Managing biofouling in shipping - The Idling Challenge

How idling affects ship operations and profitability

i-tech
Developers of Selektope®

I-TECH AB
WHITEPAPER
SEPTEMBER 2021

I-Tech, developers of Selektope

I-Tech

I-Tech is a global biotechnology company operating in the marine paint industry. The company has developed and commercialised the product, Selektope. With Selektope, I-Tech is uniquely the first company to ever apply principles from biotechnology research in the marine paint industry to keep ship hulls free from marine fouling.

“Barnacles can cause an increase of fuel consumption of over 40% and with an increasing risk of fouling, the problem has grown to new levels. Selektope is the natural prevention alternative today and for the future.”

Selektope®

Selektope is an organic, metal-free active agent added to marine antifouling paints to prevent barnacles from settling on coated surfaces by temporarily activating the swimming behaviour of barnacle larvae. This bio-repellent effect makes Selektope the only type of technology of its kind available to the marine paint manufacturers.

Barnacle fouling is very detrimental for ship fuel consumption, emissions and invasive aquatic species transfer. The use of antifouling paints containing Selektope significantly reduces fuel consumption, which contributes to lowering emissions. It also enables ship operators to unlock financial savings associated with lower fuel bills and lower maintenance costs associated with hull cleaning.

Depending on the formulation, Selektope can also help to reduce emissions to water by reducing biocide release with up to 90 percent compared to other antifouling paints, without negatively impacting the performance of the paint.

i-tech

selektope®

Content

Key Findings	2
Highlights	3
Introduction	4-5
Biofouling - How it Occurs	6-7
Biofouling and Idling	8-9
Decarbonising Shipping	10-11
Choosing the Antifouling Solution	12
The Risk of Biofouling	13
Idling Research Study	14-15
Study Findings	16-17
Conclusions	18-21
Innovative solution	22-23
Next generation antifouling	24
Case study	24-25

Long periods of idling significantly increase the risk of marine growth on a vessel´s hull.

Idling research study

2021

Key findings

+100%

Increase in number of idling vessels within the global fleet between 2009 - 2020.

1421

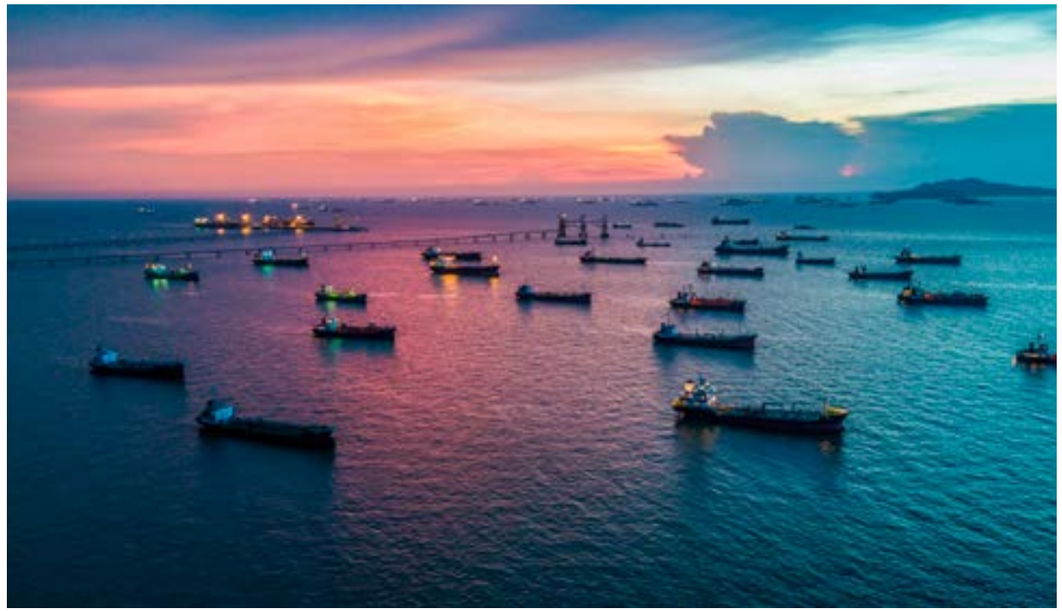
Tanker vessels at idle for more than 14 days during the peak in 2020. Half of these vessels laid up in tropical water zones, (so called ´biofouling hotspots´.)

5,5%

Of the container fleet exposed to intense fouling risk due to more than 30 days of idling during the peak in 2015.

1600

Bulker vessels at idle for more than 14 during the peak in 2016.



Highlights

The absolute number of idling vessels increased from 8,000 in 2009 to over 16,000 in 2020 indicating that the problem of idling has roughly doubled as the global fleet has grown significantly, p. 16

With an unpredictable landscape and new regulations coming into place, it is more important than ever to examine the idle period guarantees provided by coatings manufacturers and identifying what components can enable protection during extended idling periods, p.20

25% 2013 **27%** 2016 **30%** 2020

The global fleet has seen several peaks of idling vessels due to unexpected happenings around the world. During the peak of 2013 around 25% of the vessels in the global fleet were idling, in 2016 ~27% were laid up and during the latest peak in 2020, a whole 30% was idling, p. 16

1421 Tanker vessels **1500** Bulker vessels **197** Container vessels

During 2020, we saw the effects from the COVID-19 pandemic on operations of the shipping fleet leading to many vessels idling for several weeks. p. 17

With the industry still facing its looming IMO 2050 GHG reduction targets, these findings should serve as a reminder that a clean hull should be the first step of a fleet's decarbonisation strategy. p. 10-11

Innovative solution

Selektope has been approved as one in a very short list of acceptable biocides on all important markets. Selektope is effective in ultra-low concentrations and works in a non-lethal mode of action. In some cases its use can reduce biocide release from a paint by more than 90% whilst still improving hull performance to the point where even long idle periods have little impact on the coatings antifouling performance. p. 22

Vessels at idle in water temperatures above 25 degrees are at extreme risk of fouling. This study shows, month by month, just how many vessels have been in these risk-zones. p.17

The oil tanker, M/T Calypso, was the first vessel to be protected with a Selektope-enhanced antifouling coating. Even after the ship sailed and laid still in high-risk areas for marine growth for more than five years, the hull was still completely free of barnacles. p.24-25

INTRODUCTION

Why idling ships are at risk of biofouling

Biofouling has been a perennial headache for the shipping industry for centuries. However, it now looks like it's going to get far worse, particularly for those vessels idling in warmer waters.

This white paper takes a deep dive into why idling ships are at risk of biofouling and the impact of barnacle fouling on vessel performance. The paper is based on the I-Tech / Marine Benchmark study which reveals the substantial increase in the numbers of vessels at idle over the past 10 years. A vocal finding is also the high extent of vessels idling in so called biofouling ´hotspots´, with water temperatures above 25°C . Vessels spending the majority of their time sailing in these regions are at acute risk of excessive hard fouling accumulation.

To make matters worse, these fouling windows could intensify with ports becoming more congested as shipping continues to be the lynchpin of the global economy. Furthermore, with global ocean temperatures rising, biofouling hotspots could become more widescale, so more ships could be finding themselves in one of the regions and facing a new, higher risk of fouling.

The issues highlighted in this paper are driving the need for high performance, advanced antifouling technology in the maritime industry. Ship operators are increasingly demanding antifouling paints that are both well-suited to specific ship trading patterns, and varying activity levels in addition to protecting against both soft and hard fouling. When looking at the future trading potential, ship operators need to ensure that their ship is protected whether it be in constant active service, idle for long periods of time, or is at risk of fluctuating between the two.

This future-proofing approach to antifouling coating selection, without any certainty of future trade, is exerting great pressure on the coating suppliers, prospering great innovation and new approaches of fouling prevention technology using the active substance Selektope®. This is supported by increasing demand for antifouling coatings that contain the anti-barnacle active agent from ship owners and operators.

New approaches of fouling prevention technology using the active substance Selektope® can help future prove vessel operations.

A growing problem

Marine biofouling is a biological process which immediately affects every surface submerged in sea water. Ship hulls attract different types of organisms, with barnacles as the main issue, but algae, bacteria and weeds also pose a problem. Over time, a thick layer of fouling can form on the ship hull which significantly increases friction against the water when a ship is sailing. This leads to major consequences for the shipowners.

Fouling can occur at any time but because of the way it accumulates it will become much more of a problem when vessels spend long periods either idling or sailing at lower speeds that the coating in use was formulated for. The scale and extent of marine fouling depends on the temperature of the water and the availability of light and nutrition. Fouling takes place significantly faster in warm, tropical waters. Ships exposed to longer periods at anchor waiting for cargo or access to port face a larger risk of fouling than those that are moving.

Ships laid up for any reason are obviously susceptible to a higher risk of fouling. Most of the advice disseminated by class societies and others to owner of laid up ships is for access to sea chests and other inlets to be sealed at the beginning of lay-up, and an underwater inspection to take place before bringing the ship back into service. The inspection should be followed by an appropriate fouling removal operation. It is also recommended that, where possible, lay ups should be done in areas where conditions are the most unfavourable for fouling to occur. This can include areas where the water is fresh or brackish and at higher latitudes where temperatures are lower. Strong currents or river outfalls will also help as this will simulate to some extent the movement of the ship through the water.

For ships idling for other reasons such as waiting for berths or waiting for orders in slow markets, some options may be available. If possible, the ship can up anchor and sail at a suitable speed for as long as considered sufficient to remove any early fouling. This may not be an option where ships must wait in turn unless the port authorities, and in some cases also the charterers, agree. For the owner, the cost of any fuel used in doing this should be considered against the possible alternative of employing contractors to clean the hull of any fouling.

From larvae to barnacle colony

1

Larvae

Like other stationary marine invertebrates, barnacles begin their lives as highly mobile larvae. Each barnacle parent can release anywhere from 10,000 to 20,000 larvae, and they survive for several weeks in the water. In order to complete the transition to adult life, the barnacle larvae must attach to a hard substrate. The perfect, submerged, static surfaces presented by ship hulls are very attractive real estate. However, it should not be assumed that a vessel must be static for barnacles to attach as their presence on whales and turtles is evidence otherwise.

2

Adult Barnacle

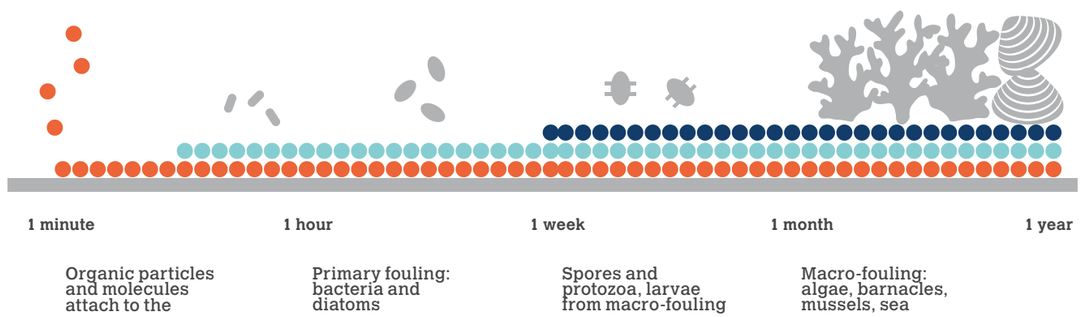
Once on the hull, cyprid barnacle larvae explore the hull surface, walking around using a pair of attachment organs called antennules. Once they find a suitable place to settle, they attach themselves head-first by releasing a glue-like substance (called proteinaceous cement); only then can they develop into the calcareous-shelled adult barnacles. The strength of this glue-like substance is such that mechanical forces are required to dislodge attached barnacles.

3

Barnacle Colonies

For barnacles, attracting more barnacles to mate with is important. Therefore, while exploring a surface, they leave behind blobs of temporary adhesive 'footprints' which operates as a signalling molecule to induce the settlement of additional barnacle larvae.

Therefore, once a ship hull has some barnacle fouling, the problem will only get worse. As soon as some few barnacles have settled this is a starting point for more growth.



Biofouling and Idling

Biofouling is currently receiving a huge amount of attention most of which is related to the new pressure from regulation and the increased fuel use. As a consequence, operators are also being forced to re-examine their approach to the issue.

Financial impact

A biofouled vessel must burn more fuel to attain the same speed through water, resulting in higher fuel costs for the ship operator.

A hull suffering from heavy fouling is also extremely impactful on maintenance costs. Costs associated with hull cleaning services are factored into a ship operator's operating expenditures (OPEX) but as global biofouling risk increases, hull cleaning is likely to be required more frequently, increasing maintenance costs. Repeated cleaning of the hull can also remove layers of the antifouling coating, reducing its service life.

Putting an exact price on fouling is an impossible task and will depend upon several factors and the ship's operating profile. The IMO has calculated that around 9% of all fuel consumed by ships can be attributed to the effect of biofouling. Other research suggests that even a small amount of slime on a hull can cause a 0.5kt speed reduction. Proactive owners who undertake regular cleaning of hulls may be sceptical about the IMO's 9% figure but at the other end of the scale it is likely that the 9% is an underestimate.

Using the IMO's 9% average figure, a VLCC that theoretically consumes 65 tonnes of bunkers per day when in clean condition might need to burn another six tonnes per day when fouled. That would equate to between an extra $1,260 and $4,146 per day using the minimum and maximum figures above. Assuming 280 days at sea per annum would mean an additional bill of between $352,800 and $1,160,880. Large container ships would face even high bills as they tend to travel faster.

The actual cost attributable to biofouling to operators and charterers will also depend upon the cost of bunkers which can fluctuate wildly. For example, in early January 2020 the global average price for VLSFO was $691 per tonne but at the end of April 2020 it had dropped to just $210. In early June 2021 it had risen to $541. When prices are high, some owners will actually take a conscious decision to slow steam to save costs and this in turn can accelerate fouling.

Managing the coating performance and limiting fouling either at regular intervals or after extended idling by initiating a hull cleaning is not cheap since each cleaning can cost between $15,000 to $45,000 depending on the size of the ship.

A lethal combination for vessel profitability

Operators are very aware of the impact of fouling in terms of both ship performance, profitability and commercial reputation. In recent years a new hazard has been added to the list by way of regulations connected with the threat of alien invasive species and potentially new costs incurred if market-based measures are introduced aimed at limiting CO2 emissions.

Operational impact

There are different drivers for owners depending upon their operating strategies. A badly fouled ship which is being operated directly by the owner for his own account whether in a line service or carrying spot cargoes will increase the fuel bill for the owner or its lack of speed will impact earning ability and there is always the risk of refusal to enter port.

If the ship is operated under a time charter, the owner could be on the wrong end of a speed and consumption claim or may even find it impossible to market the vessel commercially.

Apart from the reduced hull performance, fouling can also have an impact on so called "niche areas", this type of biofouling can detrimentally impact the health and efficacy of a vessel if it's allowed to accumulate without maintenance. For example, fouling build-up in a sea chest can impact the functioning of the box coolers, a vessel's water-cooling system. When heavy fouling occurs here, the box cooler's ability to control temperature can be compromised, or even fail completely.

For the chartering party it is difficult to assess the hull condition before signing and the only way of assessing the hull condition during an on-hire survey is either an underwater inspection by a diver or a drone. Once under charter, the only way to improve the hull condition beyond scheduled drydocking is an underwater hull cleaning which is expensive, can only be done on some locations and needs a certain level of planning as well as putting the ship off-hire for the duration of the cleaning.

Environmental impact

The IMO's calculations that around 9% of all fuel consumed by ships can be attributed to the effect of biofouling results in some 80-90 million metric tonnes of CO2 being needlessly released into the atmosphere.

But emissions are far from the only consideration. Hull biofouling also poses a significant biosecurity threat to marine ecosystems through its role in transporting invasive aquatic species (IAS). According to the International Maritime Organisation (IMO) vessel biofouling has been a comparable, if not more significant factor than untreated ballast water for the introduction of invasive aquatic species. Of course, this raises serious questions about our ability to protect the world's ecosystems.

Decarbonising shipping

Reduced CO_2 emissions across international shipping by at least 40% by 2030, targeting 70% by 2050.

To accelerate decarbonisation in shipping, the IMO has developed two regulations; the CII and EEXI.

Ship's efficiency reduces as fouling accumulates and emissions increase. To meet regulations, avoiding fouling is essential.

Regulations - driving the demand for excellent hull performance.

The IMO has been regulating the efficiency of new vessels since 2013 under the Energy Efficiency Design Index (EEDI) regulations. In addition, ships are required to have a Ship Energy Efficiency Management Plan or SEEMP, which details best practices, but in reality does little beyond helping identifying potential savings and does not require ships to take any concrete action.

To accelerate the decarbonisation of the industry, there has been pressure to do more to make vessels outside of the EEDI rules to improve their efficiency. As a consequence, after several years of work, the IMO has developed two measures that will apply to older ships. These are the EEXI (Energy Efficiency Existing Ship Index) and the CII (Carbon Intensity Indicator.) These two measures were adopted at MEPC 76 in June 2021 and subject to usual IMO procedures will come into effect in January 2023.

The EEXI is a technical requirement and is based on EEDI rules. Ships over 400gt will be affected. Ships will be categorised similar as for EEDI and given an efficiency index number that they will need to achieve.

There is free choice for the owner in how to do this and options include a switch to a lower carbon emitting fuel, adaptations to the ship's hull to improve efficiency, a derating of the engine or modifications such as installation of a shaft generator or energy storage system.

The CII is an operational measure for ships over 5,000gt and will revolve around the ship's usage and productivity. There is still work needed with regards to exactly how this will operate not least because comparing ships of similar size that are carrying widely differing cargoes over different trade areas, which in many cases switch trades frequently, is an extremely difficult task.

For both the EEXI and CII the impact of biofouling is something that the IMO seems to not have properly accounted for. That may be surprising given that all operators know that a ship's efficiency reduces as fouling accumulates and emissions increase, as more fuel is used to maintain performance.

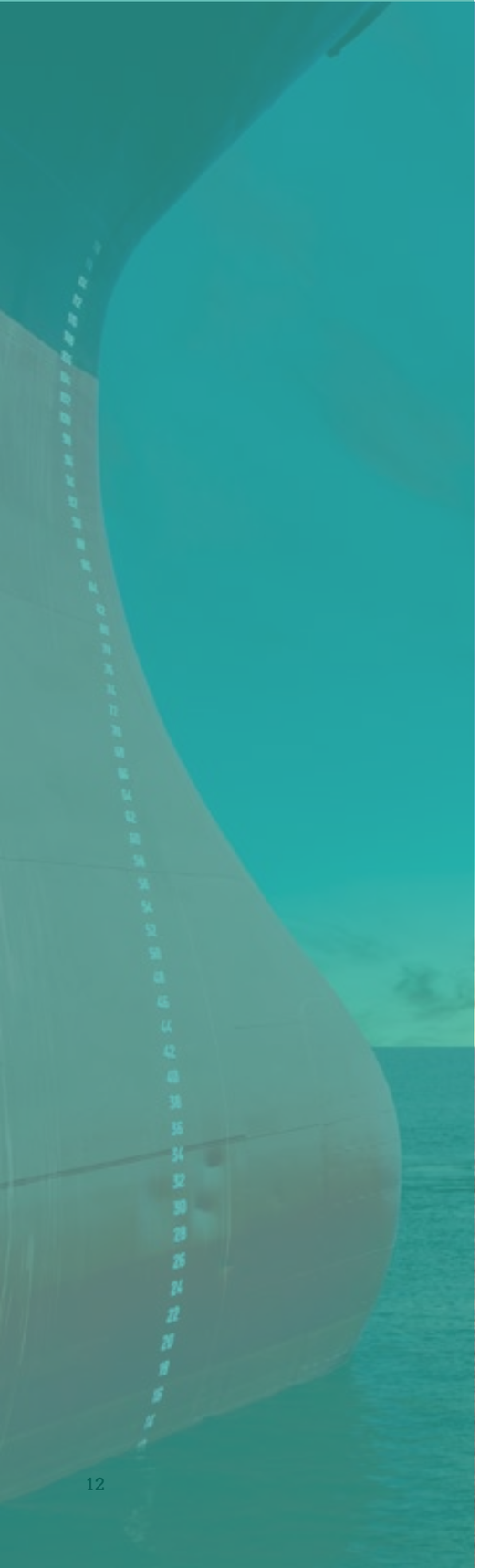
The availability of more data concerning biofouling risks and the effectiveness of coatings may lead to a methodology whereby coating choice can be built into the calculations for the new measures. With a planned review of the two systems due to take place in 2026, there is the possibility that antifouling measures may become a factor that is written into the rules.

Approaches to reduce fouling

Currently there are mainly two ways to control the status of the ship hull. Some shipowners constantly measure performance and if there is a significant drop in performance it can be assumed that either the propeller is damaged, or the hull has some fouling. The appropriate action in the latter case is a hull cleaning. Depending on the severity of the fouling and the cleaning method employed, the antifouling can be damaged and will lose performance. Alternatively, some companies do diver inspections on a regular basis. When fouling is detected on an early level it can be removed by gentle cleaning without damaging the hull coating.

As a third option, for an individual vessel, there is also the possibility to predict the risk of being fouled. From available data such as AIS data, speed, activity, water temperature, length of idling and the location of idling, an algorithm can calculate the risk of a vessel being fouled.

Also, the risk of fouling can be different depending on the idling location, and if possible, a lower risk location can be chosen. Such an approach only gives an estimation of the risk of fouling as the real performance of a vessel also depends on the quality of the coating and other factors such as previous hull cleanings or the general condition of the hull coating.



Choosing the antifouling solution

When initially choosing a coating for their ship or changing coatings after an unsatisfactory experience, shipowners have little to guide their choice beyond advertising material, recommendations from peers and discussions with potential suppliers.
Some coating suppliers will offer guarantees for their products, but the terms and conditions of such guarantees are not easy to discover. Furthermore, information about number of claims submitted and settled under guarantees is a confidential matter between the supplier, the contractor, and the shipowner so details of settlements made is not transparent.

A key detail for ship owners is to examine the idle period guarantees. Long idle periods are a challenge for foul-release and biocidal coatings, for which an idle guarantee of 14-21 days is the most common scenario. However, some coatings provide longer idle guarantees, for example, those containing the antifouling agent Selektope®.

Guarantees regarding fouling and operation are not solely the preserve of the coating supplier. If chartering their vessel, the owner and charterers may have legal obligations towards each other. For example, during fixture negotiations the speed and consumption conditions would have been established.
Under normal conditions the owner is effectively guaranteeing a standard of performance that might become impossible to maintain over time. On the other hand, the charterer is taking on the commercial operation of the ship and therefore needs to be considering the consequences of his own actions.

There have been a number of legal cases in which the issue of fouling after long idle periods has been pivotal. In some the charterer has been prevented from succeeding in a consumption claim against, because the idling was a result of his orders to the vessel. However, in others the owner has still been found liable even under similar circumstances.

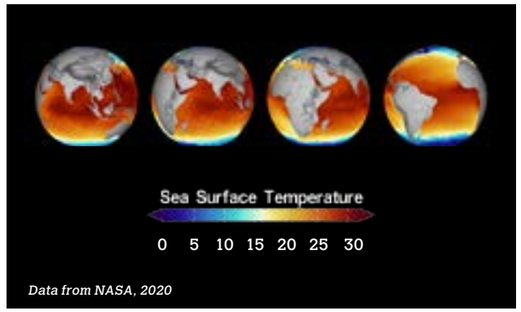
To address the issue of fouling, BIMCO developed its Hull Fouling Clause for Time Charter Parties in 2013 to transfer hull cleaning obligations to charterers where, as a result of their trading requirements and employment orders, a vessel is subject to a prolonged period of idling in port or at anchorage that results in fouling of the hull and underwater parts to an extent that may affect vessel performance. After six years of practical experience the Hull Fouling Clause was revised in 2019 to address feedback on the use of the clause and to improve clarity.

Global warming and the growing risk of biofouling.

Biofouling and climate change are inextricably linked. Biofouling, especially what is commonly referred to as 'hard' fouling caused by shell-forming marine life, such as barnacles, causes some of the highest levels hydrodynamic drag created by their volcano-shaped shells on vessel hulls. A vessel with just 10% barnacle coverage requires an increase in shaft power of 36% to maintain the same speed through the water (Schultz et al. 2011) compared to a vessel free of hard fouling. This leads to higher fuel costs, higher emissions, and reduced efficiency for many owners and operators.

A study conducted in 2019 by I-Tech and independent marine coating consultants Safinah found that, out of 249 vessels surveyed, nearly every vessel had a degree of underwater hull hard fouling. On 44% of vessels surveyed, over 10% of the underwater hull surface was significantly covered with hard fouling to a level that is deemed to cause an 'unacceptable' impact on performance by experts.

Approximately 25% of vessels displayed hard fouling coverage of between 10-30% and the remaining percentage of vessels suffered much higher levels. Extrapolating from published data taken from a 2011 study by Michael P. Schultz, this level of hard fouling (assuming a 10% coverage of hard fouling on 40% of the fleet) could be responsible for at least 110 million tonnes of excess carbon emissions, and an additional US $6 billion spent on fuel per year for the global commercial fleet. The true figure is likely to be higher, as this is a conservative calculation based on today's relatively low fuel prices.



This high level of fouling is compounded by the fact that fouling hotspots are growing globally as an effect of our environmental footprint causing rising temperatures. Warmer waters around Mediterranean and Asian regions have long presented an added challenge for shipping's antifouling efforts, as warmer waters provide a better environment for fouling organisms to grow. With the 'hotspots' growing, so are the risks of biofouling.

It's clear, then, that biofouling produces a negative feedback loop if not tackled head-on. Higher levels of hull fouling could equate to higher emissions; higher emissions could equate to increased carbon footprint; increased carbon footprint could equate to rising water temperatures. This is an issue which affects not only the longer-term ability of shipping to meet climate goals, but its day-to-day performance.

Barnacle Coverage (%)	ΔSP (%) at 15 kts	ΔSP (%) at 30 kts
10	36	23
17	44	27
39	54	33
48	57	35
57	54	33
63	55	34
70	53	33
79	52	32
Light**	31	20
Medium**	47	30
Heavy**	76	47

** values from Schultz *et al.* (2011)

The Fifth Assessment report, published by the Intergovernmental Panel on Climate Change (IPCC) in 2013 revealed that the ocean had absorbed more than 93% of the excess heat from greenhouse gas emissions since the 1970s, causing ocean temperatures to steadily rise, generating higher risk of biofouling, which in the long run can lead to even higher levels of emissions as a result of fouling on vessel´s hulls.

IDLING RESEARCH STUDY

Study on idling and resultant biofouling

Fouling can occur at any time but because of the way it accumulates it will become much more of a problem when vessels spend long periods either idling or sailing at lower speeds that the coating in use was formulated for.

The recent study by I-Tech and independent Marine Benchmark explored the issue of idling and resultant biofouling. The results of the study show some fascinating differences between sectors of the industry and a surprisingly large increase in vessels idling over the past decade.

Remarkably, no in-depth study has been conducted to quantify the level of idling of the global fleet or specific segments. Many shipowners do have extensive statistics and knowledge on vessel activity, average speed etc.

We have seen studies about the idle capacity of different segments which is used as an indicator for available capacity and future price developments, but these studies do not include the length of the layup periods, the water temperature and fouling pressure of the idling period and its consequences for operations. As discussed, it is known that vessels at idle for 14 days or more are highly exposed to the risk of barnacle growth, especially if idling ooccurs in warm waters. This type of fouling can have significant impact on the vessel performance and thus on the bottom line of the ship operator.

The analysis and results of the idling study are based on AIS data of all IMO-registered vessels of the global fleet. We have been able to look at these vessels based on different parameters, such as size and vessel type.

In collaboration with Marine Benchmark

For this study I-Tech teamed up with maritime data analysts Marine Benchmark which develops interactive tools and reports providing valuable insights for businesses in the maritime sector combining different type of datasets. For example, Marine Benchmark can provide global vessel and fleet analytics including: utilisation, slow steaming, time in ports, voyage days and delays.

Marine Benchmark has developed a complete web platform with capability for a full bottom up AIS based fuel consumption calculation, globally and by countries EEZ (Exclusive Economic Zones). The database has an online feed from IHS Markit including a feed from their AIS antennas and IMO vessel register. Its algorithms are run live 24/7 on its 18 servers performing global calculations of distance, speed, fuel consumption, cargo onboard, transport work and EEOI.

MARINE BENCHMARK

Defining idling

As discussed, there is often a dispute between the shipowner and the coatings supplier and yet there is no clear definition of idling, which is surprising as idling guarantees are based on this. To complicate matters further different coating suppliers may offer their own definition of idling and there is no clear industry standard on how idling is defined. The narrowest definition is a vessel on a defined spot without any movement. But what happens with very short trips or manoeuvring. If an idling guarantee stipulates a maximum period, some shipowners may make a short trip prior to the maximum period being exceeded with the intention to limit the idling time and thereby keeping the guarantee active.

How we define idling in this study

The focus of this study is to look at vessels where idling results in high fouling risk, for the study, this is referred to as "fouling idling".

To begin, we introduced "fouling idling" as distinct from "commercial idling". Where the purpose of commercial idling is to measure the commercial activities and inactivity's of vessels, and the purpose of fouling idling is to define idling as a risk for operations due to the resultant fouling. For example; a vessel waiting for discharge of cargo or being stationary as a floating storage is commercially employed and active, but it is idling when it comes to fouling exposure.

In the collected data, stationary times at yards will not be counted as fouling idling because the vessels are usually dry-docked and, in most cases, a long stay implies that the vessel will be re-coated with new anti-fouling coating. This study is also linking the idling to water temperature and how long the vessel is fouling idling in an unbroken sequence.

Though all vessels are included in the database it is well known that some ship types, in general, have a trading pattern which can be regarded as idling, these type of vessels include tug boats, fishing boats, bunkering vessels and some type of ferries. These vessels are taken out of the analyses to give a more accurate result.

The folloing steps have been used to filter the AIS data:

1. The vessel has a registered IMO-number.
2. Vessels are divided into three segments depending on activity:
   a. *Stationary - below 1 knot (at yard and outside yards)*
   b. *Manoeuvring - 1 to 6 knots*
   c. *Steaming - above 6 knots*
3. To be defined as fouling idling, the following intermedite activities are allowed:
   a. *Up to 12 hours manoeuvring is allowed between 2 stationary activities*
   b. *Up to 6 hours steaming are allowed between 2 stationary activities*
4. Exclude all yard calls since these vessels are going into drydock.
5. The distance between first and last AIS observation for each fouling idling period is calculated and a maximum distance of 100 nautical miles are allowed.
6. Sea water surface temperatures in three groups below 15, 15 to 25, above 25°C.
7. Data is divided in number of vessels staying in fouling idling periods above 14, above 30 & above 45 days.

Study findings

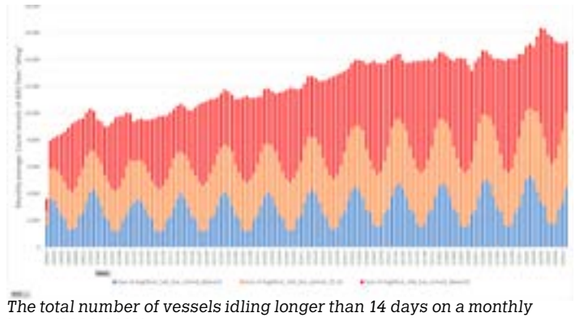
The overall picture from this study shows that the number of idling vessels is increasing constantly. Over the last decade, the number of idling vessels has roughly doubled and, on top of that, a lot of idling is taking place in tropical waters where vessels are exposed to an intense fouling risk.

The Global Fleet

The overall idling picture within the complete global fleet from 2009 to 2020 shows a steady increase in the number of vessels idling for longer periods.

Increased idling in the Global Fleet

Looking at the trends of idling over the complete global fleet, one can see that fouling idling, in line with our definition, increased constantly since 2009. With a starting point of 25.4% to a peak of 35.0 % in May 2020. However, when looking at the number of vessels, the difference is much bigger since the fleet has also experienced a substantial growth in the number of vessels trading on the world's oceans. The absolute number of idling vessels increased from 8,000 in 2009 to over 16,000 in 2020, indicating that the total idling problem has roughly doubled over the past 10 years.



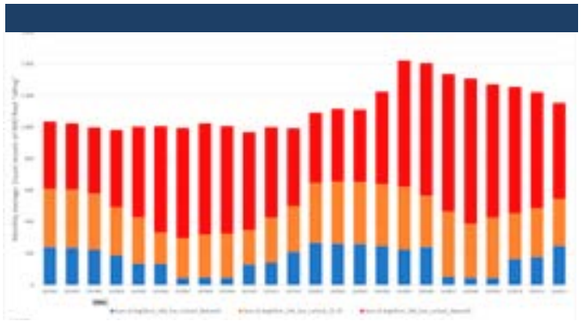
The total number of vessels idling longer than 14 days on a monthly basis (2009-2020)

Idling in warm waters

As the risk of biofouling increases in warm waters, peaking in water temperatures of above 25 degrees, this has also been an important factor of the study. Looking at the global fleet overview, water temperatures of idling vessels have large seasonal differences. The blue bars show vessels idling at a water temperature below 15°C, the orange vessels idle at a temperature between 15 and 25°C and the grey at a water temperature above 25°C. There is less idling in cold water in summer and less idling in warm waters in winter. Important to notice is that idling in warm temperatures are common during all seasons. Depending on season, between 50% - 85% of idling is occuring in water temperatures of above 15°C.

KEY FINDINGS

- The total number of vessels idling has roughly doubled over the last decade.
- High percentage of idling is occuring in water temperatures above 15°C
- Bulker Fleet: Many bulker vessels are idling even outside of peaks. The level of idling is regularly above 1000 vessels monthly.
- Tanker Fleet: The number of idling tanker vessels has constantly increased since 2009, peaking in 1421 vessels in 2020.
- Container Fleet: During the idling peak in 2020, nearly all idling container vessels were laid up in warm waters



Bulker vessels (in number), 2018-2020 on a monthly basis with idling longer than 14 days.

2020 - Idling vessels peaking

Taking a closer look at the most recent peak during 2020, compared to the previous years (2018-2019). We see that the number of vessels idling for more than 14 days increased for most segments within the global fleet. For example:

For the Container fleet, there was a clear peak in June 2020 with 99 vessels idling at warm waters, 96 vessels idling at medium waters and 2 vessels idling at cold waters giving a total number of 197 vessels being idle. Comparing this to June 2019 when there were only 22 vessels idling at warm waters, 13 in medium waters and 1 in cold water giving a total number of 36, this is an increase of over 447% year on year.

The effects of the pandemic had an impact also within the bulker fleet. There was an increase from 1,100 vessels being idle in the beginning of 2020 to over 1,500 in April 2020. The majority of vessels were idling in water warmer than 25°C.

For the Tanker fleet, Idling was at the highest level in May 2020 since 2009 with 15.4 % of idling tanker vessels. A notable 84.2 % of the idling happened in medium to warm waters with high risk of fouling. Looking at number of vessels idling, the peak in May 2020 resulted in 1421 tanker vessels at idle for more than 14 days.

The cruise fleet results show an extreme picture. Comparing the time before the Covid break out with after, vessels at anchor for more than 14 days increased from an average of 3% to between 20-30%. In numbers, idling went from less than 10 vessels with long idling periods monthly, to over 60 vessels being laid up.

Unpredictable idling

Trends show that external factors has a disruptive effect on operations in shipping. Overviewing the global fleet, peaks of idling are spotted on regular basis, and often, these peaks can be linked to a happening or crisis in the world. For example, after the economic crash of 2008, many vessels – especially container (see graph below) and bulk ships – were forced to go into lay-up. Seven years later, the fall in crude oil prices caused a major downturn in the offshore sector that still has not been resolved.

Container fleet idling peaks, +14 days of idling, Jan 2009 - Dec 2020

30 days of idling

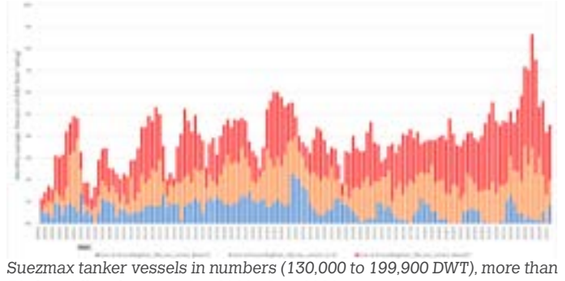
It is commonly known that lying at anchor for more than 14 days exposes a vessel´s hull to a high risk of biofouling, thid study looks at even longer periods, when the fouling risk is highly intensive. We see that many vessels are idling for more than 30 days, and some even for longer than 45 days.

For the global fleet, regular peaks of idling between 2009-2020 showed that many vessels had idling periods (30 days or more.) A deep-dive into segments of the fleet confirmed the problem of vessels idling for over a month.

For example, looking at the peak in 2015, 5,5% of all container vessels (10000 to 13499 TEU) were idling for more than 30 days, and at the 2020 peak, the number was close to 3%.

For Suezmax tanker vessels (130,000 to 199,900 DWT) idling was peaking to above 4% on regular occasions and during the 2020-peak, 8,5% of vessels were idling for over 30 days.

Capesize bulkers (120,000 to 349,900 dwt), are also part of this trend with several idling peaks between 2009-2020 where 2-4% of all vessels in this segment had idling periods of longer than 30 days.



Suezmax tanker vessels in numbers (130,000 to 199,900 DWT), more than 30 days idling between Jan 2009 - Dec 2020.

Warming waters and idling vessels

This study reveals a surprising increase in the idling problem in the global fleet, and also proves that peaks of increased idling for all types of vessels occur regularly due to unpredictable circumstances around the world. At the same time as the global fleet is increasing – and with that the number and problem of idling vessels, so are the water temperatures, and the high-risk areas for fouling.

With larger risk zones and hundreds of idling vessels, we can assume that there are increasing numbers of vessels suffering from biofouling. At the same time, technology is advancing, and several methods to tackle the biofouling issue are available. For example, antifouling solutions with high static performance could be a rewarding investment.

Moreover, with measurable regulations such as EEXI and CII coming into force, ship owners need to thoroughly analyse what is the best way to make their vessel sustainable in the long run. Even though there are many ways to reduce emissions, all efforts will benefit from the vessel´s hull and niche areas having a solid protection against fouling.

Certainly, idling has always been a challenge for the shipping industry. During the COVID-19 pandemic in 2020, idling within the global fleet was at a peak. But similar levels have been seen on several occasions during the past 10 years. For example, after the economic crash of 2008, many vessels – especially container and bulk ships – were forced to go into lay-up. Seven years later, the fall in crude oil prices caused a major downturn in the offshore sector that still has not been resolved. External factors can always have some disruptive effect on operations and make predictions difficult. The most important thing is to ensure that, after any idling, the vessel is in good condition to perform optimally. Familiarisation with the individual vessel's risks of biofouling based on its operating footprint is a good starting point.

In addition, we are seeing first-hand that climate change is having an impact on biofouling and hard fouling levels and owners need to be looking at where their vessels are operating. Warmer tropical and sub-tropical waters contain the highest concentration of creatures responsible for hard fouling. Vessels spending the majority of their time sailing in these regions are at acute risk of excessive hard fouling accumulation.

The study on idling conducted by I-Tech and Marine Benchmark in 2021 shows a surprising number of vessels idling in these so-called "biofouling hotspots". As an example, during the idling peak in 2020, a total of 197 container vessels were laid up. Of these, 195 were idling in warm waters and 99 of these in water temperatures of above 25°C – making them highly exposed to the growth of barnacles. As shipping continues to be a vital part of the global economy, these fouling windows could intensify, with ports becoming more congested, so more ships could find themselves facing a new, higher risk of barnacle fouling colonization. It is becoming clear that the problem of fouling as a result of idling is not decreasing - the fleet is growing and so is the incidence of fouling in many commonly used shipping routes and ports.

The issues highlighted in this study prove the need for high performance, advanced antifouling technology in the maritime industry. Ship operators are increasingly demanding antifouling coatings that are well-suited to both specific ship trading patterns and varying activity levels, and that also provide protection against both soft and hard fouling. When looking at the future trading potential, ship operators need to ensure that their ship is protected, whether it is in constant active service, idle for long periods of time, or at risk of fluctuating between the two.

A preventative approach is key

An upredictable landscape

With the industry still facing its looming IMO 2050 GHG reduction targets, the findings from this study should serve as a reminder that a clean hull should be the first step of a fleet's decarbonisation strategy. Not to mention the cost saving potential of a clean hull, reducing both fuel and maintenance costs. As the study by I-Tech and the Safinah Group shows, over 40% of vessels surveyed had a barnacle fouling coverage on the hull of over 10%. This level of biofouling could be responsible for at least 110 million tonnes of excess carbon emissions.

However, there is a significant amount of debate amongst owners about the best approach towards achieving a clean hull. Arguably, the best starting point is to take a robust preventative approach concerning antifouling technology within marine coatings. To examine an antifouling technology mix that is suitable for the vessel type, activity, and trading patterns but that also offers an insurance of extended static protection against barnacle fouling during unexpected long idle periods. In combination of a solid antifouling coating, operators would benefit from planning their potential idling periods away from the biofouling high-risk zones.

Antifouling Guarantees

With unpredictable operations resulting in long periods of idling being a fact, it is more important than ever to examine the idle period guarantees provided by coating manufacturers and identify what components can provide protection during extended idling periods. Apart from the owners investigating the guarantees, it has also become clear that there is a need for an industry definition of idling to clarify the meaning of guarantees and make it easier to choose the most suitable antifouling system for a vessel´s operation.

For most antifouling coatings, protection guarantees range between 14 and 21 idle days, with the majority of premium antifouling coatings offering up to 30 days idle guarantee. Some few premium antifouling coatings offer idle guarantees over 30 days. However, under tough market conditions such as those encountered during the current COVID-19 pandemic, this study has proven that it is not uncommon for a vessel to be idling for more than 30 days, and in some cases even longer than 45 days. It is therefore clear that owners and operators need to take into consideration that only the best protection guarantees are sufficient. For many antifouling coatings on the market this is made possible by the inclusion of antifouling agent Selektope®. This can also be considered alongside prospective operating geography for their vessels, especially if they foresee operating and idling in warmer, tropical waters, which are well-known barnacle fouling hotspots. This future-proofing approach to antifouling coating selection, without any certainty of future trade, is exerting great pressure on the coating suppliers, prospering great innovation and new approaches of fouling prevention technology using the active substance Selektope®. This is supported by increasing demand for antifouling coatings that contain the anti-barnacle active agent from ship owners and operators.

The negative effect that biofouling has on hydrodynamic hull performance cause significant financial and environmental penalties for the shipping industry.

INNOVATIVE SOLUTION

Coating manufacturers have responded to the challenge of tackling biofouling with many new and innovative products, though generally all make use of similar biocide chemicals or some form of foul release technology alone or in combination to make products effective.
One such technology is I-Tech's Selektope.

Developed initially as a veterinary sedative medicine, it has another characteristic that is highly effective in antifouling use against barnacles and some other marine organisms. As mentioned earlier in this paper, barnacles attach to surfaces when in the larva stage but if a larvae comes into contact with a coating containing Selektope, this innovative technology interacts with the larva's neuro system temporarily stimulating a receptor, causing a hyperactive swimming behaviour which makes it impossible for the larvae to attach to the surface. Once out of contact with the Selektope, the effect ceases, and the larvae can swim away unharmed to settle elsewhere.

After risk evaluation, Selektope has been approved as one in a very short list of acceptable biocides on all important markets. I-Tech does not market a coating of its own but works with coating manufacturers in what is an extremely competitive and conservative business arena.
The company has already sealed significant deals with Chugoku Marine Paints and is also collaborating with the major coating's suppliers Jotun and Hempel.

In addition, I-Tech is working to establish more development collaborations in new areas with the long-term aim of establishing Selektope-based products within the portfolio of all the leading marine paint manufacturers.

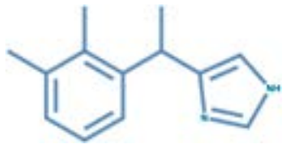
The amount of Selektope needed to be effective is very small but its use can make good antifouling products even better. Its unique level of power can be added to most coating formulations. In some cases, its use can reduce biocide release from a paint by more than 90% whilst still improving hull performance to the point where even long idle periods have little impact on the coatings antifouling performance. Another benefit of Selektope is that it helps preserve natural resources. Over 50,000 tonnes/year of metal oxides are used in marine paints and Selektope can massively reduce this figure, thus saving natural resources such as copper.

Also, with extended static exposure in combination with increasing water temperatures due to global warming, the task of keeping hulls clean during outfitting is more challenging than ever. Yards and paint makers struggle to avoid manual cleaning prior to sea trials. Such cleaning activities are costly and impacts the coating lifetime negatively. Selektope-containing products are offered by several leading paint manufacturers to raise outfitting performance to the next level.

Next generation antifouling

With the new regulations on energy efficiency and carbon intensity in shipping, antifouling coatings need to meet high performance demands. Evidence shows that there is a big chance owners and operators would benefit from a high performing antifouling

A way to the future of antifouling solutions could be to include antifouling agent Selektope in the paint mix. Through its bio-tech concept, it provides unmatched power to keep surfaces clean from barnacle fouling, upscales the static guarantees and reduces needs to apply severe cleaning modes, damaging the coating.



Selektope® prohibits barnacle settlement regardless of vessel activity or area of operation. It's applied to a large number of newbuilds to secure best possible coating condition at delivery and service. It has the capability of protecting the vessel under 60-month service intervals, this was recently demonstrated through a 63-month case study on the M/R tanker vessel; M/T Calypso.

M/T Calypso - Barnacle free after 63 months in operation

After 5 years of operation, the first ship fully coated with a Selektope-containing antifouling paint went in for regular maintenance at a Chinese shipyard. The hull was completely free of barnacles, this after the ship both sailed and laid at anchor in high-risk areas for hard fouling and the growth of barnacles. The savings from effective antifouling systems are estimated at more than 100 million tonnes of carbon dioxide for the entire shipping industry annually. Calypso has been reaping great benefits from using the active antifouling agent Selektope.

Thanks to Selektope in the antifouling paint, the vessel's hull has received outstanding protection against barnacles, even at anchor and low speeds (below 6 knots) in biofouling ´hotspots´ with high water temperatures.

During most of its operation, Calypso was operated by Team Tankers who has reaped the benefits of the high performing antifouling coating. In a performance review of the fleet, Team Tankers compared Team Calypso to 9 of its sister vessels, Team Calypso's speed losses then turned out to be significantly lower than the other tankers. Using Selektope in the coating has therefore brought great financial benefits for the operator.

Proven efficiacy during the full coating life span

The ship's hull was never cleaned during the promised service life of the paint technology, in addition, Calypso laid at anchor off the coast of China for 1 month before dry docking. During this month, the hull was exposed to a very high risk of hard marine fouling. During the hull inspection after 63 months of operating and idling in warm waters, the hull showed a normal amount of wear, but was free from barnacles.

Pictures from Chugoku Marine Paints during drydock after 63 months

Minimal speed loss.

When analysing the speed loss of Calypso during the time period of December 2015 to January 2021, when Calypso was operating with a Selektope containing paint, the conclusion is that friction and speed loss are significantly lower than industry average and the hull performance is exceptionally good. The low speed loss indicates a smooth, non-fouled hull with low friction between hull and water.

Data shows an average speed loss of less than 0.5% (0.06 kn) per year. The analysis was performed using Molflow's AI-ship modelling tool "Slipstream", the aim of the ship data model is to predict the vessel's true speed over ground at any loading condition in any weather condition.

The performance degradation of M/T Calypso was evaluated to be comparable to the in-service performance indicator of ISO 19030 (see figure). Calypso´s average speed loss over the 5 years of operation results in less than 0,5%, which is significantly lower than what is commonly known within the industry as a benchmark for average speed loss, set to around 6% over a 5 year period.
In addition, the performance of Calypso exceeds the best speed loss guarantees of premium coating systems by far, which are set at around 1.2 % annual speed loss.

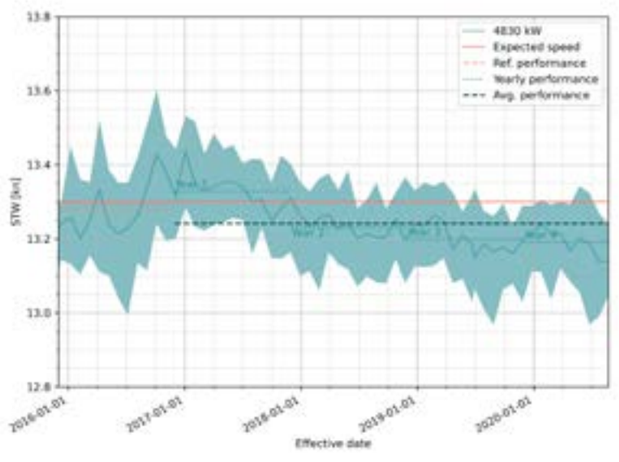


Figure: Speed loss evaluation of M/T Calypso. The speed losses are measured as the difference in knots of each evaluation period to the reference period. The average performance of the first year following the dry-docking was calculated and used as a reference performance. The average performance of each year following the reference period, as well as the average performance of the entire period following the reference period was calculated.

Contact

Please contact us with any enquires
or questions.

Email: info@i-tech.se

Phone: +46 (0)10 30 33 999

Company Web: www.i-tech.se

Product Web: www.selektope.com