Technoarete Transactions on Electrical Vehicles and Automotive systems
Vol-1 Issue-1, April 2022, PP.23-27

Usage of Electric Propulsion in Maritime to Design Green Marine Ships for Regulating Shipping Emissions in India

J. Sunil Gavaskar[1], S. Swetha[2]

[1] Assistant Professor, Lord Jegannath College of Engineering & Technology, Ramanathichenputhur.
[2]Assistant Professor, EEE Dept., Vel Tech Multi Tech Dr. Rangarajan Dr. Sakunthala Engineering College, India

[1] sun.gavas@gmail.com, [2]swethasrinivasan4@gmail.com

Abstract *- **Managing the pollution level caused by marine ships has become one of the serious matters of concern in the aspect of Indian pollution level. This study has focused on the invention of electrical marine ships to reduce the pollution level from the environment as well as save the fuel resources of India. Indian governmental legal factors also have been discussed in this tidy to identify the implementation of the regulations is whether maintained or not. Moreover, this study can help the readers to understand the effectiveness of the transformation of electrical marine ships to make zero carbon emissions.***

Keywords— Atmospheric pollution, Electrical marine ship, Mitigation, Shipping, Zero Carbon Emission, Transformation

1. Introduction

y goods across the globe. In this
ct both on the environment and
f the environment. In this regard,
. As India is one of the popular
y by day, it is necessary to bring
s in India by introducing electric

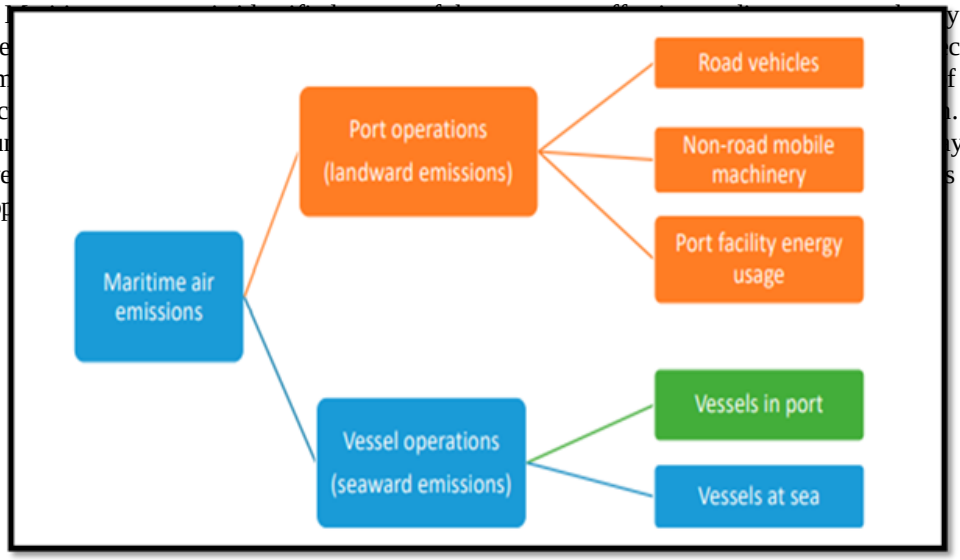

Figure 1.1: Different sources that cause air pollution
(Source: Koumentakos, 2019)

Depending on the pollution level, accompanied by the global aviation industry and contributors to greenhouse gas, only ***2%*** CO2 emissions can be possible in India (Al-Enazi *et al.* 2021). According to the ***"United Nations Conference on Trade and Development"***, under maritime transportation, there are nearly ***80% to 90%*** of transported products that increase the pollution level of India. As per the view of Verma and Kumar (2021), ***13% and 15% of global SOx and NOx*** have occurred due to the

production of marine ships. The maritime pollution has been caused due to port and vessel operations where it has been found that maritime pollution has resulted in ***60,000 deaths*** (Koumentakos, 2019). Since marine ships are releasing Sulphur oxides (SOx) and nitrogen oxides (NOx) that affect human health along with the environment, it is considered necessary to emit this impact.

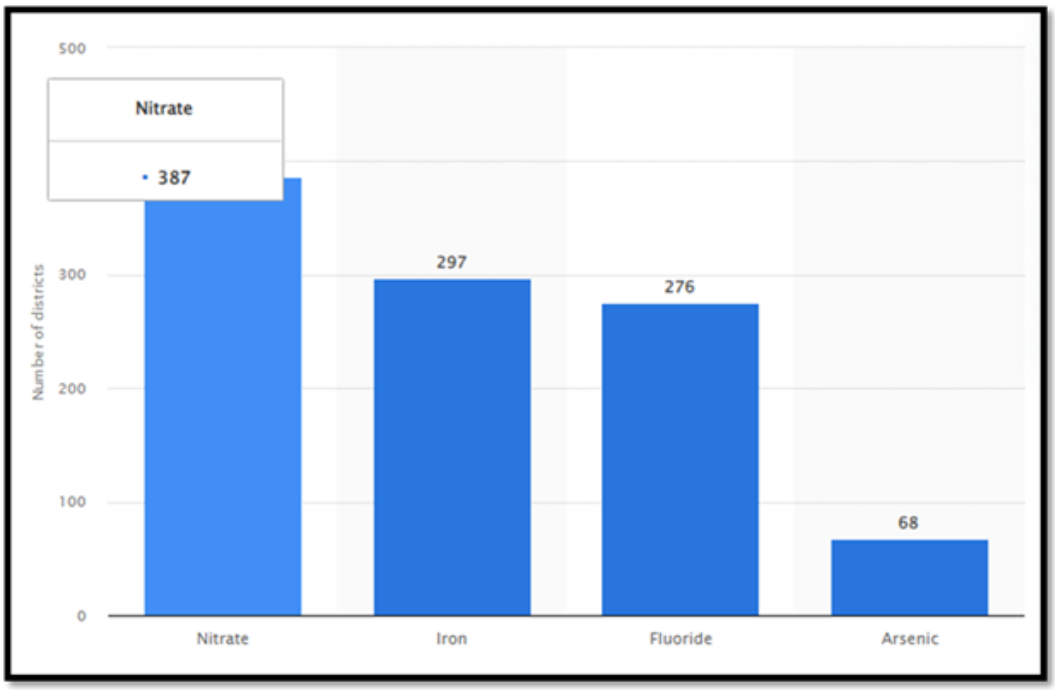

Figure 1.2: Number of districts with contaminated water in India in 2019
(Source: Statista.com, 2019)

In India the water pollution causes several types of diseases such as ***Typhoid, Amoebiasis, Cholera, Shigellosis,*** and ***Hepatitis A***. Behind the water pollution there is a huge contribution that has remained with marine transport: ***it releases chemicals, discharges radioactive elements,*** and ***releases solid waste***. Due to the reduction of these pollutant elements, water pollution can be mitigated in India.

2. Aim and objectives

This study aims to introduce the usage of electric propulsion in maritime to regulate shipping emission through designing various green ships in India. The objectives are as below:

- To understand the advantages of electric propulsion in maritime in India.
- To find out the ways of inventing different designs in marine ships.
- To analyse the impact of the usage of electric propulsion to reduce pollution in India.

3. Literature Review

3.1 Diesel Engines and Electric Motors

In the propulsion system, the usage of diesel engines provides heat and continuous pressure that creates water pollution. Thus, beside the water transports, almost every vehicle in India runs through diesel engines. As opposed by Koumentakos (2019), considering the constant reduction of petroleum resources as well as raising the unit price, the engineers have focused on the renewable energy sources to balance the ratio. Alternative fuels have also become a concerning area in the Indian rising pollution. Harmful gases such as ***particulate matter (PM), SOx, NOx, CO2, CO*** are produced by the sea level. As the marine is running through under the water level, it could not balance the pollution level. Considering all the obstacles in diesel engines, it has been considered that electric motors can play a vital role in the ***hybrid propulsion system***. It is a vehicle propulsion system that is combined with two or more resources in the propulsion system to modify the design. Accompanied by electric motors the release of harmful gases can be mitigated to reduce the pollution level in India.

Controlling speed and torque, direct current motors have been considered as helpful in direct proportion by current and voltage. In this regard, both the ***"stator"*** and the ***"rotor magnetic field rotate"*** have become helpful in operating the marine ships. As augmented by Kim *et al.* (2021), electrical energy is capable of converting into mechanical energy that helps marine ships to keep its running process and control the pollution level. Thus the engineers are continuously working on this process to bring invention in the design of green marine ships. With the rising concern regarding the health of the Indian people, the

increase of demand for alternative propulsion systems becomes considerable. Observing the rising demand it can be understood that electrical marine ships have a promising future to sustain for a long term issue.

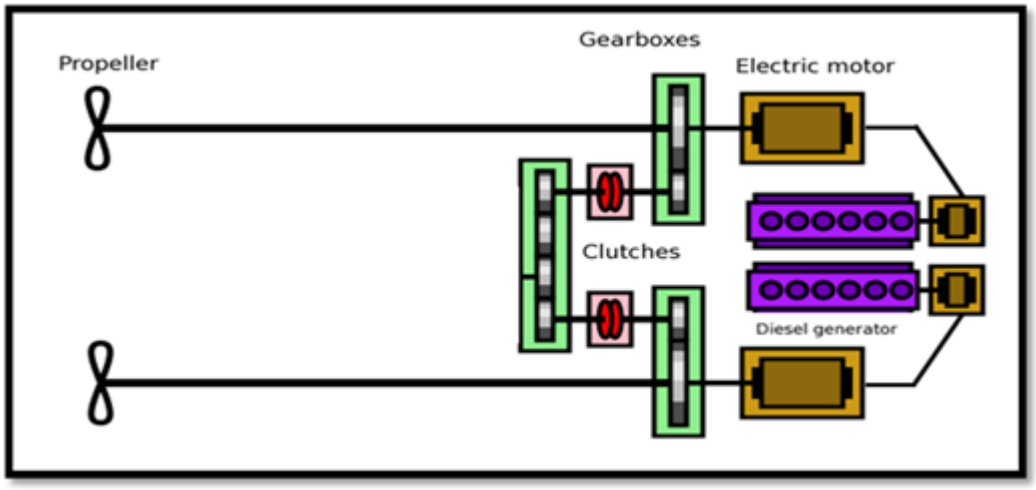

Figure 3.1.1: Possible Design of Electrical Marine Ship
(Source: Marineinsight.com, 2021)

3.2 Emissions and IMO Regulations

Considering the constant rising pollution in India, marine engineering designers have focused on the innovation to bring electrical marine ships for ***climate change, improving human health,*** and ***atmospheric pollution***. As observed by Xing *et al.* (2020), the water pollution can be generated by two elements such as human-induced and natural. In this regard pollution caused through marine ships is entirely human-induced. According to the ***"International Maritime Organization (IMO)"*** regulations the pollution level could not be as high as ***> 130 kW*** (D'Agostino *et al.* 2020). The entire standards of IMO represent the safety and security measures for the shipping procedure. In India, the shipping industry followed the instruction of IMO, but it could not balance the pollution level. Following IMO regulations Indian maritime can reduce at least 20% of pollution level to save the environment.

Comparing the pollution level of land vehicles and marine vessels, the researcher has identified that introducing electrical engines in marine ships will be more effective. According to Mauro, *et al.* (2021), the electric invention is able to complete the requirement of fuel that not only saves the fuel resources but also reduces the pollution level from the environment of India. The health issues of the people in India are quite high compared to the other countries. Depending on this and following IMO regulations, the implementation of electricity can be executed by several steps such as ***switching to Liquified Natural Gas, switching to Low-sulphur fuel oil,*** and ***while using Scrubbers, continuing burning HSFO.*** The main aim of this invention is about decreasing the high fuel consumption based on per unit power at low loads and brings an alternative way of propulsion to secure the environment of India.

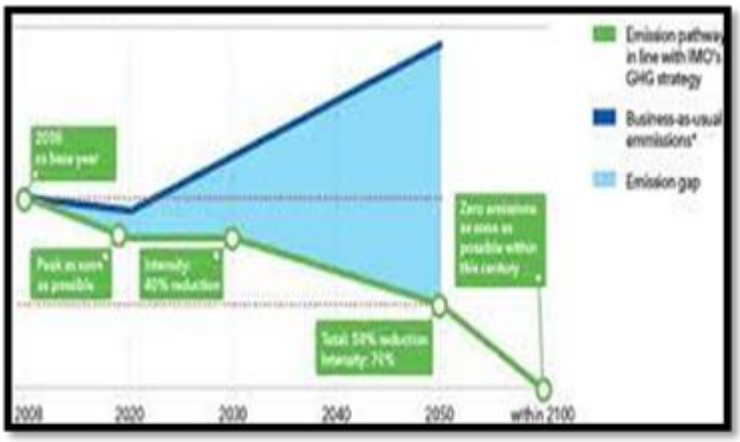

Figure 3.2.1: International Maritime Organization Regulations
(Source: Influenced by Xing *et al.* 2020)

4. Methodology

The researcher has followed qualitative research methods to lead this study further forward. In addition, the researcher has utilised a literature review method due to gather the relevant data to find out an effective decision after completing the research process. As stated by Serra and Fancello (2020), in the evaluation of large commercial vessels it is important to choose the correct source of data. As possible by the researcher several individually evaluated sources by measuring the levels of small vessels have been collected to analyse the valid data. Assessing several citations that were related to the topic have been found between the publications from 2017 to 2021 for inclusion in the dataset.

In addition, utilising Google Scholar due to looking for the headings that contain "boats" or "vessels" or "pollution emission" has been collected to make this study reliable and valid. In the words of Milios *et al.* (2019), having broadband sources in the publications can help in estimating proper resources to lead the research work in an effective way. Along with this, investigating previous existing reports and studies also helped the researcher to identify the valid data to execute the study. Observing and discussing the matter with different vessel operators and collecting the samples based on vessel types, all appropriate information provided in the report.

5. Result and Discussion

5.1 Legal Framework for Monitoring CO2 Emissions from Maritime Transport

Due to observing the constant rise of carbon level the legal factor has been adopted by the Indian Government. Per year in India, the maritime transport system causes around ***100 million tonnes of CO2*** that is responsible for ***2.2%*** of global warming (Primorac, 2018). As the pollution is a matter of serious concern, the Indian government has taken a series of actions against the legal framework to reduce the pollution level from the Indian climate. As opined by Chou *et al.* (2021), in maritime the marine ship is the one vehicle that causes a huge amount of pollution and observing this factor it is needed to understand the potential steps to control the negative impact.

The government has introduced the ***promotion of cleaner production processes*** that can enable the blend of fuel extract. In addition, by 2017 ***"Bharat Stage IV (BS-IV)"*** norms the cities have been restricted to Bio-medical Waste into water. As stated by Gabbar *et al.* (2021), under ***"Section 18(1)(b) of Water Act", 1974*** the government has declared the restrictions regarding water pollution and announced the renovation of zero emission marine ships. In this regard, ***Delhi Government*** has introduced a ***Master Plan of Delhi in 2001*** in order to shift as well as stop water pollution.

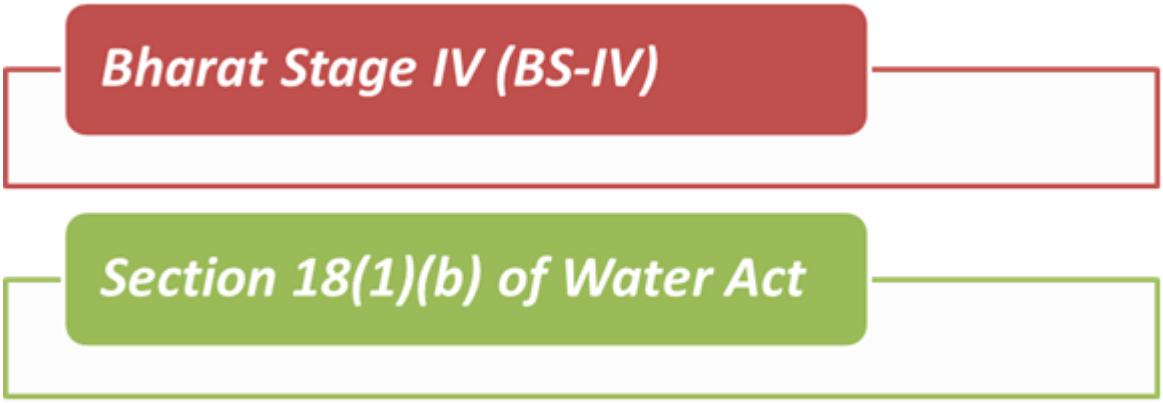

Figure 5.1.1: Legal Acts adopted by Indian Government
(Source: Influenced by Chou *et al.* 2021)

5.2 Enhancing the Security of Ships and Ports based on Port State Control

Maritime has been identified as the starting point of the maritime navigation that earns a huge amount for the development process of the Indian economy. As opposed by Hernández-Fontes *et al.* (2021), an implementation of a security can supports in the monitoring process whether the regulations are maintained or not. An investment of ***Rs. 6,000 crores*** has been invested by the government into the maritime ship development process to make the zero emission targets to save the world (Gov.in, 2020).

In return, it has been expected that the revenue at the end of the project ***1115.37 crore***s will be back (Gov.in, 2020). According to the governmental rule, the ship-owner has a duty to notice the weight of the ship to measure the potential fuel requirement. Compared to India, Europe has grown its CO_2 emissions by 58% that is indicating a good approach. Observing all the facts, the transformation of electrical marine can save the risk factor regarding fuel reduction and a load of goods. Installing

broadband resources, the implementation of electrical marine ships can be possible in a better way. From 1st January 2018, the implementation of regulations has been pressurized to be maintained strictly by the ship-owners.

6. Recommendations and Conclusion

Based on the above analysis it can be stated that following the constant rising pollution in India, it has become an essential factor to focus on the bringing process of alternative ways. Accompanied with advanced technologies and engineer's invention power, the marine ship can be converted into electrical transport that not only saves the fuel resources but also reduces the pollution level from the environment of India. As per the view of Zhen *et al.* (2019), in the invention process, design is one of the effective tools that influence the acceptance activity of the new machine. By increasing the alternative information value, an unbalanced random vessel effect can solve the pollution level as well as maintain the environmental impact.

In this regard, marine ships have remained one of the most affected polluted transport systems that released several harmful gases and fuels. In this study, all the issues behind the diesel engine marine have been discussed to introduce the potential possibilities to overcome the obstacles. This study can help the readers to understand both advantages along with disadvantages of electrical marine ships to reduce the pollution level in India.

Reference List

1. Al-Enazi, A., Okonkwo, E.C., Bicer, Y. and Al-Ansari, T., 2021. A review of cleaner alternative fuels for maritime transportation. Energy Reports, 7, pp.1962-1985.
2. Chou, T., Kosmas, V., Acciaro, M. and Renken, K., 2021. A Comeback of Wind Power in Shipping: An Economic and Operational Review on the Wind-Assisted Ship Propulsion Technology. *Sustainability*, *13*(4), p.1880.
3. D'Agostino, F., Kaza, D., Martelli, M., Schiapparelli, G.P., Silvestro, F. and Soldano, C., 2020. Development of a multiphysics real-time simulator for model-based design of a DC shipboard microgrid. Energies, 13(14), p.3580.
4. Gabbar, H.A., Adham, M. and Abdussami, M.R., 2021. Optimal Planning of Integrated Nuclear-Renewable Energy System for Marine Ships Using Artificial Intelligence Algorithm. *Energies*, *14*(11), p.3188.
5. Gov.in, 2020. *GOVERNMENT OF INDIA*
6. Hernández-Fontes, J.V., Maia, H.W.S., Chávez, V. and Silva, R., 2021. Toward More Sustainable River Transportation in Remote Regions of the Amazon, Brazil. Applied Sciences, 11(5), p.2077.
7. Kim, Y.R., Kim, J.M., Jung, J.J., Kim, S.Y., Choi, J.H. and Lee, H.G., 2021. Comprehensive Design of DC Shipboard Power Systems for Pure Electric Propulsion Ship Based on Battery Energy Storage System. Energies, 14(17), p.5264.
8. Koumentakos, A.G., 2019. Developments in Electric and Green Marine Ships. Applied System Innovation, 2(4), p.34.
9. Koumentakos, A.G., 2019. Developments in Electric and Green Marine Ships. Applied System Innovation, 2(4), p.34.
10. Marineinsight.com, 2021. Electric Propulsion System for Ship: Does it have a Future in the Shipping? https://www.marineinsight.com/marine-electrical/electric-propulsion-system-for-ship-does-it-have-a-future-in-the-shipping/
11. Mauro, F., Ghigliossi, E., Bucci, V. and Marinó, A., 2021. Design of hybrid-electric megayachts: The impact of operative profile and smart berthing infrastructures. Journal of Marine Science and Engineering, 9(2), p.186.
12. Milios, L., Beqiri, B., Whalen, K.A. and Jelonek, S.H., 2019. Sailing towards a circular economy: Conditions for increased reuse and remanufacturing in the Scandinavian maritime sector. Journal of cleaner production, 225, pp.227-235.
13. *MINISTRY OF SHIPPING.* https://shipmin.gov.in/sites/default/files/Shipping%20Annual%20Report%20English_compressed.pdf
14. Primorac, Ž., 2018. Legal challenges of implementing the system of monitoring carbon dioxide emissions from maritime transport within ports of call under the jurisdiction of eu member states. Pomorstvo, 32(1), pp.3-9.
15. Serra, P. and Fancello, G., 2020. Towards the IMO's GHG goals: A critical overview of the perspectives and challenges of the main options for decarbonizing international shipping. Sustainability, 12(8), p.3220.
16. Statista.com, 2019. Number of districts with contaminated water in India in 2019, by contamination type. https://www.statista.com/statistics/1111747/india-number-of-districts-with-contaminated-water-by-contamination-type/
17. Verma, J. and Kumar, D., 2021. Metal-ion batteries for electric vehicles: current state of the technology, issues and future perspectives. Nanoscale Advances.
18. Xing, H., Spence, S. and Chen, H., 2020. A comprehensive review on countermeasures for CO2 emissions from ships. Renewable and Sustainable Energy Reviews, 134, p.110222.
19. Zhen, L., Zhuge, D., Murong, L., Yan, R. and Wang, S., 2019. Operation management of green ports and shipping networks: overview and research opportunities. Frontiers of Engineering Management, 6(2), pp.152-162.