



The Effect of Biocide Free Foul Release Systems on Vessel Performance

John Willsher – International Paint

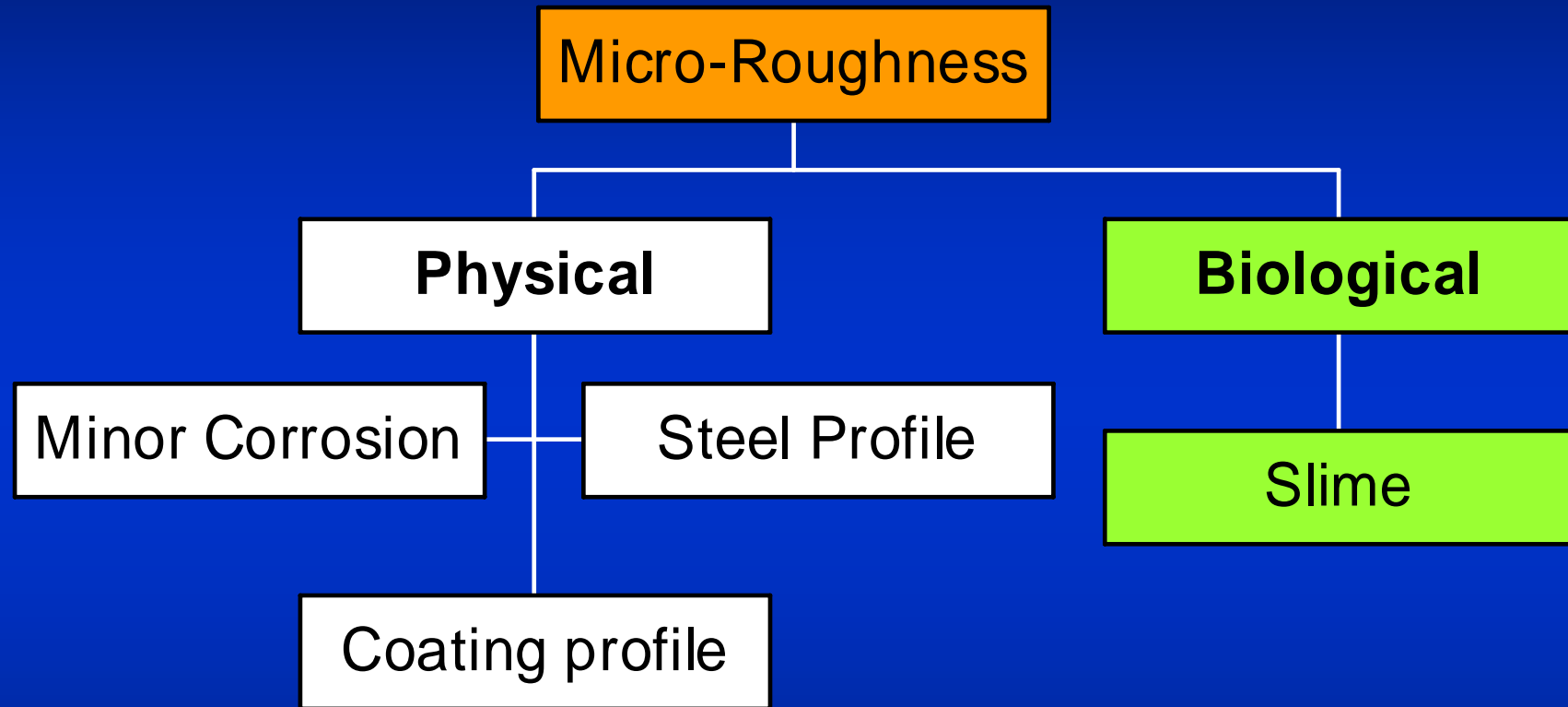
History of Fouling Control using Coatings



Agenda

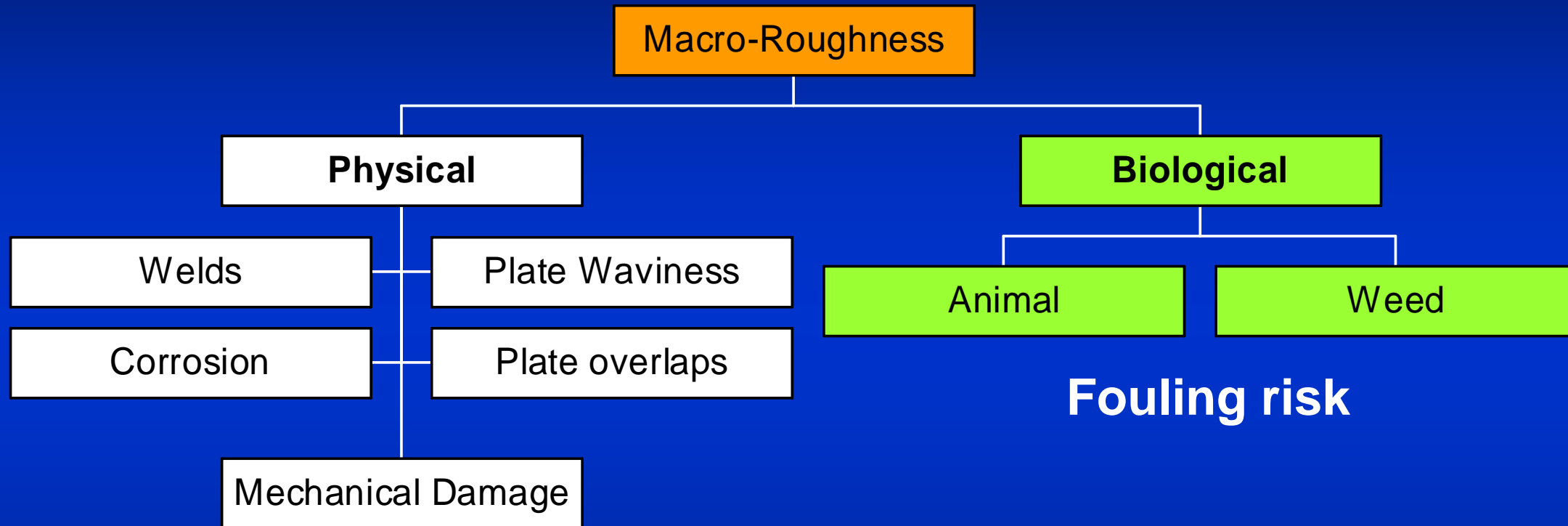
- Theory behind reduction of resistance and fuel consumption
- Application Process
- Advantages and disadvantages
- Results from the fleet in-service

Theory behind Reduction of Resistance and Fuel Consumption

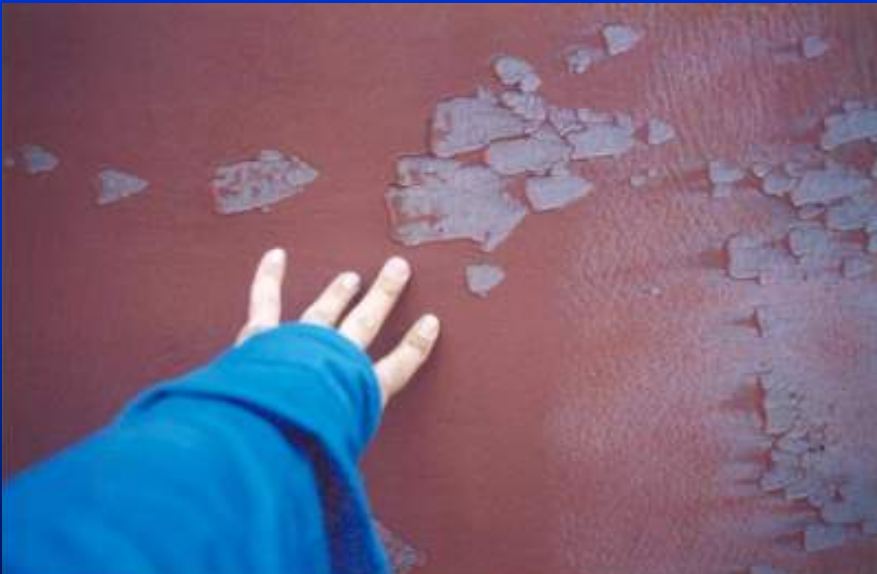


Physical roughness

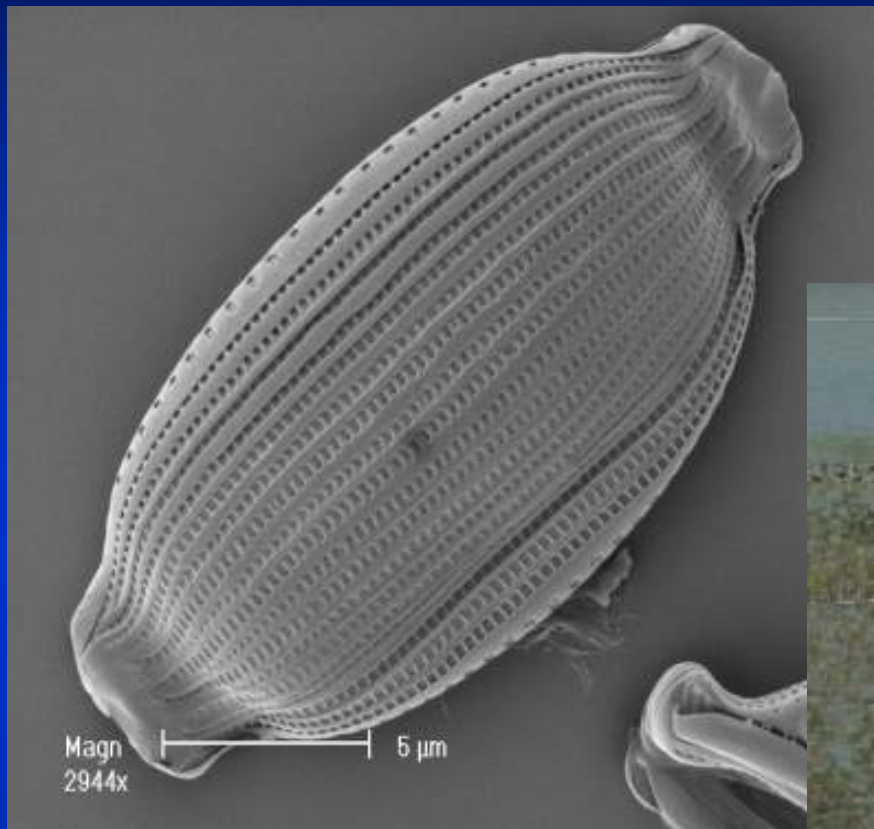
Roughness and Ship Performance



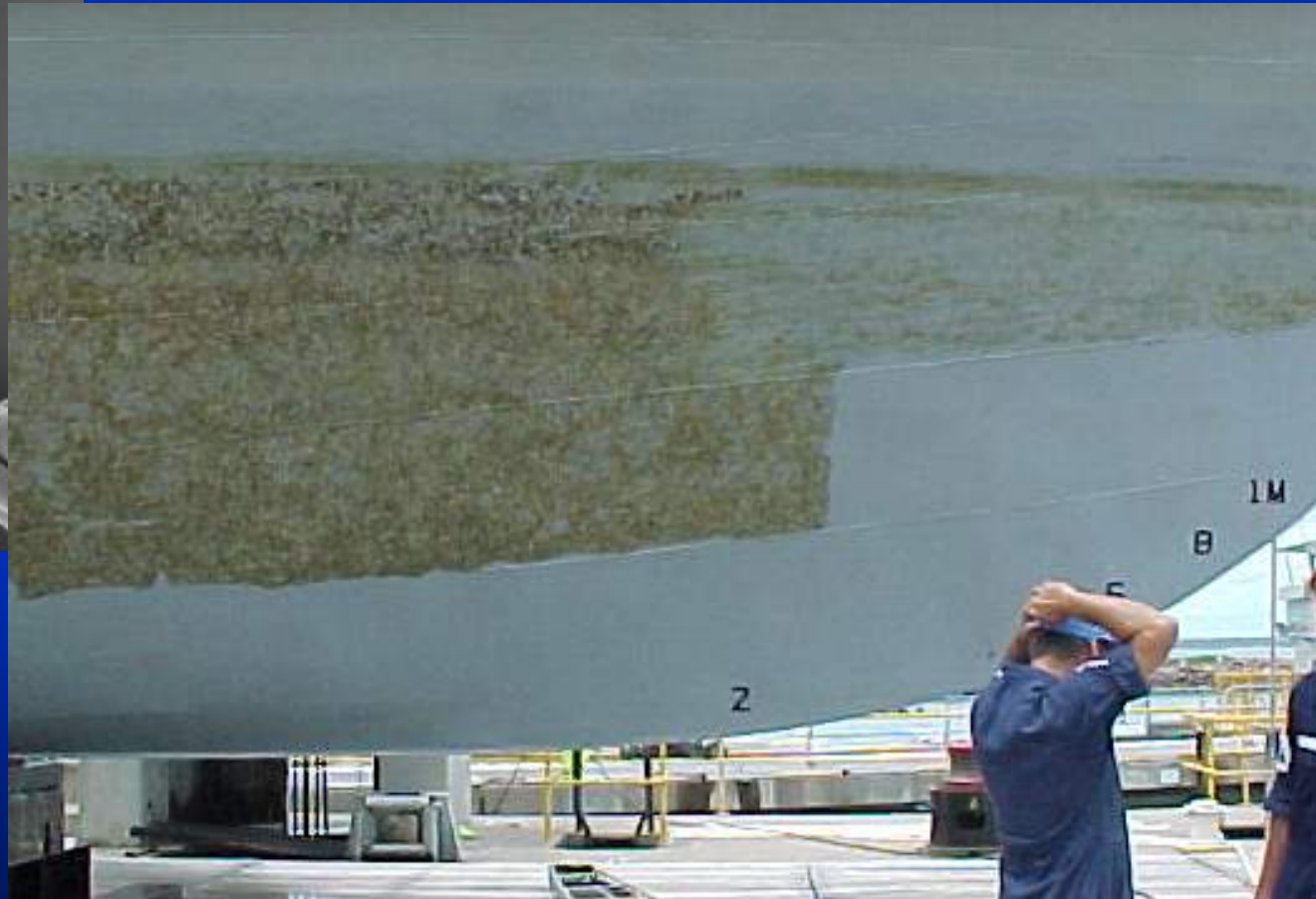
Coating Roughness – Cracking, Detachment, Cold Flow, TU Repairs



Slime Fouling



1~2 % increase in drag



Weed Fouling



Ulva (Green)

10% increase in drag



Ectocarpus (Brown)

Shell Fouling



Mussels

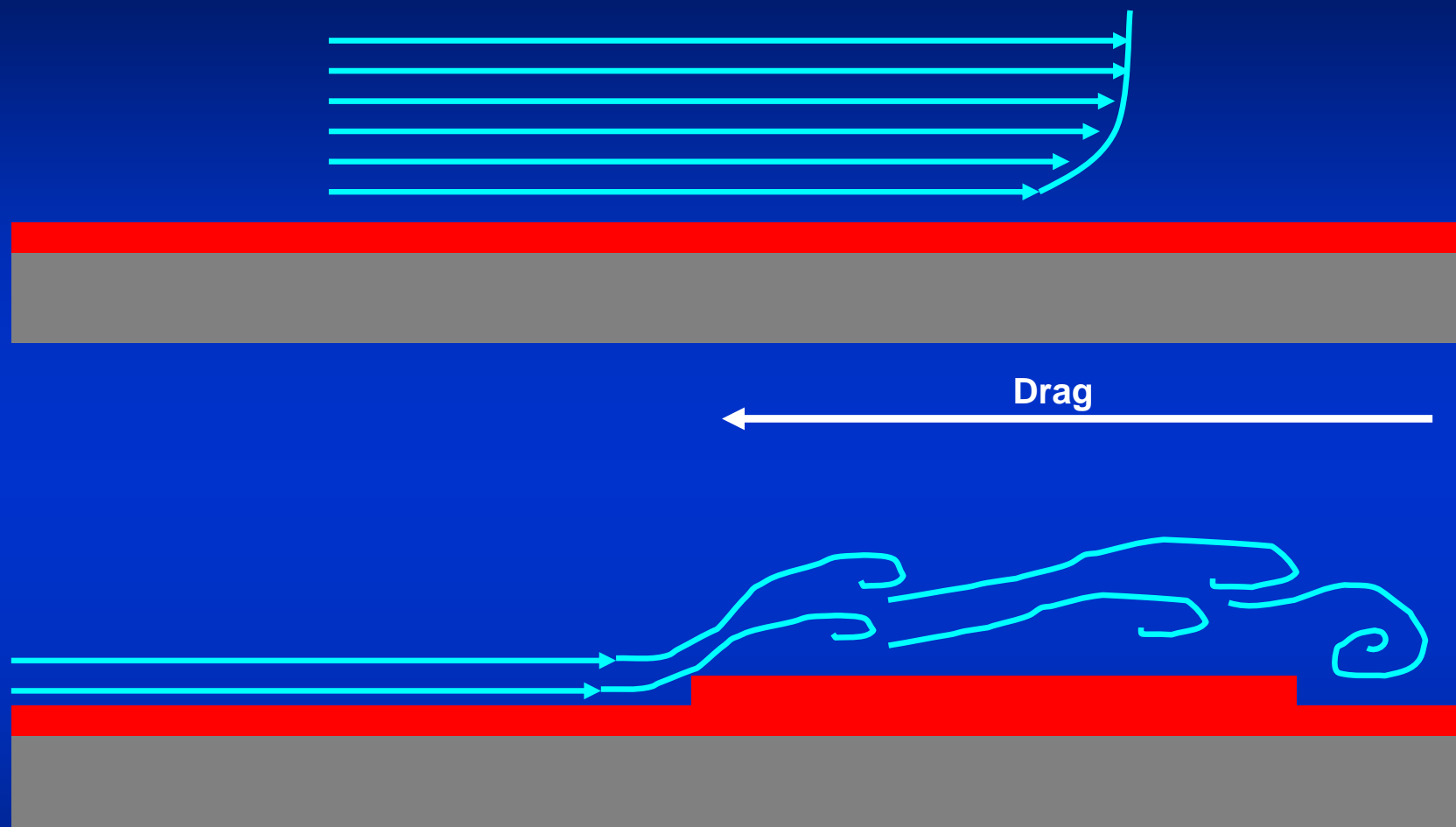


Barnacles

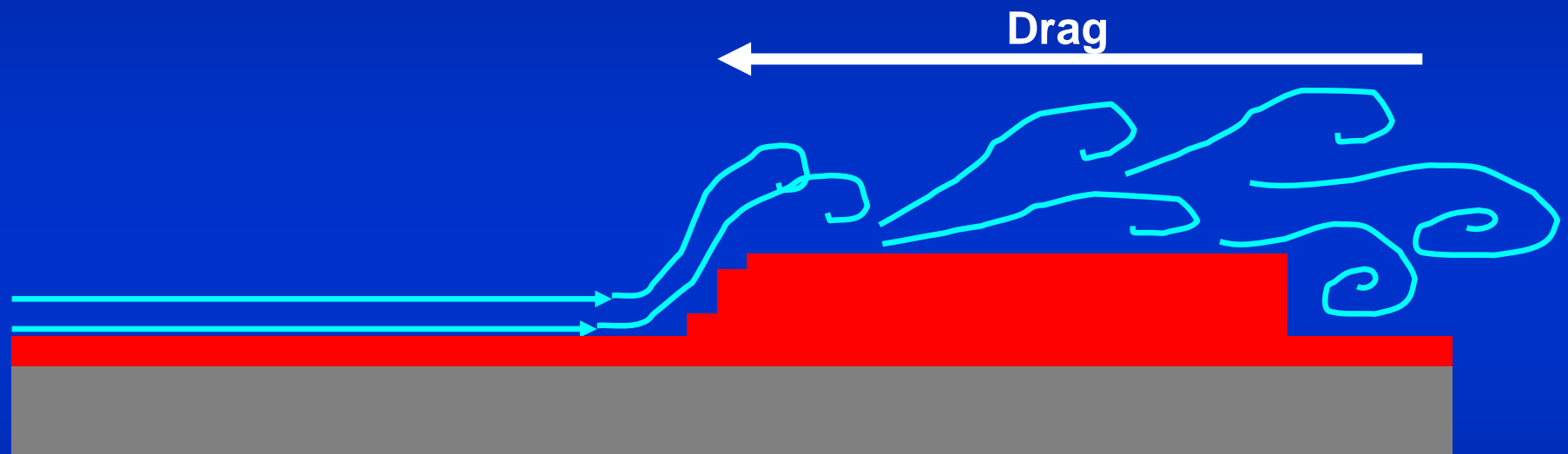


40% increase in drag

The Boundary Layer



The Boundary Layer



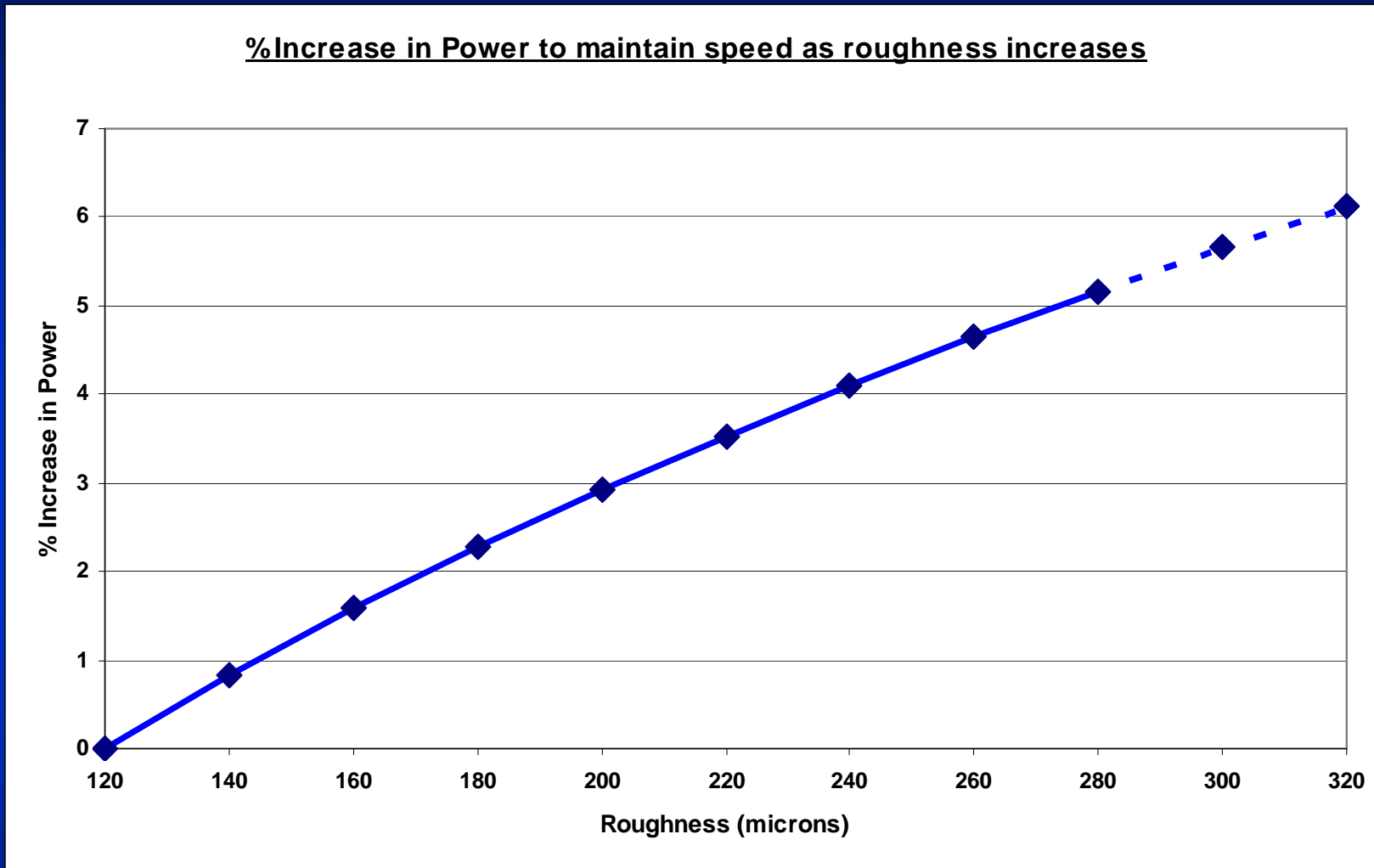
The effect of Micro-Roughness

What impact has hull roughness on a vessel?

The effect of Micro-Roughness

- It's all about power
- The rougher the hull the more power needed to push the vessel through the water, if the vessel cannot increase power it will slow down
- The more power needed means the more fuel used and an increase in level of emissions
- The more fuel used the more money needs to be spent
- So how is roughness linked to power ?

The effect of Micro-Roughness

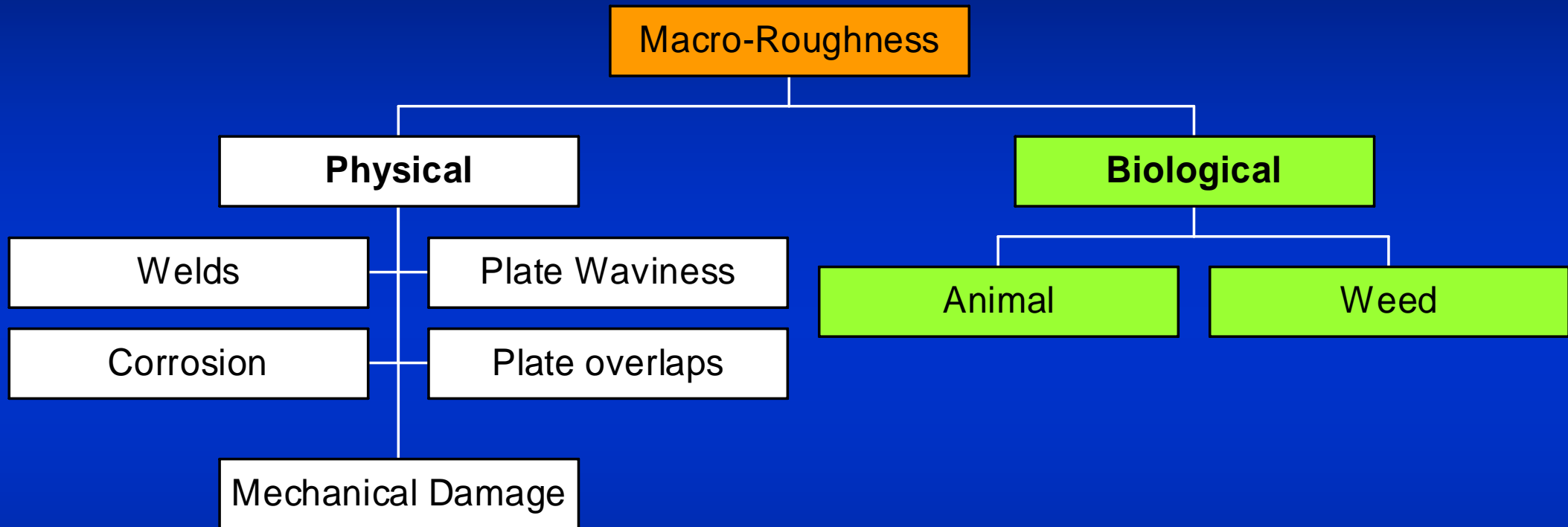


**“Fuel Economy due to Improvement in Ship Hull Surface Condition”,
R.L.Townsin et.al., Int’l Shipbuilding Progress, 33 (383), 1986, 127-130.**

The effect of Micro-Roughness

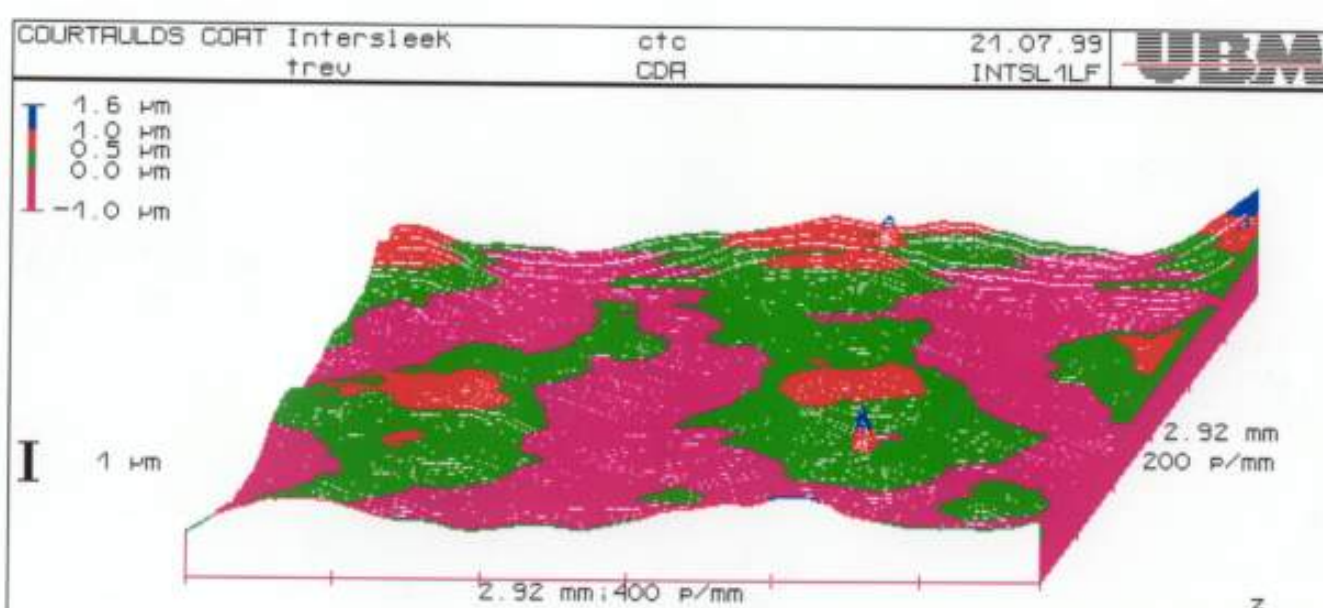
**Does the type of coating used
Have any effect on hull roughness?**

Roughness and Ship Performance



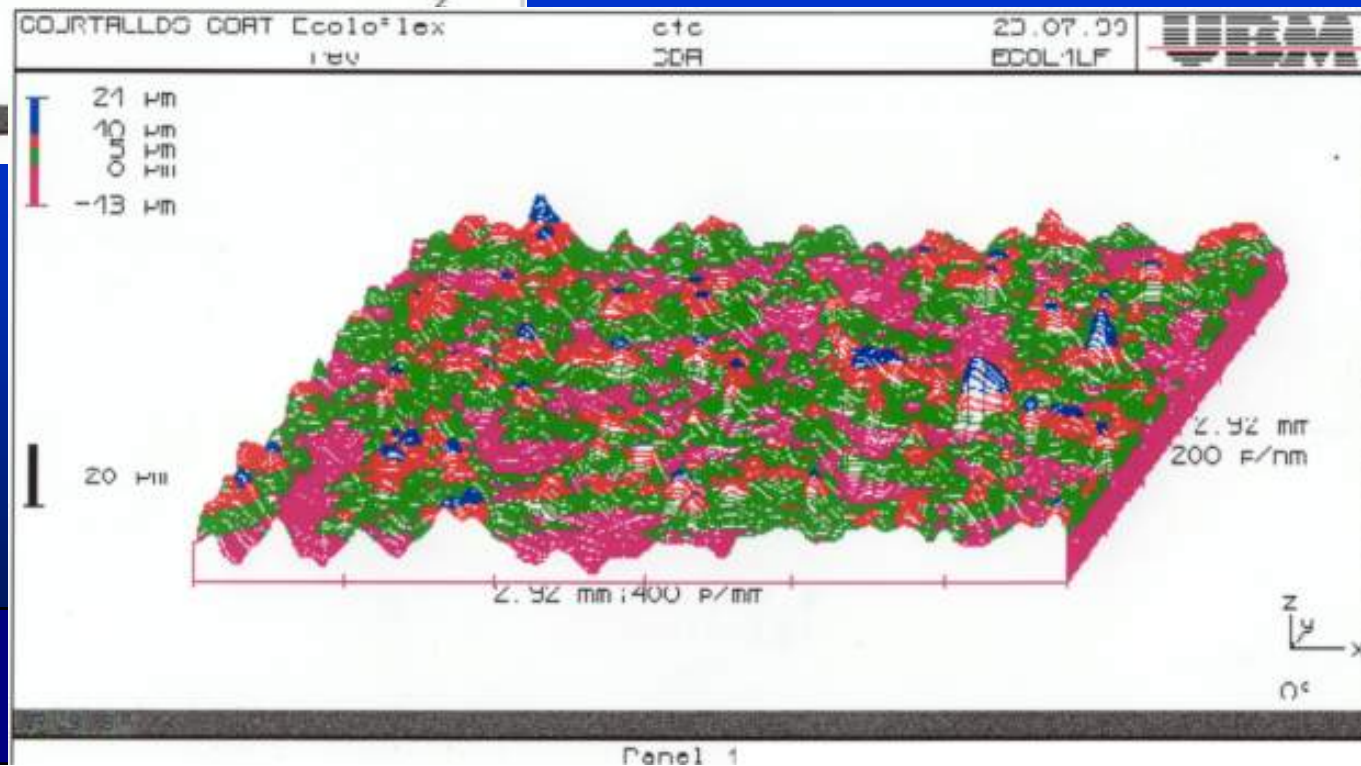
For Foul release systems to improve efficiency they need low hull roughness, good resistance to mechanical damage and to prevent attachment of fouling

Foul Release Products have lower Hull Roughness than Biocidal Antifoulings



Silicone foul release coating - freshly sprayed (approx. 100 microns AHR)

SPC antifouling - freshly sprayed (approx. 125 microns AHR)



Fluoropolymer Foul Release Systems Have Even Lower Hull Roughness



Full ship result, Fluoropolymer Foul Release
TI Africa (OSG) = 64 microns AHR (3rd lowest AHR ever recorded)

Foul Release Products have good resistance to mechanical damage and resistance to fouling

“Al Khor” (72176 dwt, 58 months)



Before / During Washing



Is it Difficult to Apply Foul Release Products?

- Application of Foul Release coatings is carried out using standard spray equipment. However, new spray lines and stripped and cleaned (or new) pumps are required. Foul release products are not compatible with other paint types, so dedicated equipment is required
- Masking ~2m in the topsides is the only “extra” requirement:



Singapore, Sept 2001



Innoshima, August 1999

Foul Release - Masking at M&R



“Doha”, Singapore, April 2004

Advantages of Foul Release Coatings

- No release of biocide in to the environment
- Unlikely to be affected by future environmental legislation
- Reduced paint volume (and solvent emitted) on first application
- Good antifouling performance on a range of vessel types
- Good resistance to mechanical damage
- Reduced hull roughness giving improvements in vessel performance
- Less time in dock, paint required and application costs at future dockings

Experience of Re-docking Vessels with Foul Release Coatings - Volumes of Foul Release Coating Used at Re-docking

Foul Release Coatings : Lower M&R costs

- Re-coat volumes on Gas Carriers with foul release coating:

<u>Vessel</u>	<u>Application</u>	<u>Next DD</u>
	<u>Date, Volume</u>	<u>Date, Volume, %</u>
“Al Khor”	11/01, 8470 l	05/04, 620 l 7.3% (7 days in dock)
“Broog”	05/03, 7750 l	10/05, zero (4 days in dock)
“Al Wakrah”	10/03, 8510 l	5/06, zero (4 days in dock)
“Al Wajba”	05/05, 8480 l	6/07, zero (4 days in dock)
“Doha”	04/04, 8490 l	5/07, zero (3 days in dock)

Disadvantages of Foul Release Coatings

- Higher initial cost of paint and application
- Quality of application is very important
- Masking and dedicated equipment required
- As product is biocide-free, resistance to slime for silicone foul release systems are lower than some biocidal AF

Results from the Fleet in-Service

Effect of Fluoropolymer FR on the “Hibiscus”

Saving 37lt/hour

37 x 12 hours = 444lts/day

Approx 0.5 te/day

350/2 = \$175/day

\$175 x 365 days = \$63,000 year

Or 6% fuel saving



6 months

Effect of Fluoropolymer FR on the “Corona Ace”

The chief Engineer said:

Speed : Improved from 12.7 to 13.7knots (in ballast condition and ideal conditions
14.7knots recorded

Fuel consumption is 32.6te in Dec.

Speed **1 knot increase**

RPM **105rpm down to 98rpm**

Fuel **32.60** te/day from 35.37 te/day

Currently **8.5%** fuel savings



Performance on Corona Ace After 6 months (including 27 day static period)





Bulker, 5,717 DWT, 12 knots G/Cargo, 03/06, 6 months in-service



Ikuna 9 months in-service trading 11 knots in Australian Coastal waters

Our chartering department has given me the vessel's voyage data dating back to late 2002 and I have compared average monthly speed and fuel consumptions (on a daily basis) from January 2003 up till December 2006. This period covers a mixture of voyage types from a few hours coastal up to 10 days deep sea.

We have noticed a definite increase in speed but no marked increase in fuel consumption for the additional speed. The speed increase is certainly a bonus allowing us to fit in more voyages over the year thus increasing revenue.

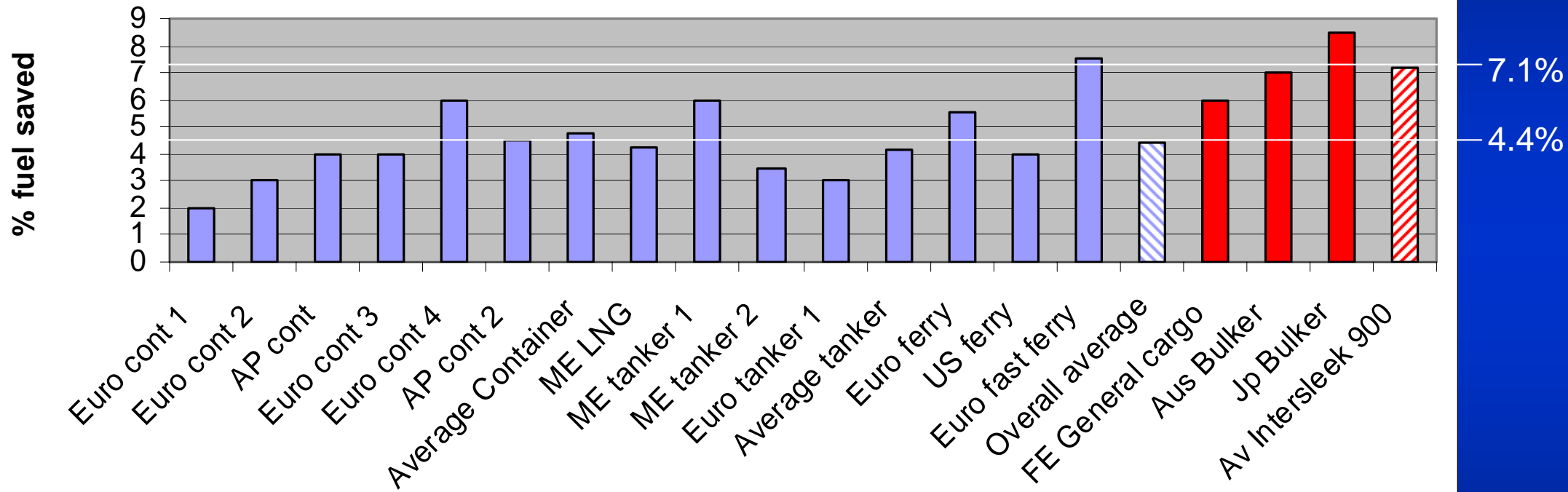
The recent in water inspection showed a **minimal slime growth** that was very easily removed with a quick wipe of the hand. The sea suction gratings which were also coated with **fluoropolymer showed no slime/weed** what so ever.

Average speed 2003, 10.76 knots
Average speed 2004, 10.85 knots } **Av 10.56 knots**
Average speed 2005, 10.08 knots }
Average speed 2006 after docking and fluoropolymer application **11.6 knots**, on average an increase of just under **10%**.

Average daily fuel consumption 2003, 12.15 TPD }
Average daily fuel consumption 2004, 12.35 TPD } **11.89 TPD**
Average daily fuel consumption 2005, 11.18 TPD }
Average daily fuel consumption after docking and fluoropolymer application **11.9 TPD**
which when compared to the average of the previous three years shows negligible difference.

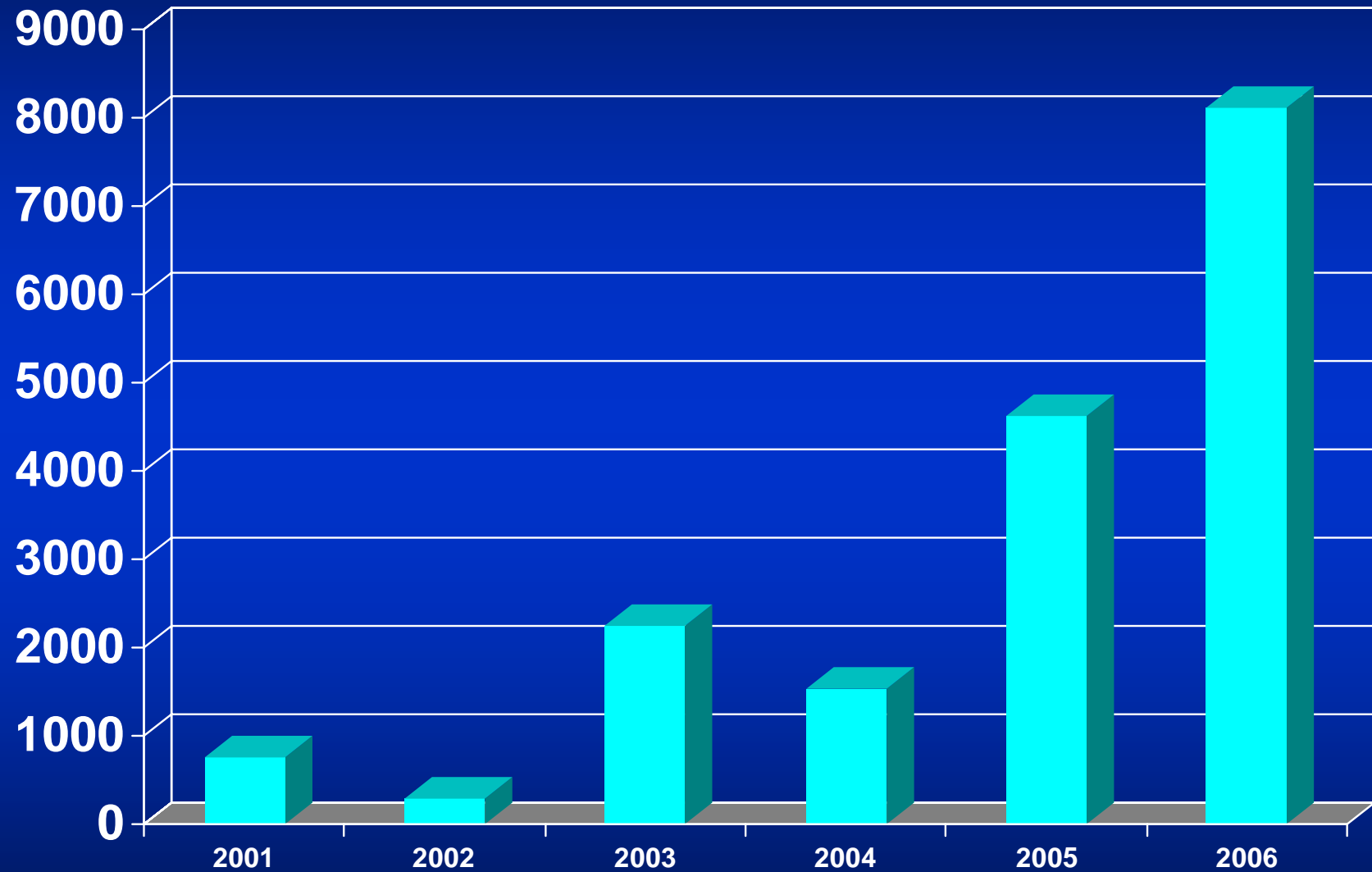
Rgds
Colin Macphail
Engineering Manager
Inco Ships

Customer reported fuel savings (%)



Silicone
 Fluoropolymer

Foul Release Applications – by Year ('000 DWT)



The Effect of Biocide Free Foul Release Systems on Vessel's Performance

- Foul Release Products give lower hull roughness than biocidal AF
- Foul Release Products require masking and dedicated equipment for application
- Main advantages are improved vessel efficiency, reduced environmental impact and reduced future drydock time and costs
- Main disadvantages are higher initial costs and more difficult application process
- A wide range of vessels have achieved efficiency improvements by using foul release products
- The number of foul release applications is increasing rapidly

