleaning of a fixed structure (FPSO) if needed will enable a successful UWILD by class
- Just before the UWILD - biofouling may have adhered well
  - heavy cleaning to remove
  - high probability of destroying any remaining AFS
  - worse situation at the 10 year, 15 year and 20 year UWILD.
- Choice
  - Diver with powered rotary brush or non-contact or ROV
  - Location, availability of each technology and the local restrictions.
  - Consider this at initial specification stage. Engage partners.
  - Cost \$5k to \$50K\*



\* GloMEEP site

# The questions Cost

- Fouling control coating systems vary considerably in terms of cost
- Basic biocidal antifouling for a COT could be \$161,000 (dependant on activity and speed)
- For a high performance SPC system\* it could be \$268,000 (dependent on activity and speed)
- For a foul release system\* it could be \$426,000
  
- These systems allow ship's hull performance to also vary considerably - Return on investment
  - Fuel saving
  - Speed

\* Full blast and full A/C and AFS (112K DWT tanker, 6000SMM)



# Developing your strategy

- You know what questions need to be answered
- There are many potential solutions
- You should also know that there is not one solution for every case
  - **Choice based in expectations and understanding what success looks like**
- There will always be a 'best' solution, if you understand what 'best' means

# Process for choosing

- Collect the information about the problem (**questions you need to ask yourselves**)
  - The asset/structure to be protected
  - Reason for protecting against fouling
  - Performance expectation – is your past performance good enough? Did it work? Did you have to clean?
  - Where will the asset be coated (and is it Newbuilding, Conversion, or Dry Dock)
  - Where will the asset be located or trading when in-service
  - Consideration of speed, activity, sea water temperature

# Process for choosing

- In-service period and/or expected time to next DD
- Substrate and substrate preparation (spot blast or full blast)
- Any sustainability considerations
- Are there any synergy opportunities (combined coating/cleaning expectations)
- Budgetary constraints
- Is there any anti-abrasion needs (Ice/or anti-abrasion belt), rudders etc.
- Others??

# Process for choosing

- Develop the RFQ using the information collected highlighting the 'must haves'.
  - Include the 'functional specification'
- Develop a list of potential suppliers that could offer the choices
  - Coating company's
  - Underwater inspection company's
  - Underwater cleaning company's
  - Hull performance monitoring company's
- Send RFQ and ask for supplier option(s) reasoning/justification, track record, price etc
- Hopefully, receive commercial/technical offer/quotations. You may get a visit.
- Remember, the suppliers want your business

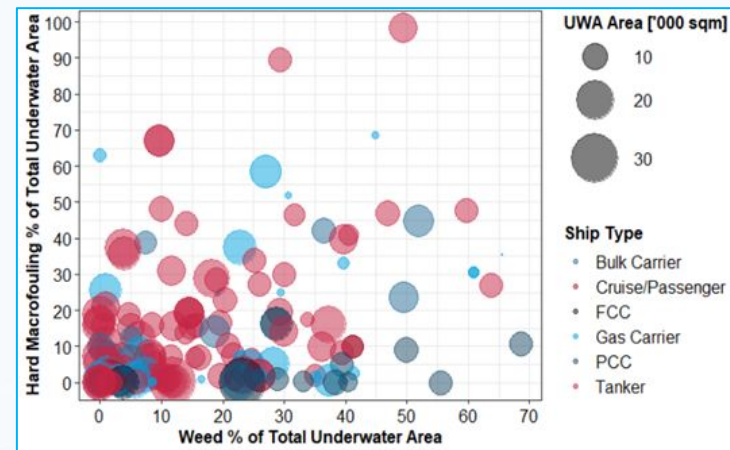
# Process for choosing

- Analyse quotations/solutions
- Negotiate?
- What are you negotiating? Price generally.....
  - Paint guarantee
  - Hull performance guarantee if applicable and relevant
  - Rebates
  - Owner benefits
  - Product performance
- Make a decision
  - Who?
  - Price?
  - Performance?
  - Sustainability?



# Take an independent view

- Use a company that has seen performance of antifoulings - 800 dry dockings of all AF coatings
- Help to specify the performance requirements
  - Development of **functional specifications**
- Unbiased technical assessment of paint systems
  - Paper based (chemistry/formulation)
  - Performance based (Safinah database), we are now doing 200 Drydocks/year
- Unbiased commercial assessment of paint systems
  - Commercial parameters on specification
  - Paint performance guarantee terms
  - Vessel performance guarantee terms



# Finally

- Fouling Control solution should not be an afterthought.
- Fouling Control strategy should be considered as part of the engineering
- Make the wrong decision and it'll cost more whether financial or environmental.