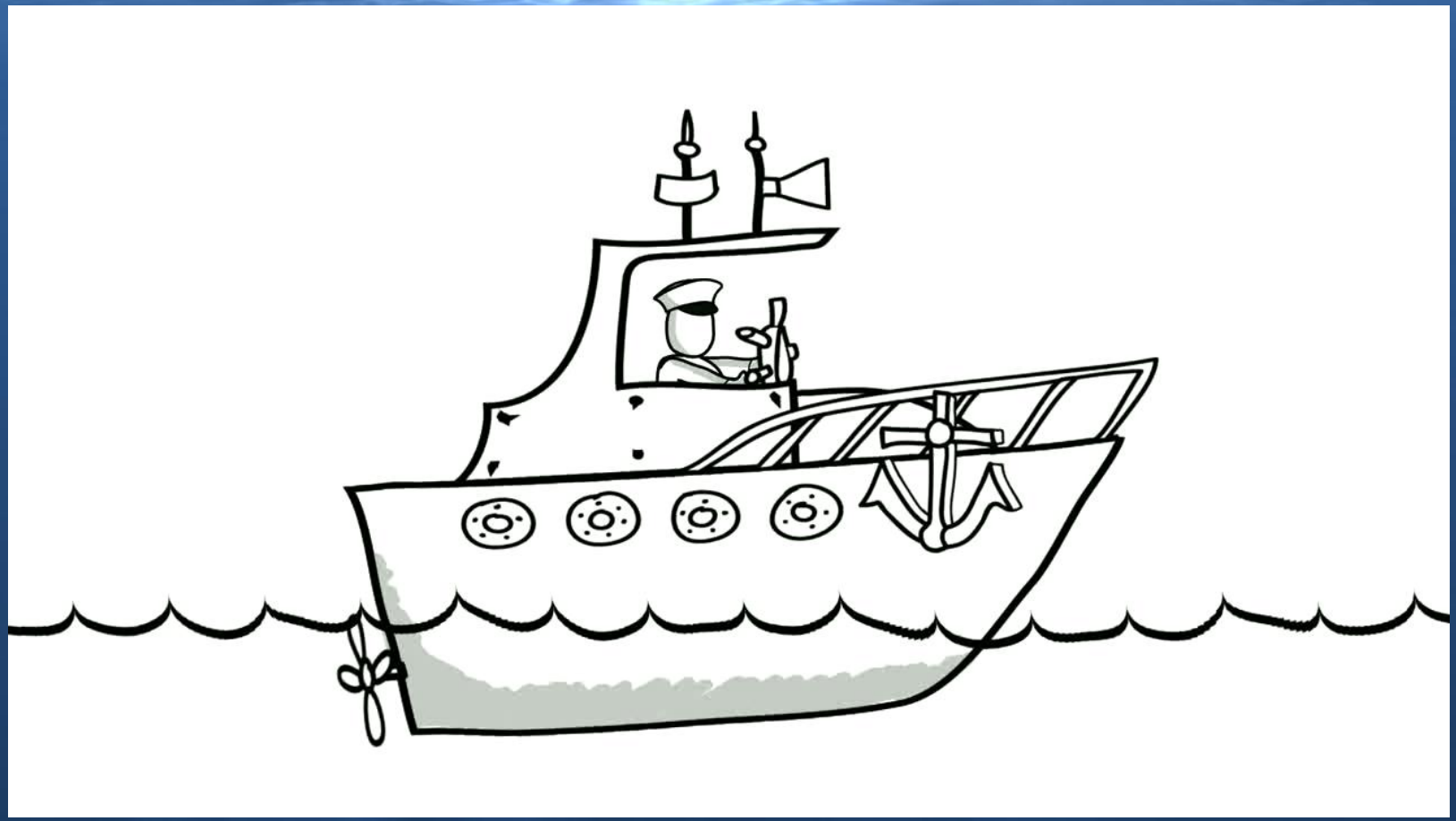
# Thorn-D®

Non toxic anti fouling

By micanti

## Non-toxic, cost and labor friendly antifouling

# Introducing Thorn-D

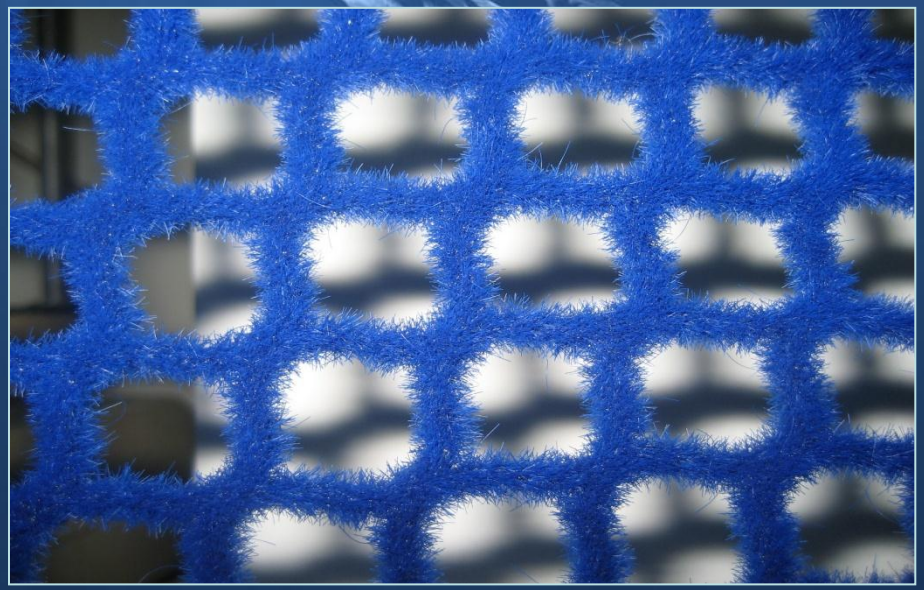


# CONTENT

1. Introducing Micanti – Thorn-D
2. Working principle
3. Antifouling effectiveness
4. Drag performance
5. Sustainability Evaluation
6. Summary

# MICANTI'S PRODUCT: THORN-D®

- The first truly environmental friendly antifouling
- Patented worldwide
- Developed in cooperation with leading institutes and companies



# MICANTI'S PRODUCT: THORN-D®

Thorn-D® is a self-adhesive film with specific micro-fibers. The fibers create a physical barrier through forming a textured surface.

# Use of Foils Common to Industries


Planes


Short Sea Shipping

Powerboats

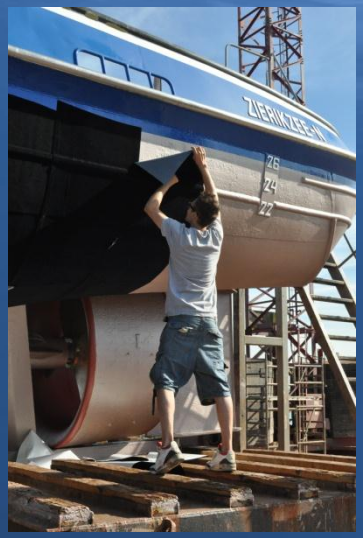

Sailboats

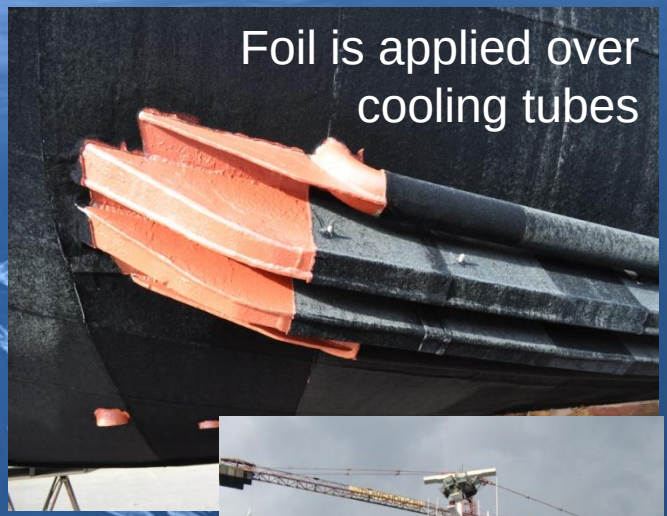

Trucks

Offshore


Ferries

# Application Process






Self adhesive foil directly applied on the primer

Zinc anodes are applied on top of foil

# STATUS TECHNOLOGY

- 6 years effectivity proven on full scale in Mediterranean (aquaculture)
- 6 years effectivity proven in North Sea (panel tests Oosterschelde)
- Product expected lifetime: at least 5 years
- Application carried out on various ships
  - (pleasure craft, 200ft$^2$ with difficult shapes
  - professional craft up to 4000ft$^2$ with need for high speed application
- No effect on drag observed for major market segments

# WHY DO WE BELIEVE WE WILL SUCCEED IN SHIPPING INDUSTRY?

- Thorn-D® is the first product in the world that prevented fouling on static objects for more than 5 years
- Preventing fouling on static objects is far more challenging than on moving objects
- Thorn-D® has been tested at various locations such as Norway, Chile, Scotland, Canada, Turkey, France etc.

- Cooperating with well established companies diminishes most of the technological obstacles and facilitates fast market penetration.

# WORKING PRINCIPLE

1. Sorts of species
2. Drawings of mechanism

# Fouling Species

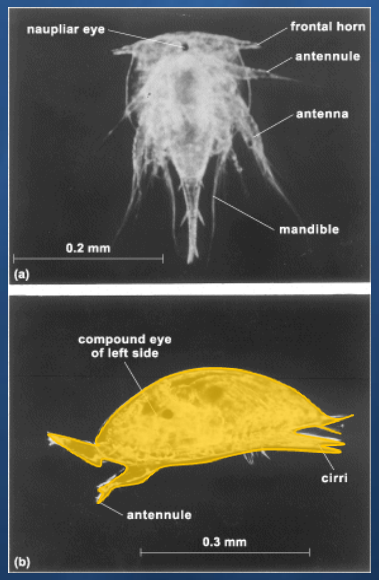
Settlement of species takes place in three different mechanisms:

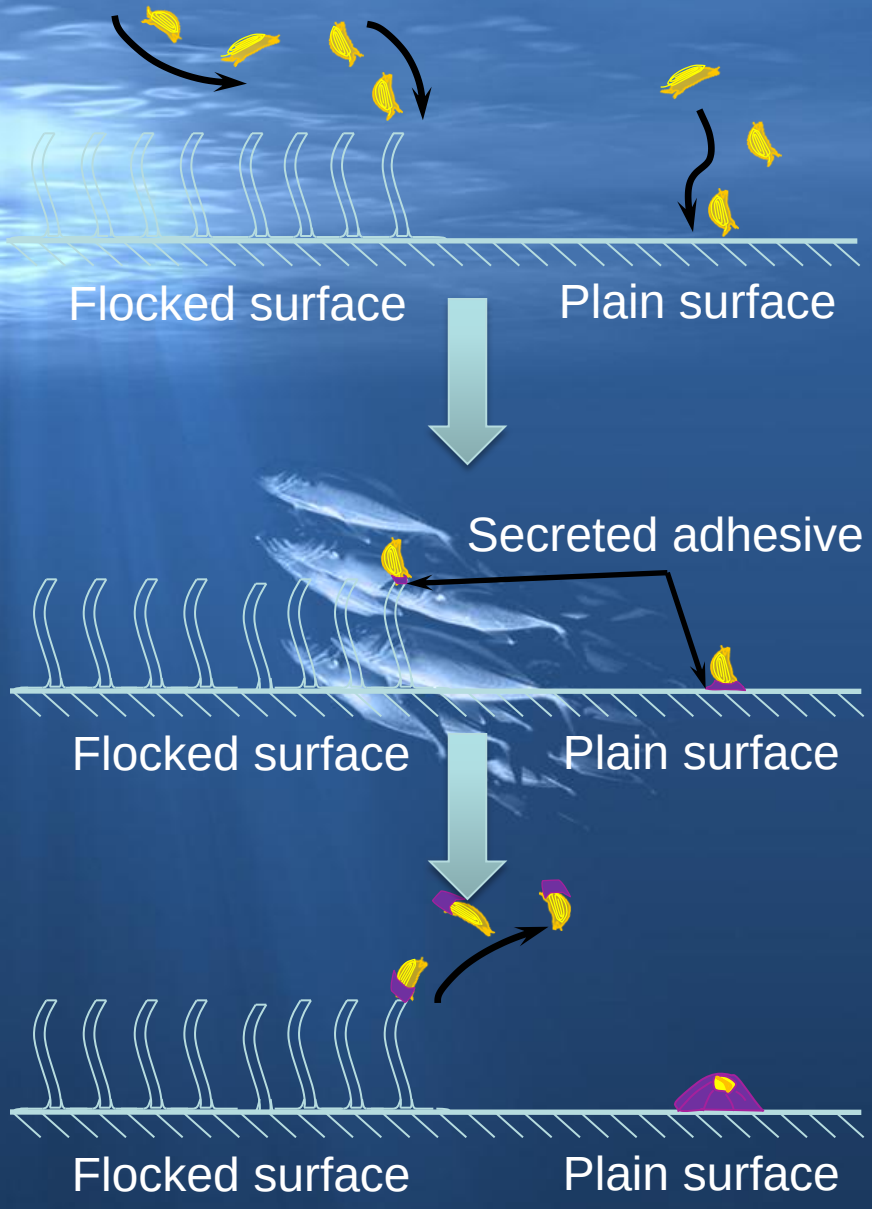
- Spore settlement (algae, seaweeds, kelp)
- Larvae settlement (bivalves, barnacles, tubeworms, ascidians, hydroids)
- Single cell attachment (bacteria, microalgae, diatoms)

Though for each climate, different species arise, these broad categories are found anywhere.

# WORKING PRINCIPLE

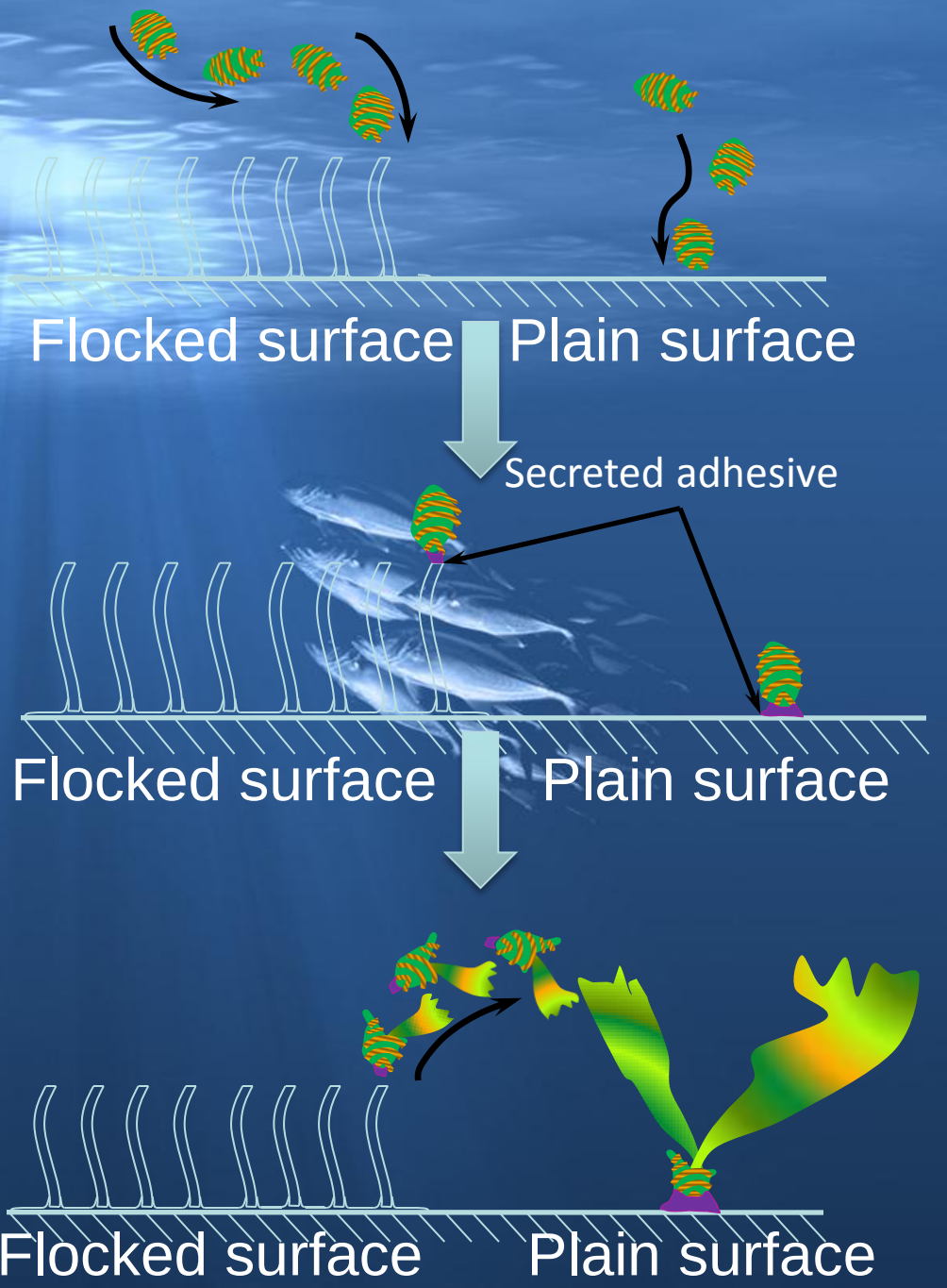
*Settlement of barnacle larvae*



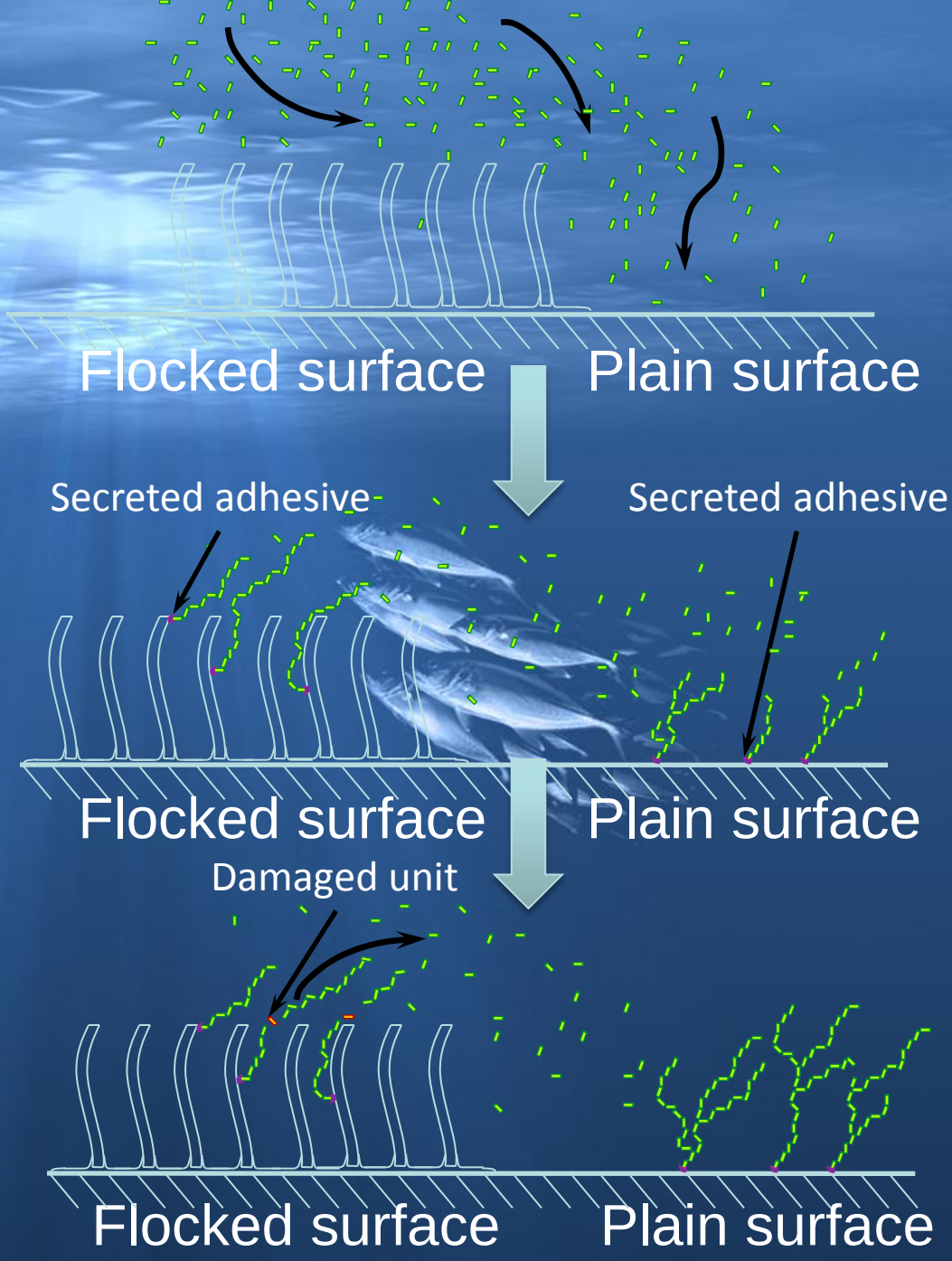
# WORKING PRINCIPLE

*Settlement of algae spores*



# WORKING PRINCIPLE

*Settlement of microalgae*

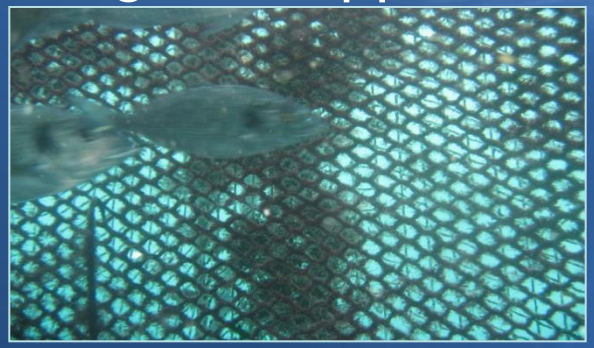


# Antifouling Effectiveness

1. Results Aquaculture (Mediterranean)
2. Panel tests Oosterschelde (NL)
3. Results Pilot Boat (NL)
4. Performance on Regal motorboat (Mediterranean)
5. Performance Electric Boat (FL)
6. Performance 32’ Grand Banks (CA)

# THORN-D® IN PRACTICE

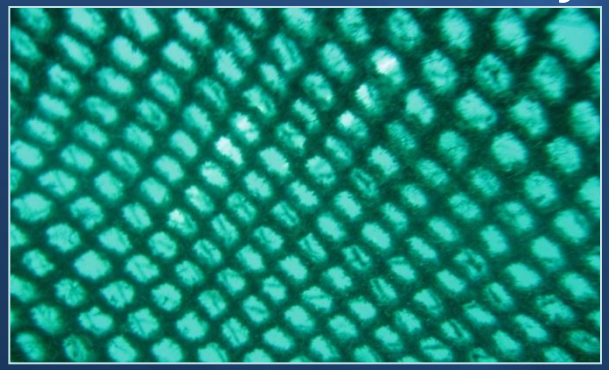
## Regular copper antifouling in Turkey



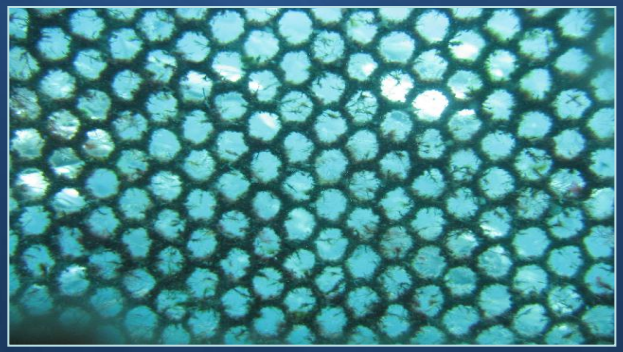
6 months

12 months – meshes are blocked

## Thorn-D® in Turkey



6 months



12 months

# THORN-D® IN PRACTICE

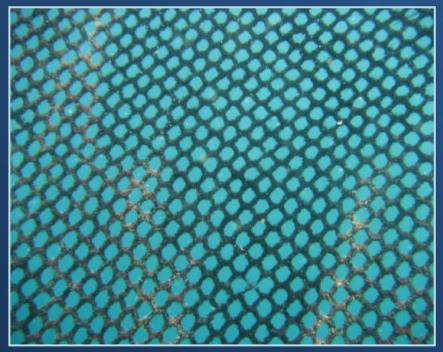
Regular copper antifouling (net needed to get out of the water to be washed)

1.5 year

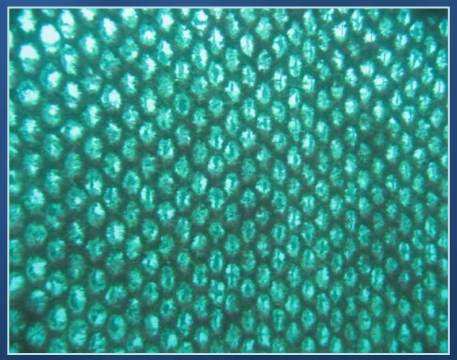
2 years

2,5 years

Thorn-D® - net is still clean after 5 years clean, even when is fish is fed every 5 minutes !



1.5 year



2 years

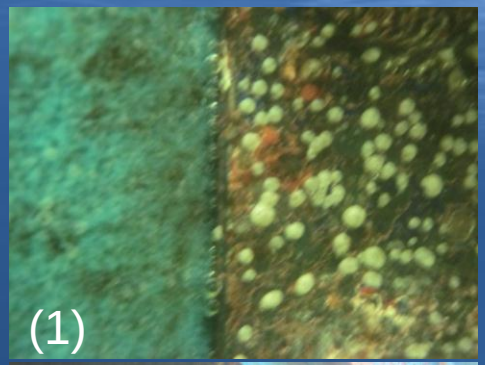
5 years

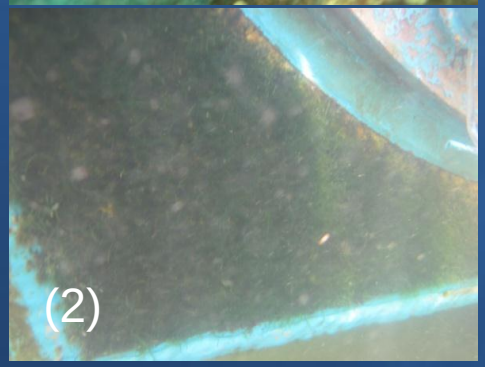
# Performance foils

**Long term performance**

In the Oosterschelde (NL), antifouling tests are continuing since 2006.

# Inspection Pilot Boat After 6 months North Sea





Test Pilot boat, after 6 months in the water in The Netherlands. Pilot boat runs 25 knots, 24/7.


Picture 1: left hand Thorn-D®, right hand unprotected by Thorn-D®

Picture 2: unprotected area

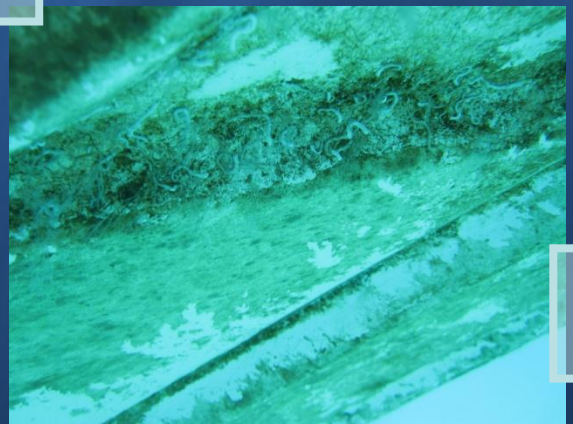
Picture 3: a competitive product for commercial shipping failed to protect against barnacle growth, even when vessels run 25 knots in cold water

# Performance on Motor Boat Mediterranean

**In July 2010, a Regal motorboat was coated partially with Thorn-D, partially with Interspeed .**

Thorn-D, slight green thread like algae and hydroid formation

Interspeed covered with microalgae and slime



Strong hard fouling on old Interspeed (Thorn-D torn off due to low quality foil)

Interspeed with initiation of hard fouling (tubeworms)

# Performance on Duffy Electric, 1.5 year Florida

Duffy Electric boat in Florida. Duffy sails every 2 weeks at a maximum speed of 5 months. The owner, Dennis Delong, normally cleaned the hull every month.

Dennis Delong: "*We applied Thorn-D ® about a year and a half ago to my Duffy Classic 21 in S. Florida, amazingly it has kept the bottom un-fouled. Thorn-D is the ideal product*"

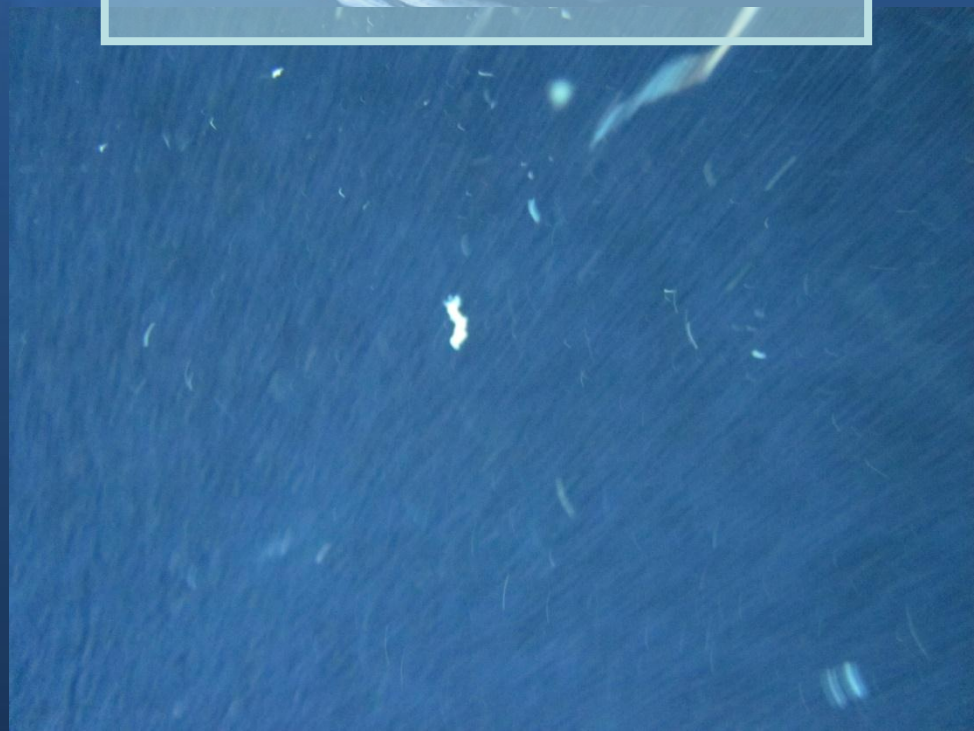

A close up of the hull

Clean hull after 18 months

# Performance 32’ Grand Banks
# 6 months San Diego

Some tube corals attach in between fibers (product has been modified to prevent this

Cleaning can be done with a nylon brush



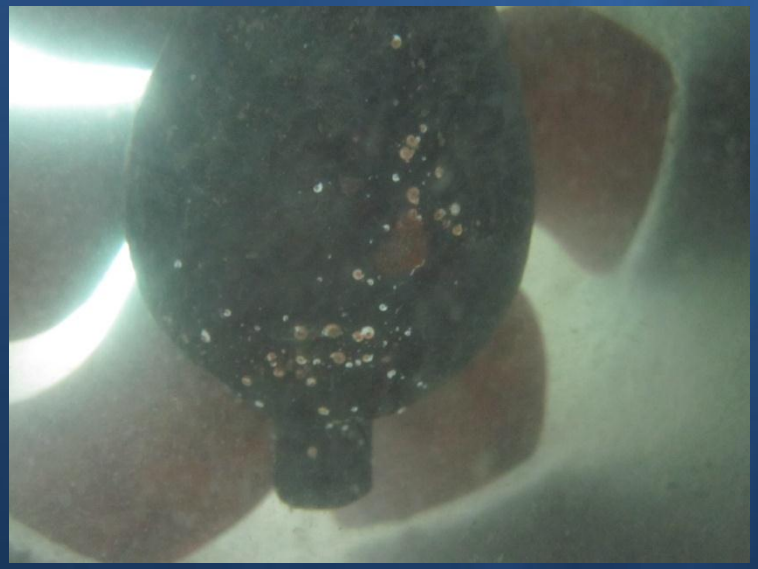
# Performance 32’ Grand Banks 6 months San Diego

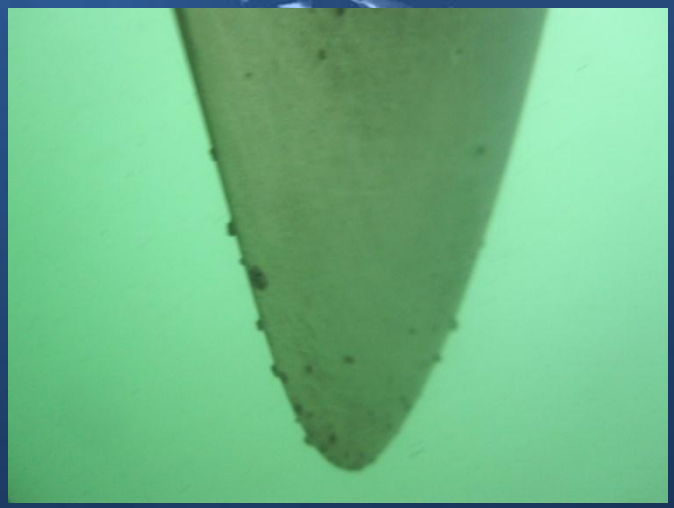
Some algae attach

Cleaning is easy and can be annulled by some sailing action

# Performance 32’ Grand Banks 6 months San Diego

Hard fouling (barnacles and tubeworms) attach on non-protected area’s





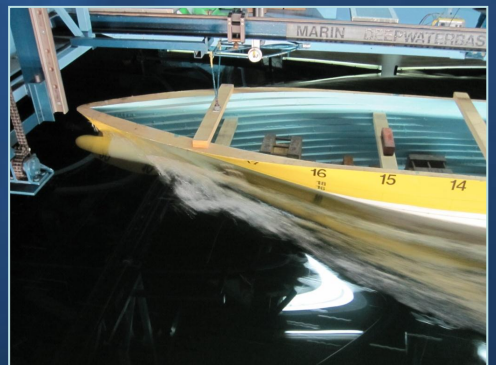
# Drag Performance

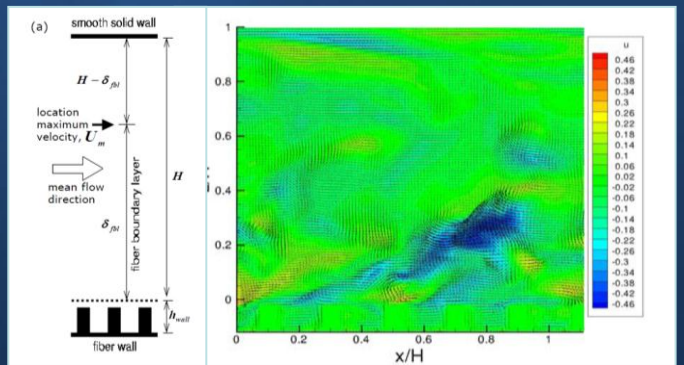
1. Towing tank tests at MARIN
2. Surface friction tests at TNO/TU Delft
3. Various field measurements on ships out
4. Computer modeling at TU Delft

# Drag Tests

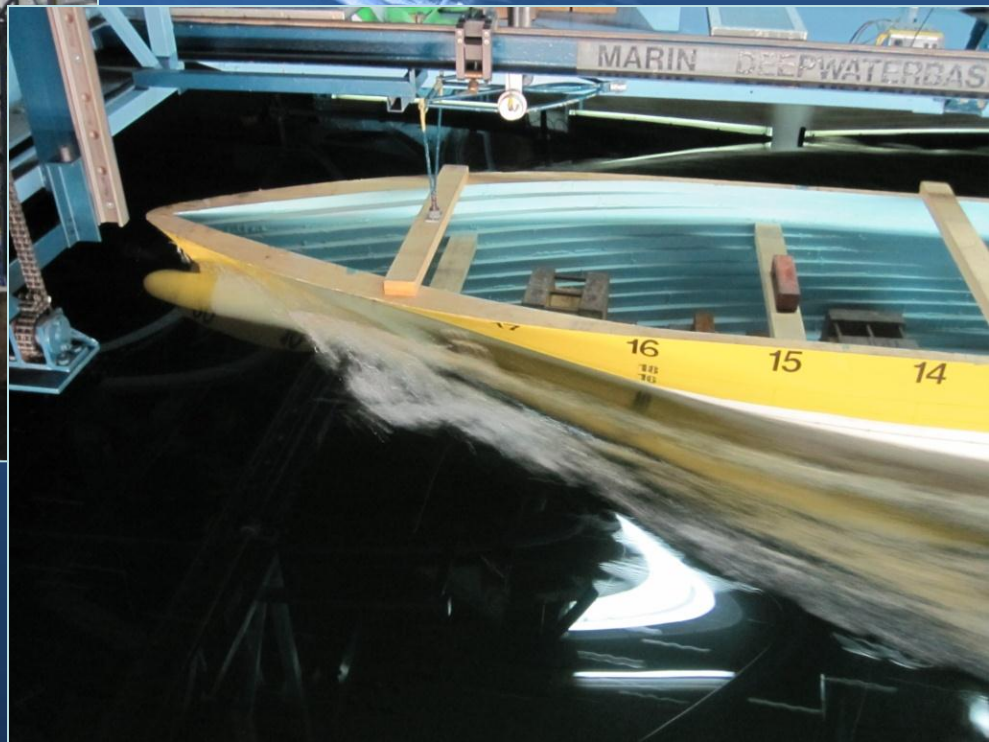
As the fiber structure of Thorn-D modifies the surface properties, drag tests have been carried out to evaluate the performance:

1. Towing tank tests at MARIN
2. Surface friction tests at TNO/TU Delft
3. Various field measurements on ships
4. Computer modeling at TU Delft



# TOWING TANK TESTS MARIN



# Towing Tank Tests MARIN

Thorn-D®

uncoated


Change in flow patern:

Delayed bow wave separation

Lower ripple

No wake

# How does Thorn-D® work? (VI)

## Beneficial texture for drag decrease

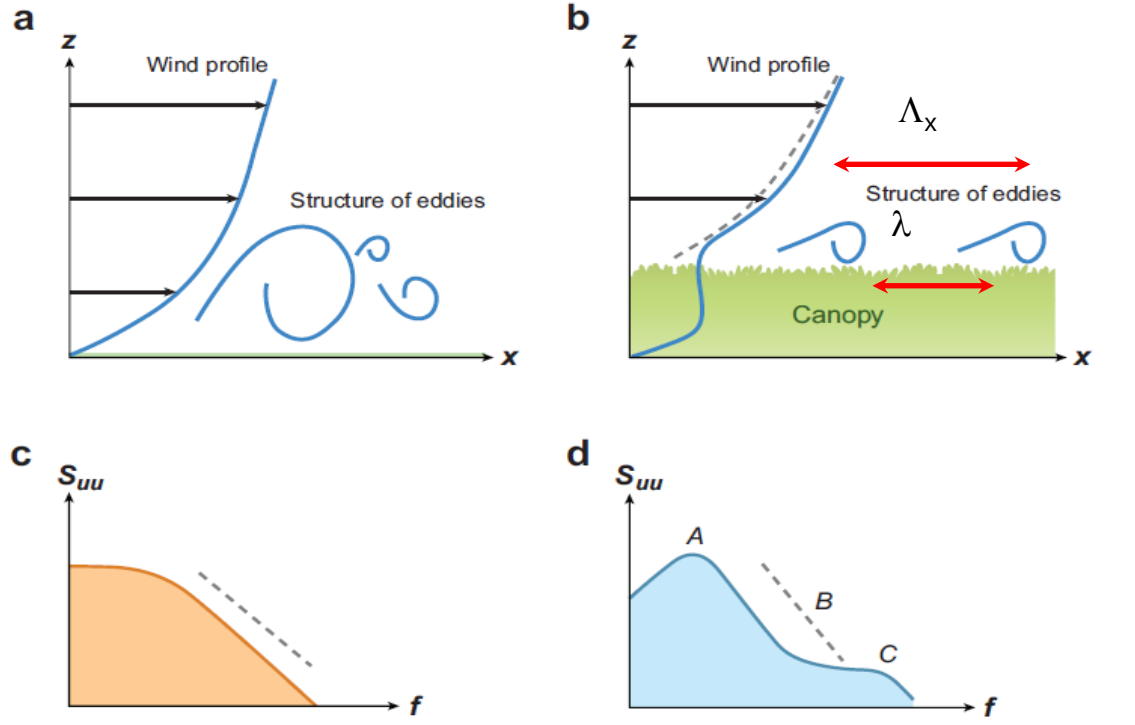



Figure 3

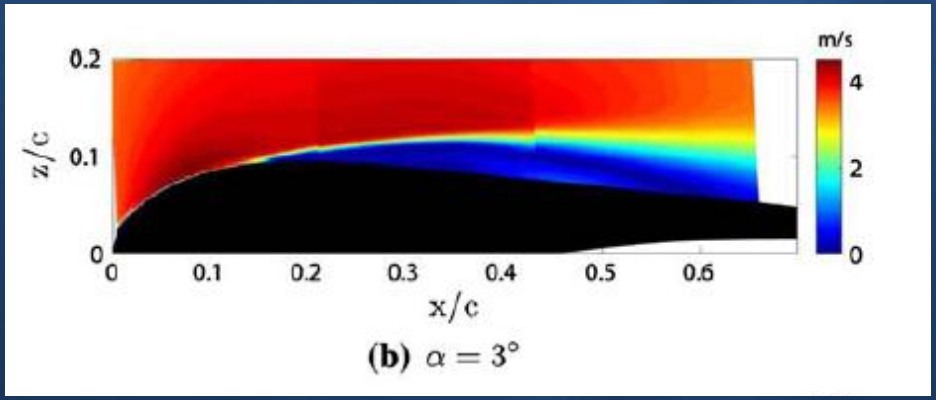
Main differences between boundary layer flow (*a*, *c*) and canopy layer flow (*b*, *d*). (*Top panels*) Wind profile and structure of eddies. (*Bottom panels*) Spectrum of fluctuations of the horizontal velocity, $S_{uu}$. The canopy layer velocity spectrum (*d*) differs from the boundary layer spectrum (*c*) in three aspects. First, it shows a more pronounced peak at a central frequency, which is that of the mixing-layer instability (**A**). Second, because of the drag on all elements of plants in the canopy, the dissipation cascade is enhanced, showing a steeper decrease with frequency (**B**). Finally this interaction with the plants, as well as the possible swaying of branches or leaves, causes the emission of vortices at higher frequencies, resulting in a possible second peak in the spectrum (**C**).

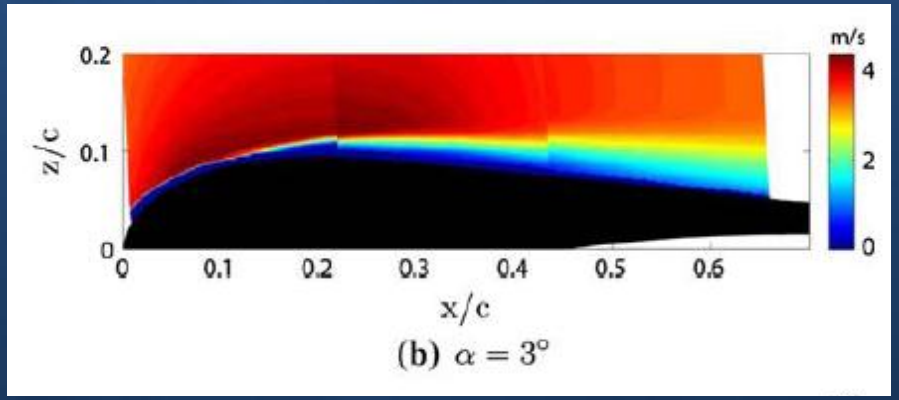
Turbulent flow over and in canopies is dominated by large coherent structures, that scale with the canopy height.

# How does Thorn-D® work (V)?

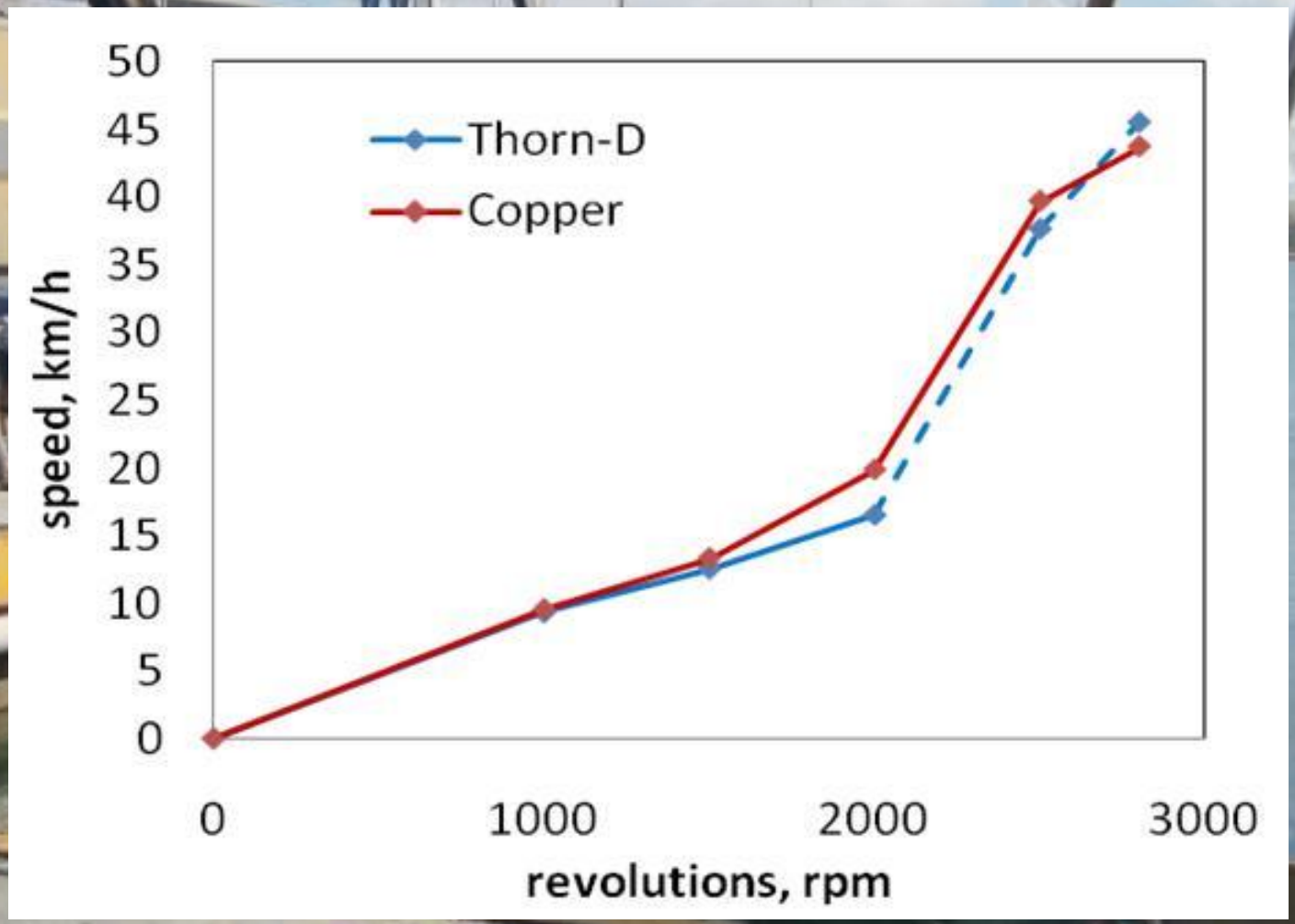
## Beneficial texture for drag decrease

Passive flow separation control of flocked surfaces

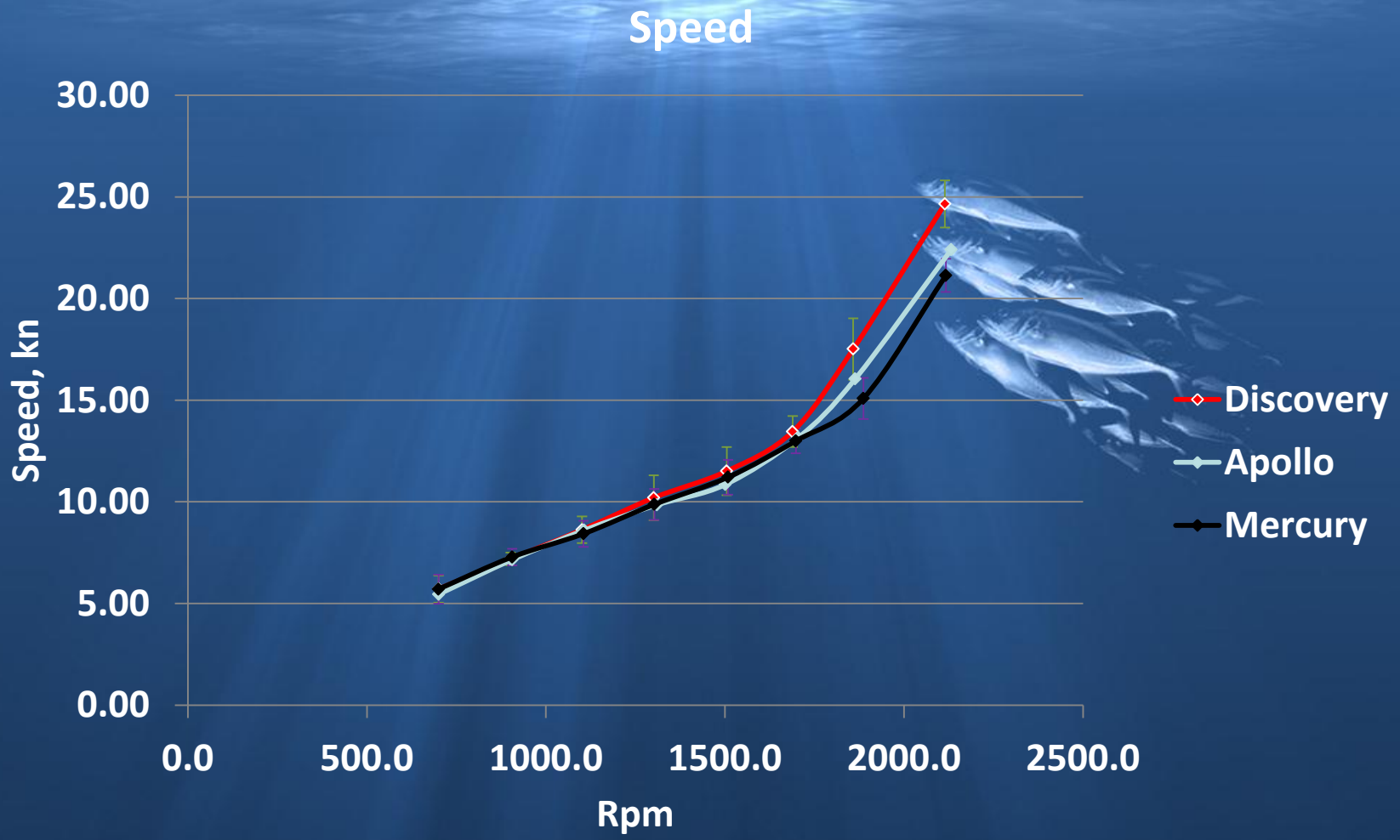


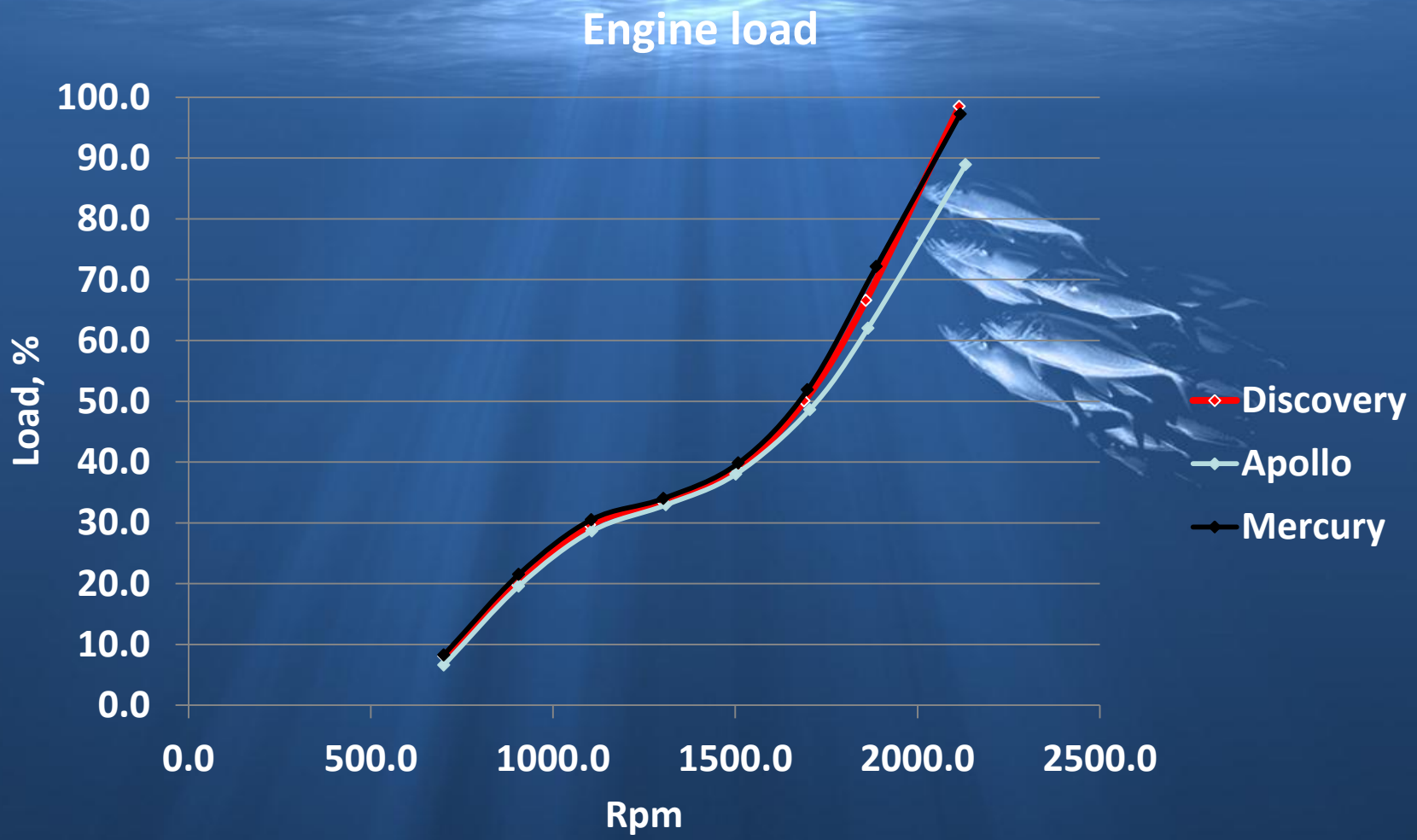
# Performance tests Regal Motorboat



# Performance test
# Fast Professional Craft

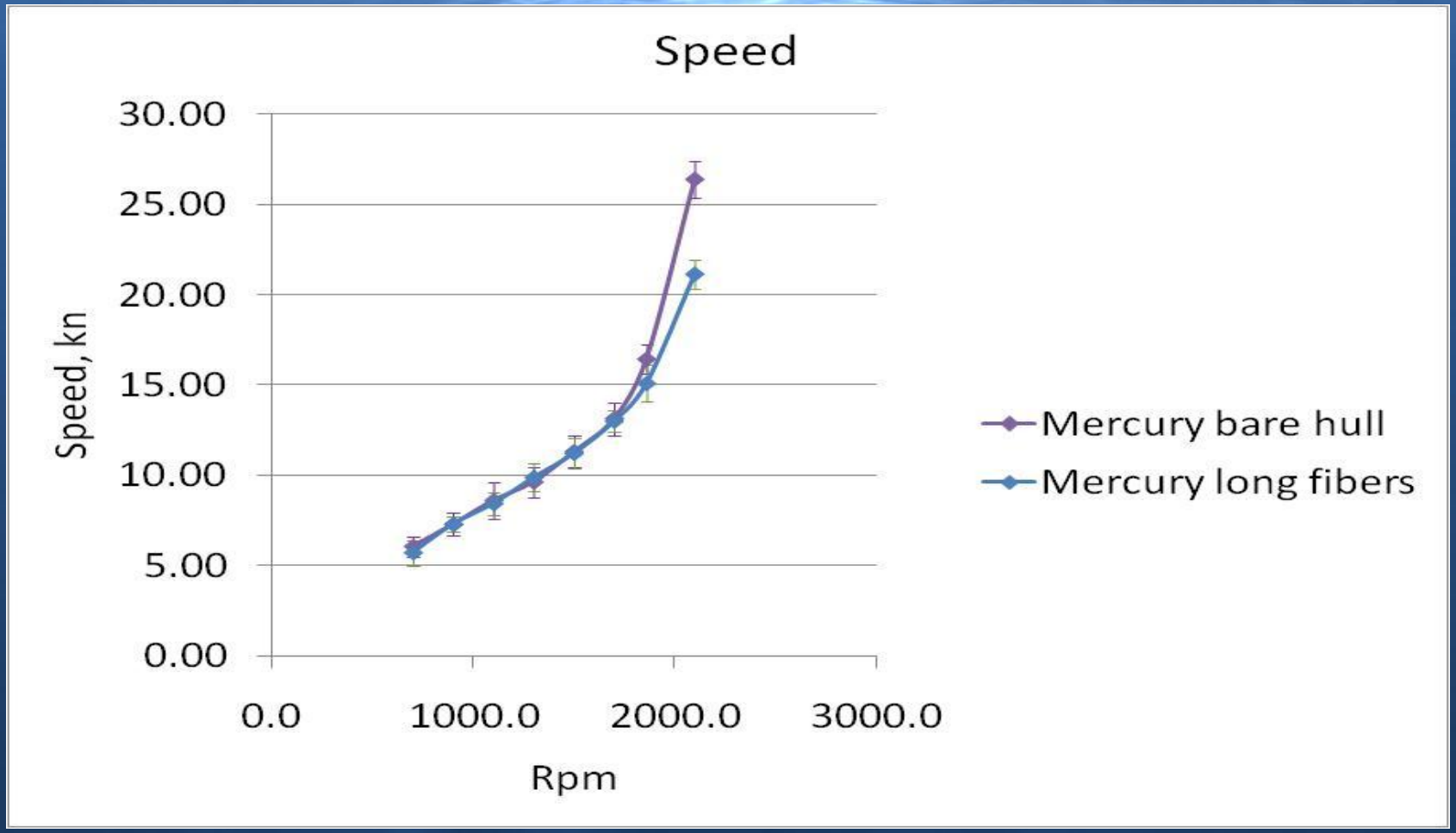


# Performance test
# Fast Professional Craft



# WHAT ABOUT DRAG? (VI)

## PERFORMANCE TESTS PILOT BOAT



# How does Thorn-D® work (V)?

## Conclusion Drag

Conclusions test lab and in practice:

1. No drag increase observed for major market segments
2. The change in water flow around the hull changes stern and bow wave

# SUSTAINABILITY EVALUATION

# Comparison: Toxic bottom paint

| Current practice: Copper based antifouling | Thorn-D |
|---|---|
| Toxins (copper and other organic biocides) leach into the environment | Thorn-D is based on a physical mechanism, no leaching |
| Binder material leaches into the environment | Thorn-D foils are stable for many years and are collected after their use for recycling |
| Paint based on organic solvents, VOC's are evaporated during drying and contribute to greenhouse gas effects | VOC's used in production, they are used for heating production lines (flocking) or recycled (foil production) |
| During lifetime, fuel consumption increases gradually, rule of thumb: 6% drag increase after 6 months | No increase in time, stable fuel consumption leading to lower fuel consumption during lifetime compared to toxic coatings |

# Comparison: Foul Release Coatings

| Current practice: Foul release coatings (FRC's, silicone coatings) | Thorn-D |
|---|---|
| FRC's contain high amounts of dibutyltin compounds, higher than allowed according to IMO ban on organotin compounds | Thorn-D is based on a physical principle and does not leach products into the environment |
| FRC's are difficult to apply and to keep them stable, many dangerous (carcinogenic) solvent are used that are evaporated during application | VOC's are used in production lines, they are used for heating the production lines (flocking) or are recycled (foil production) |
| FRC's claim to have fuel reductions due to slippery surface. In practice this is only true at the highest speeds (24kt or higher) that are not used in operation (common cruising speed: 19kt). | Thorn-D has fuel reductions for all speeds as no growth is occurring and the effect of structure has effect at all speeds |

# Summary

# What do we offer the Shipping Industry

- Reduction of fuel consumption
- No more cleaning (pleasure craft US)
- Long lasting protection
- Easy and clean to apply
- Environmentally friendly

**Applying the Thorn-D® foil instead of painting**

# More Information

**Contact details**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