GREEN SHIPS AND SECURITY - "THE VOYAGE TO GREEN FUTURE"

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INTRODUCTION:

Designing a Ship in present times has become a challenging task for now a ship has to be fully complied with new environmental rules and regulations. A few benchmark technologies have already been developed to reach the ultimate goal of building a “Green ship” which would not only comply with the new environmental rules and regulations but would also leave least possible carbon foot-prints. The object of green ship is to minimize the offal and harmful emissions in order to reduce the pollution to air, water and soil, save resources and improve economical and social benefits.

The need for a sustainable Future is environment friendly, efficient and affordable transport systems, therefore the Marine transport as the primary global transport system is instrumental to globalization – and we must be aware of our role and responsibilities.

EXAMPLES OF EMISSION FROM SHIP:

Ships emitting greenhouse gases like SOx and NOx which creates air pollution.

Ships emitting sewage and ballast water which affects the marine environment.

These are issues that should be taken into consideration when talking about reducing the environmental impact of vessels as we briefed in the abstract:

1. Reduction of Gas Emissions
   a. SOx,
   b. NOx,
   c. CO2,
2. Ship Waste Disposal
3. Black and Grey Waste Water Treatment
4. Ballast Water Treatment

1. REDUCTION OF GAS EMISSION:

The technological measures outlined in the report published by the European Commission's Joint Research Centre (JRC) could reduce shipping emissions of sulphur dioxide (SO2) and fine particles

(PM) by 90 per cent, nitrogen oxides (NOx) by 80 per cent, and carbon dioxide (CO_2) by 70 per cent.

a) SULPHUR OXIDES OR SOX REDUCTIONS:

The sulphur oxides emission is due to the presence of sulphur compound in the marine fuels used in marine engines on board vessel. The smoke containing sulphur oxides emitted by the combustion of marine fuel will further oxidize and in presence of catalyst like NO_2, will form sulphuric acid which is a major cause of acid rain.

Better the grade, lower will be the sulphur content as it is removed by refining of the fuel. Fuel switching from 2.94 per cent sulphur heavy fuel oil (HFO) to 0.5 per cent sulphur fuel oil is estimated to cost €1,300/tonne, while switching from 2.94 per cent sulphur HFO to 0.1 per cent sulphur marine gas oil (MGO) would cost €3,600-4,300/tonne. If sea water scrubbing is used instead, costs are estimated at €310-550/tonne of SO_2.

EFFECTS OF SOX EMISSION:

SOx emissions can cause acid rain in coastal areas having a detrimental impact on the environment. SOx as a product of combusting fuel oil can be reduced by decreasing the sulphur content in the fuel supplied to the vessel. Reduction of SOx can be achieved by the after treatment of the exhaust gases from engines and boilers via cleaning. The sulphur content of fuel influences the emissions of particulates. Less sulphur means less particulate matter (PM).

POSSIBLE SOLUTIONS FOR REDUCING SOX:

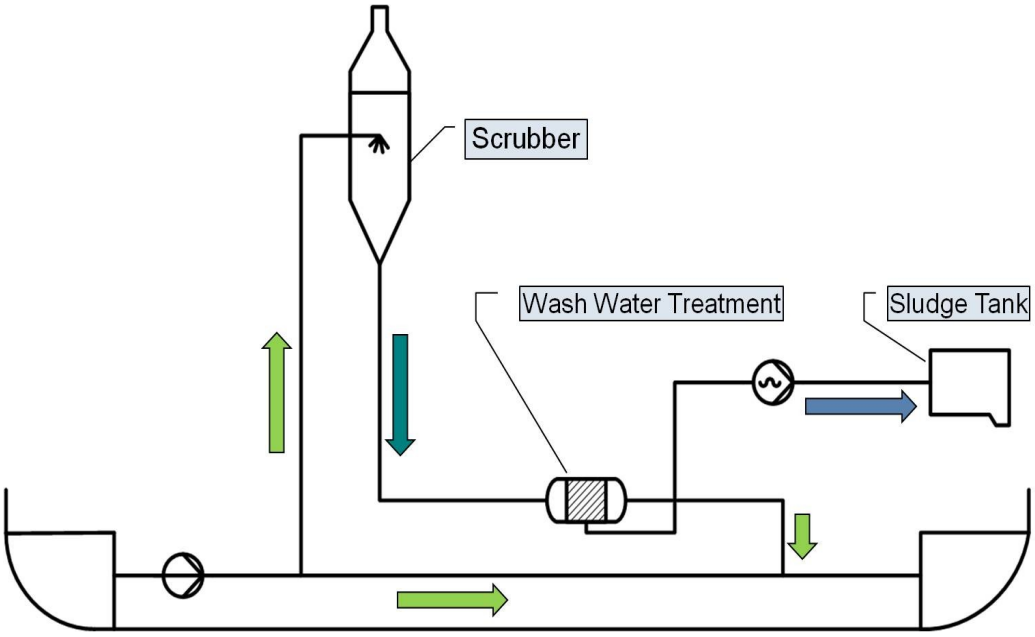
1. Increased use of fuels with low sulphur content.

2. Adopting Dual-Fuel-Engines so that a ship could use heavy fuel oil (HFO) on the high seas. In certain costal areas, entering and/or leaving harbours, the main engines are then driven by Liquefied Natural Gas (LNG).

3. SO2 – scrubbers can also remove SO2 from exhaust with or without the help of seawater or in a closed loop system by the addition of chemicals. Scrubbers have been proven to reduce SO2 emissions by >85%.

SULPHUR SCRUBBER SYSTEM:

The exhaust gas scrubber, (known as the open loop scrubber) reduces the sulphur oxide content of the exhaust gases by 90 to 95 per cent. The spray jets similar to the design of shower heads drench the exhaust gas with sea water just before the flue. Water and sulphur react to form sulphuric acid, which is neutralised with alkaline components in the sea water. Filters separate particles and oil from the mixture before the cleaned water is given back into the sea.



b) **Nitrogen Oxides or NOx:**

With more and more ships travelling each day to different parts of the world, the air pollution caused by them is on the rise and is one of the major global concerns. The two main pollutants from the ship's emission are Nitrogen oxides (NOx) and Sulphur oxides (SOx). These gases have adverse effects on the ozone layer in the troposphere area of the earth's atmosphere which results in the green house effect and global warming.

EFFECTS OF NOX EMISSION:

CO_2 is one of the gases which cause global warming. Reduction of CO_2 emissions is necessary for climate reasons.

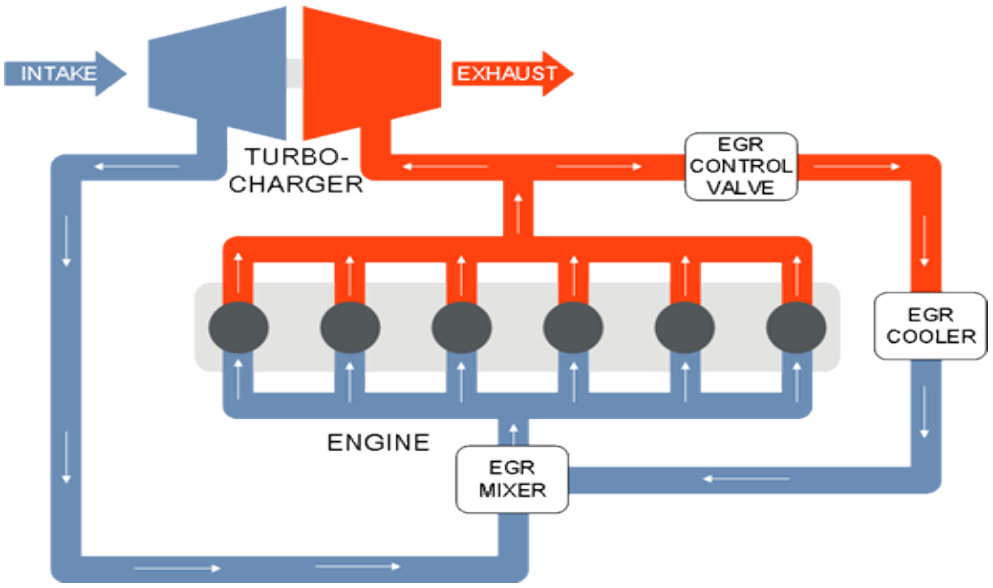
POSSIBLE SOLUTION FOR NOX EMISSION:

There are several technologies that lower the temperature of combustion, e.g. by injection of water that can reduce the emissions of NOx from ships resulting in a positive impact on the environment: Humid Air Motors; Direct Water Injection; Exhaust gas recirculation; Fuel-Water Emulsification. Other technologies such as Exhaust Gas after Treatment Technologies: These technologies have been proven capable of reducing emissions from engines sufficiently to meet new

regulation standards; Waste heat recovery systems can also substantially reduce the levels of NOx;

EXHAUST GAS RECIRCULATION:

As the name suggests, a fraction of the exhaust gas is filtered and re-circulated back into the combustion chamber after cooling. The formation of NO_x is reduced since the specific heat capacities of the principal exhaust components are higher than air; a lower oxygen supply also prevents the formation of NO_x.



c) CO2 Emission:

For 2007, shipping was estimated to have emitted 3.3% of global CO2 emissions, to which international shipping contributed 2.7%, or 870 million tonnes2. Although international shipping is the most carbon efficient mode of commercial transport, total emissions are comparable to those of a major national economy, necessitating emission reduction.

EFFECTS OF CO2:

CO2 is one of the gases which cause global warming. Reduction of CO2 emissions is necessary for climate reasons.

POSSIBLE SOLUTION FOR CO2 EMISSION:

CO2 emissions are a direct result from thermal combustion of fuel. This means that the most substantial effect would be cutting energy consumption, i.e. by reducing speed. Further research and utilising the following processes allow for a further decrease of CO2 and other emissions to be achieved:

HYBRID AUXILIARY POWER GENERATION:

A hybrid auxiliary power system usually consists of a fuel cell, diesel generating set and batteries. The intelligent control system balances the loading of each component for maximum system efficiency. This system can also accept other energy sources such as wind and solar power. If such a system could be introduced a significant reduction of CO2, NOx and particulates could be achieved.

CHANGE OF FUEL TYPE:

Liquefied natural gas.

ALTERNATIVE PROPULSION:

A kite on the bow of a ship can use wind energy to give the ship and added means of propulsion. The average tanker could save approximately up to 20% of fuel depending on route and wind conditions. Kite technology, as a result of its compact size could easily be retrofitted onboard existing ships. It has also been argued that kites could be used alongside conventional means of thrust contributing to hybrid propulsion. By having such high fuel efficiency ships would need to burn less resulting in a reduction of CO2 and other harmful emissions.

2. SHIP WASTE TREATMENT:

The definition of garbage is as follows: Garbage includes all kinds of food, domestic and operational waste, excluding fresh fish, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically. The annex totally prohibits the disposal of plastics anywhere in the sea, and severely restricts discharge of other garbage from ships into coastal waters.

EFFECTS OF SHIP WASTE:

The main problem is that the disposal of garbage occurs to a large extent out of the public eye. 70% of ships garbage immediately sinks to the bottom of the ocean. Rather often, rubbish such as bottles and receptacles with openings, can lead to the death of fish and other marine organisms. 15% of garbage is washed up on the shore. The remaining 15% floats on or just under the surface of the sea. Often this rubbish comes together and forms large ‘garbage islands’. These ‘islands’ can grow uncontrollably as a result of the sea currents picking up more rubbish. They are also used by countless animal species as a means of transport. Sensitive ecosystems, for example, in the Polar Regions, can be put at risk as result of these floating ‘islands’ and the alien organisms being carried by them.

Waste discharge into the sea is allowed by MARPOL under certain conditions. The discharged waste has to be noted down, in a waste disposal log stating the following information:

The type of discharged waste;

The amount of discharged waste;

The time and position of discharge.

TYPE OF WASTE	DISCHARGED OUTSIDE THE SPECIAL MARITIME AREAS	DISCHARGED INTO THE SPECIAL MARITIME AREAS
Synthetic materials such as rigging, netting, plastic bags, etc:	FORBIDDEN	FORBIDDEN
Floating materials such as cork, foam, packaging, etc:	Allowed with an offshore distance of > 25 nm	FORBIDDEN
Metal, paper/card, Stoneware, Glass, etc:	Allowed with an offshore distance of > 12 nm	FORBIDDEN
Other waste: incl. Metal, paper/card box, stoneware, Glass, etc: broken or crushed with a thickness < 25mm	Allowed with an offshore distance of > 3 nm	FORBIDDEN
Food remains, not broken down:	Allowed with an offshore distance of > 12 nm	Allowed with an offshore distance of > 12 nm
Food remains, broken down:	Allowed with an offshore distance of > 3 nm	Allowed with an offshore distance of > 12 nm
Mixed waste	In the case of mixed waste stricter regulations apply.	In the case of mixed waste stricter regulations apply.

POSSIBLE SOLUTIONS FOR SHIP WASTE DISPOSAL:

There are currently technological solutions that could be implemented and further developed to ensure that waste is no longer

discharged at sea. Due to limited space onboard ships, the equipment manufacturers have developed various methods of waste treatment.

WASTE COMPRESSORS:

They reduce the volume of rubbish so that it can be stored onboard before being offloaded to shore based facilities. This can be done by simply squeezing and breaking down waste followed by the process of compression. This might it difficult to be recycled further. Compressing and storage of waste is an effective technical solution to dealing with the rubbish being thrown overboard.

PLASMA TECHNOLOGY:

Plasma technology used in conjunction with other onboard systems is another example of effective garbage disposal. Plasma, which can reach temperatures of up to 6 thousand degrees centigrade, can reduce waste into a non toxic sludge. The complex compounds which make up plastic, etc. can be reduced into hydrogen and carbon dioxide.

3. BLACK WATER AND GRAY WATER:

Black Water is a term used to describe wastewater containing faecal matter and urine (water from toilets). Grey Water is a term generally used to describe water generated from domestic activities such as dishwashing, laundry and bathing.

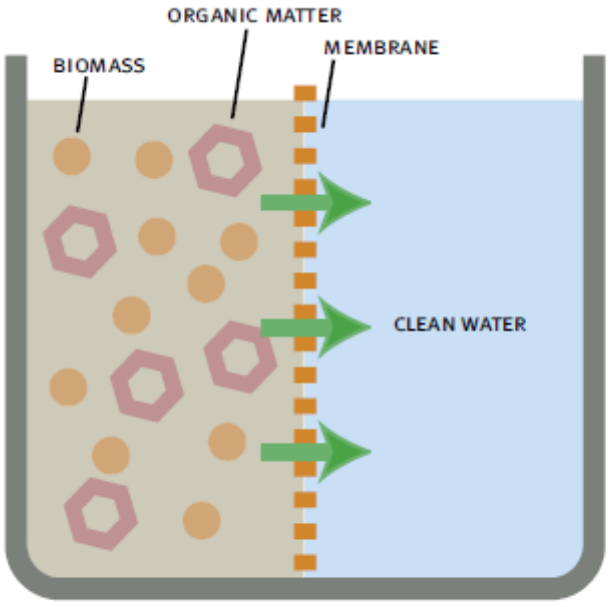
EFFECTS OF BLACK WATER AND GRAY WATER DISPOSAL:

Discharged waste water can lead to hygienic problems like the dangerous germs being released in coastal regions. In addition to this, waste water released in sheltered coastal areas could contain harmful nutrients, disinfectants as well as detergents that can have a largely detrimental impact to marine environments. The problem of waste water is the variety of pollutants it contains some of which are soluble and others in solid forms. Non biodegradable elements such as plastic, grain, hair, fibers and different kinds of fat must be removed from the water by periodic de-silting or by extraction through a suitable filtration system. The amount of black water onboard ships depends on the technology installed to sanitize it.

POSSIBLE SOLUTIONS FOR BLACK WATER AND GRAY WATER DISPOSAL:

MEMBRANE BIOREACTORS:

Membrane Bioreactors can effectively cleanse black and grey wastewater. The water is first fed into the bioreactor where biomass breaks down the organic matter. This is then processed through a filter and into a second bioreactor. The solution is put through membrane modules to make sure it is scoured and properly cleaned. What is left after the cleaning stage can then be directly discharged into the sea.



How a Membrane Bioreactor (MBR) works (simplified drawing)

VACUUM TOILETS:

Vacuum toilets can reduce the amount of black water discharged black water by 1/3. This technology can be combined with a sludge reactor with membrane filtration, collecting grey water. The grey water following treatment in the reactor can be used for the flushing of toilets therefore reducing its volume by 75%.

5. ## BALLAST WATER:

Ballast water is essential for ship stability e.g. when it is carrying an unevenly distributed load. A ship fills up between 10 and 50% of its whole tonnage with ballast water in coastal regions and discharges it when the load is changed. (A tanker when empty fills up with 60,000 tons of ballast water when it has a carrying capacity of 200,000 tons. A container ship fills up 10-20% of their carrying capacity when empty.) Therefore per year up to 10-12 billion tons of salt water is displaced**.**

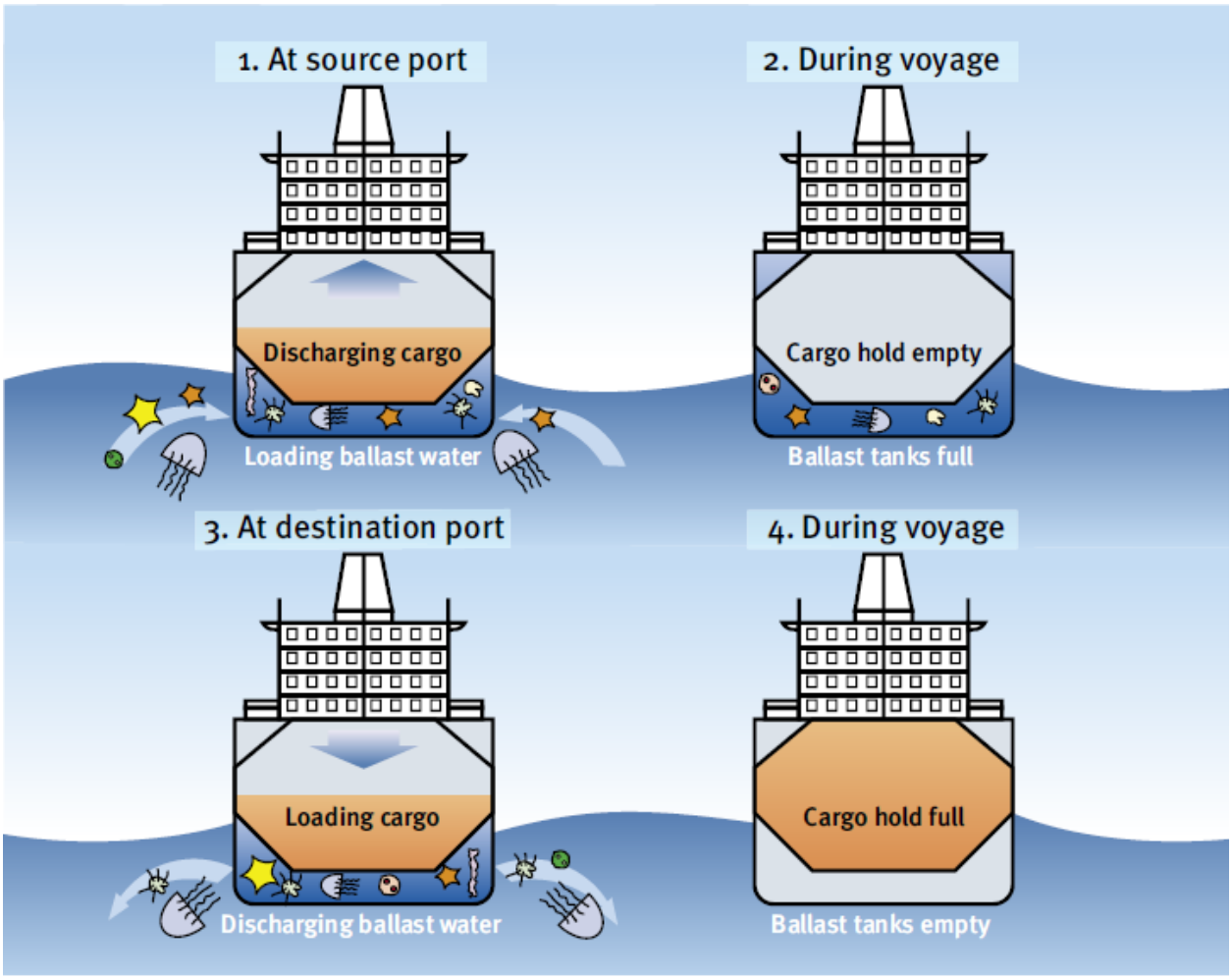
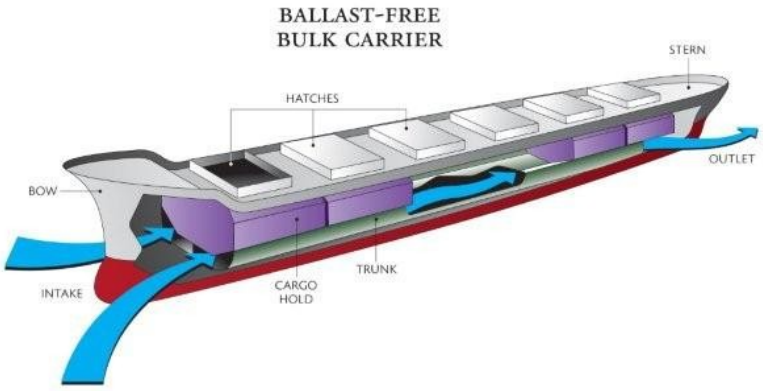


Figure: the circulation of the ballast water during the ship's voyage

WHAT IS NON BALLAST OR BALLAST FREE SHIPS?

Ballast water convention by IMO focuses on reducing the transit of sediments and micro organisms of one territory to another through

the ballast of ships. In order to prevent this condition, plans of making a “No Ballast Ships” is under progress. A no ballast ship or similar system can drastically reduce this problem.



FEATURES OF BALLAST FREE SHIPS

- **BALLAST TRUNKS:**

Ship ballast tanks are replaced with longitudinal structural ballast trunks consisting of one centre tank, two intermediate tanks and two side tanks which surround the cargo hold below the ballast draft and are connected to an intake plenum and a discharge plenum near the bow and the stern respectively. These ballast trunks are swamped in the ballast circumstance to diminish the ship’s buoyancy.

- **PROPULSION:**

The twin screw and optimum diameter propellers allow low draught aft in the unloaded condition and ensure high propulsive efficiency by overlapping propeller arrangement. Propulsion power is estimated on the basis of the resistance and propeller analyses.

SECURITY

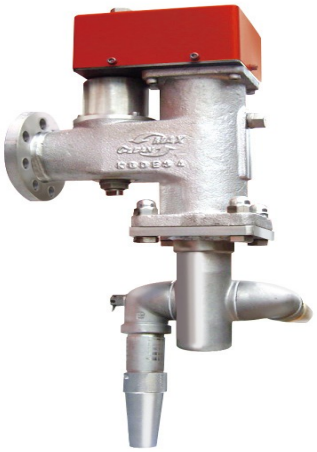
What is the relation between security and green ships? Ships can and will become ‘greener and greener’ by more frequently and more intensively applying various possibilities as we stated above. But if this green ship gets caught in the hands of pirates ?? ?

Now think about the situation!!!

One of the possible ways used to repel the pirates is the JET GUN technology. Let us discuss about this in detail.

JET GUN:

This is an innovative



water-jet system which defends the vessel against forced boarding by the pirates. It consists of two water jet guns mounted on the shipside, rotating 90 degrees and continuously shooting a high pressure stream of water. It can be installed on all kind of vessels and is especially suitable for oil, chemical, LPG and LNG ships as it is intrinsically safe. This system is easy to install and operate, because it uses the existing facilities of fire fighting pumps, pipelines and hoses. Therefore no additional installation is required onboard the vessel.

The system can be operated for an indefinite amount of time and can be started from a safe location within the accommodation. The water pressure being used is of 8~16 bars and the flow rate is about 30~100m^3/hr.

ADVANTAGES:

- Easy installation
- Quick operation which is completely safe for crew onboard as the pressure works only along the shipside.
- No further requirement for setting the machine angle or changing the cycle.
- Simple, effective and maintenance free design.
- Continuous repeating cycle without the need to for human intervention.
- Can be installed and used on all kind of vessels safely as is intrinsically safe.
- Option of selecting the various additives for maximizing the effect.

CONCLUSION:

‘A green ship is an evolution, not a revolution’

Environmental awareness is a growing trend in the shipping and shipbuilding industry. The aforementioned issues all have solutions which exist today and can positively influence the impact a ship has on the environment. However, there are

always areas where innovation could still be promoted and further research into more efficient, innovative and eco-friendly products could be undertaken. Thus we are concluding that green technology accompanied with the secured technology will lead to a green future.