Issues owing to Legal Discharge of Chemical Tanker generated Persistent floater cargo residues in Arabian sea and Bay of Bengal.

Capt. Abhijit Arvind Mohite
ORCID number: 0000-0002-0686-5692
PhD Scholar, School of Maritime Management
(Indian Maritime University)
(IMU Headquarters. East Coast Road, Semmencherry, Chennai - 600119. Tamil Nadu, India)
{Corresponding author's email: 87.abhijit@gmail.com}

Abstract - India, Pakistan, and Bangladesh are one of the largest importers of persistent floater cargoes. Owing to a lack of monitoring and compliance checks by government authorities, these substances are discharged at temperatures where they are called solidifying or high-viscosity substances. Ports in this region are not equipped with facilities that can receive persistent floater cargo residues mixed with wash water. Most of the chemical tankers start cleaning their tanks as per MARPOL Annex II immediately after departure from port, however wind, swell, and unfavourable weather helps persistent floater cargo residues to reach coastline where marine life, beaches, cities close to the coast, etc. are heavily affected owing to the major Health, and Environmental hazards posed by these residues. The issues experienced by European countries are discussed in this article which can also be applicable to India, Pakistan, Sri Lanka, and Bangladesh.

Keywords: MARPOL; Persistent floater; Residues; Indian port; Prewash; Marine pollution

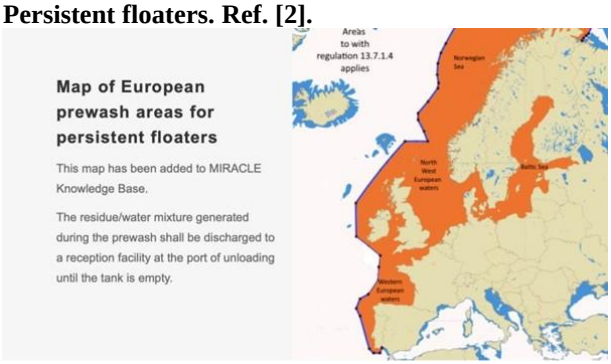
1. INTRODUCTION

Marine pollution is a major problem for human life. Inappropriate disposal of pollutants, such as oil, chemicals, plastics, sewage, and domestic waste, can cause major problems for human health and the environment. Each waste type must be studied in detail to understand the risks and opportunities for waste disposal. India has a 7516 km-long coastline, which includes the mainland, Lakshadweep Islands, and Andaman & Nicobar Islands. Andaman & Nicobar Islands is one out of four biodiversity hotspots that have "n" number of endemic marine species. Human activities in the past and present have played a direct role in the loss of biodiversity. The Indian coastland comprises different types of landforms, including lagoons, mangroves, red sand, estuaries, dune ridges, marshlands, gulfs, archipelagos, beaches, backwaters, deltas, coral reefs, and deltaic islands. To preserve the identity of these landforms along the Indian coast, extraordinary efforts are required from the Indian central, state, and local governments, primarily to prevent marine pollution from various sources, such as oil, noxious liquid substances (NLS), chemicals, plastics, sewage, grey water, and factory liquid waste.

To prevent pollution and minimise operational discharges from ships in areas close to landforms along the Indian coastline, Indian and foreign flag ships need to comply with the MARPOL 73/78 policy, which includes regulations to prevent pollution from oil, harmful substances carried by the sea in packaged form, sewage, and garbage. MARPOL 73/78 regulates the control of NLS discharge by specifying the discharge criteria for NLS waste depending on its pollution category. Certain NLS and waste are allowed to be discharged into the sea according to certain criteria.

MARPOL Annex II amendments in force from 1 January 2021 are applicable only to Northwest European waters, the Baltic Sea area, Western European waters, and the Norwegian Sea (Picture 1) and primarily specify discharge requirements for chemical tanker-generated cargo tank washings and cargo residues containing persistent floating products (e.g., palm oil, soybean oil, paraffin, and fish oil), which can solidify under certain conditions, such as high viscosity and/or melting point.

Picture 1 Map of European prewash areas for Persistent floaters. Ref. [2].



Picture Source Website: https://www.chemserve-marine.com/news/ (ChemServe GmbH, 2021)

2. OBJECTIVES

This research aimed to investigate the risks and opportunities for the Indian central, state, and local governments when they decide to follow the amendments to MARPOL Annex II Regulation 13 – Control of discharges of NLS residues to all ships calling at Indian ports or navigating in the Indian contiguous zone without calling at any Indian port.

3. BACKGROUND

Generally, chemical tankers transport palm oil, vegetable oils, paraffin, and other persistent floater cargo from Indonesia, Malaysia, and Argentina by sea for discharge in the UK, Belgium, Sweden, Germany, and the Netherlands. Most of this chemical cargo is classified as a Category Y pollutant, as per the IBC Code. These chemical tankers

maintain the cargo discharge temperature above the temperature at which these cargoes will not be considered as high-viscosity and solidifying substance cargo to avoid the mandatory prewash required as per MARPOL Annex II after discharging the cargo at the port and prior to leaving the sea for tank cleaning before loading the next cargo. Ref. [7].[8].[9]. The persistent floater cargo remains in the tank after discharge as clingage. All chemical tankers perform cargo tank cleaning and simultaneously pump out wash water after complying with the MARPOL Annex II discharge criteria mentioned in Regulation 13: Control of discharges of residues of Noxious Liquid Substances.

After the ships discharge persistent floater cargo residues at sea, especially in winter, these NLS residues solidify and float on the water. Once washed ashore owing to rough weather, they contaminate beaches close to cities and villages, and cleaning up this cargo residue mixed with water is extremely expensive. This contravenes the spirit of the MARPOL provisions for the protection of the marine environment. Although the MARPOL Annex II regulations limit the quantities discharged into the sea, they are insufficient to prevent the discharge of such NLS into the sea. Discharge of solidifying and high-viscosity NLS residues from chemical tankers is a form of waste disposal. Ref. [12]. For Ship Managers, Owners, and Charterer this reduces the disposal costs in Terminals & ports; however, it imposes higher costs on local, State, and Central governments who must pay for cleaning up their coastlines, landforms connected to shores and beaches. Clean-up and disposal of persistent floaters is costly when they contaminate sand, beaches, and other landforms along the coastline.

4. Hazards of persistent floater cargoes

a) Fire hazard: Ref. [1]. [2]. Persistent floater cargoes present a fire hazard that is identifiable using material safety data sheet information, such as flash point, boiling point, and auto-ignition point.

b) Health hazard: Ref. [1]. [2]. Persistent floater cargoes present multiple health hazards such as corrosive and poisonous effects, toxic vapours, asphyxiation, long-term damage to the eyes or nervous system, and long-term carcinogenic effects.

c) Air pollution: Ref. [2]. Persistent floater cargoes cause air pollution after their release into the atmosphere and may be categorised by the emergency exposure limit (EEL) of the substance.

d) Ref. [1]. [2]. The extent of marine pollution is dependent on several factors, including bioaccumulation and risk to aquatic life and human health. In addition, release into the marine environment may cause damage to living resources, hazards to human health, and consequent reduction in amenities.

e) Ref. [3]. Persistent floaters can interact with marine fauna once at sea or on the shoreline, with most relevant studies reporting ingestion by seabirds. However, because of the lack of identification of ingested chemical material in most of these studies, we don't have realistic figures about exposure levels to marine life.

f) Loss of revenue to the tourism industry because of dirty beaches and coasts (Picture 2). (Dahlmann et al., 1994)

g) Persistent floater cargo tank Manual cleaning required Enclosed space entry if we intent to remove residues manually from the cargo tank. These cargoes emit Carbon Monoxide toxic gas during Manual cleaning.

Picture 2 Palm oil residues on beach Ref. [2].

Picture source: (ChemServe GmbH, 2021)

5. Current regulations at Indian ports for NLS residue discharge as per MARPOL Annex II

a) Ref. [8]. "A tank from which a substance in Category X has been unloaded, shall be prewashed before the ship leaves the port of unloading. The resulting residues were discharged to a reception facility until the concentration of the substance in the effluent to the facility, as indicated by analyses of samples of the effluent taken by the surveyor, was at or below 0.1% by weight. When the required concentration level has been achieved, the remaining tank washings will continue to be discharged to the reception facility until the tank is empty."

b) Ref. [8]. "If the unloading of a substance of Category Y or Z is not carried out in accordance with the manual, a prewash shall be carried out before the ship leaves the port of unloading, unless alternative measures are taken to the satisfaction of the surveyor referred to in regulation 16.1 of this Annex to remove the cargo residues from the ship to quantities specified in this Annex. The resulting tank washings of the prewash shall be discharged to a reception facility at the port of unloading or another port with a suitable reception facility if it has been confirmed in writing that a reception facility at that port is available and is adequate for such a purpose".

c) "For high-viscosity or solidifying substances in Category Y, the following shall apply:

i. A prewash procedure as specified in Appendix 6 shall be applied.

ii. The residue/water mixture generated during the prewash shall be discharged to a reception facility until the tank is empty; and

iii. Ref. [8]. Any water subsequently introduced into the tank may be discharged into the sea in accordance with the discharge standards in Regulation 13.2."

6. Ref. [9]. Amendments to MARPOL Annex II (Resolution MEPC.315(74), enforced on 1 January 2021) are not applicable to Indian ports.

"For persistent floater substances assigned to Category Y with a viscosity equal to or greater than 50 mPa·s at 20°C and/or with a melting

point equal to or greater than 0°C, as identified by Point 16.2.7 in Column O of Chapter 17 of the IBC Code, the following applies in the areas in Paragraph 9:

a) A prewash procedure as specified in appendix 6 to MARPOL Annex II shall be applied.

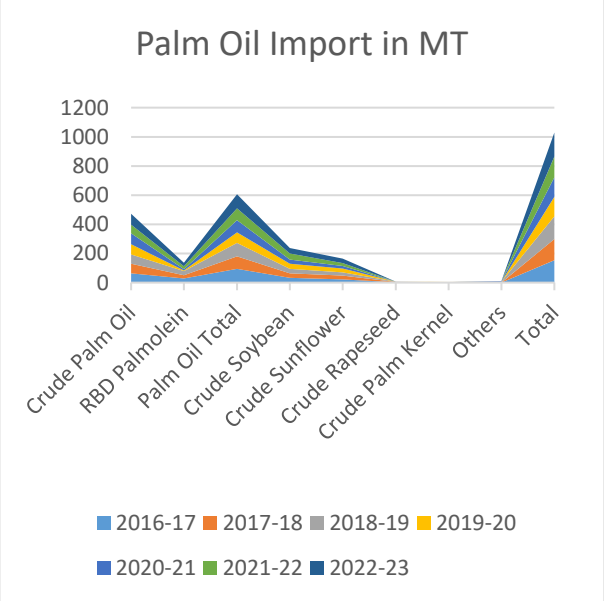
b) The residue/water mixture generated during the prewash was discharged to a reception facility at the port of unloading, until the tank was empty.

c) Ref. [9] Any water subsequently introduced into the tank may be discharged into the sea in accordance with the discharge standards in Regulation 13.2."

7. List of persistent floater cargo/chemicals

Ref. [7]. Persistent floaters comprise all types of Oil of Palm, Vegetable, Soybean, Sunflower, Cashew nut, fish, tallow, olive, mango kernel, corn, cotton seed, cocoa butter, coconut, tung, used vegetable, and rice bran oils as well as fatty acid, tallow fatty acid, shea butter, and paraffin wax. Persistent floater cargo can be identified using the list in IBC Chapter 16.2.7, as mentioned in Column O of Chapter 17 of the IBC Code.

8. Palm Oil Import in India Ref. [4].



Source: Department of Food and Public Distribution, GOI Website

9. Risks involved in complying with MARPOL 73/78 amendments — Resolution MEPC.315(74) (mandatory prewash for all chemical tankers discharging persistent floater cargo at Indian ports).

a) Generation of excess wash water mixed with residues during the prewash after discharging persistent floater cargo at Indian ports.

b) Consider an example of removing old candle wax from a candle holder for cleaning at regular intervals. Extremely hot water is required to clean the holder, as warm water is ineffective in removing wax. Similarly, in the case of a cargo tank with persistent floater cargo (e.g. paraffin wax) stuck to its walls as a clingage after its discharge to the terminal at an Indian port, effective removal of the persistent floater cargo would require hot water and substantial time to treat the entire tank surface, generating a large amount of wash water mixed with cargo residues.

c) A longer stay for vessels after completion of unloading at the port for prewashing leads to delayed port cargo turnover, other vessel berthing, and vessel next assignment or voyage.

d) Non-availability of port reception facilities for collecting wash water mixed with persistent floater cargo.

e) Non-availability of disposal facilities at ports or in nearby areas for environmentally sound treatment and disposal of wash water and cargo residues.

f) Non-availability of standard operating procedures for ports to perform prewash operations.

g) Non-availability of experienced, knowledgeable, and trained port and ship staff to perform prewash operations.

h) Non-availability of chemical cargo-resistant transfer equipment and machinery within the port or terminal.

i) Extra amount payable by the ship owner/charterer to the port authority for transfer and disposal of wash water and cargo residues.

j) Non-availability of information on outcomes/reactions of persistent floater cargo when mixed with water during prewash.

k) Non-availability of personnel protective equipment to be worn by port/terminal personnel during prewash operations.

l) Non-availability of contingency planning in case of any emergency during prewash and wash water transfer operations at the port.

10. Case studies on marine pollution by persistent floater cargo.

The following reported events and studies exemplify the various problems caused by persistent floater cargo.

a) Ref. [3]. In the Netherlands, a "serious incident caused the deaths of several Dutch seabirds in February and March 1990 and involved relatively high amounts of dodecyl phenol (isomeric dodecyl phenols) in lubricating oil. A total of 22 special cases of pollution by non-toxic chemicals (legal discharges)" during 1990–1992 were found where palm oil and paraffin wax were the cargo.

b) Ref. [20]. In Italy, a pollution incident was reported "in the Ligurian Sea (Northern Thyrrenian), and an aerial survey initially identified several patches of a floating substance along a five-mile front across the northern side of Elba Island between 16 June and 19, 2017. During this period, more than 350 kg of yellow wax lumps was recovered using a special boat. Almost double the quantity was later recovered along a 200 km coastal stretch in Tuscany. During the same period, yellow material was reported from neighbouring regions, such as Liguria and Corsica, demonstrating the rapid dispersion of this substance through wind drift and surface currents. Cleaning was largely paid for and organised by the local authorities and private beach owners, as the event occurred during the high tourist season."

c) Ref. [20]. In Italy, “Beaching event occurred in 2012 when two metric tons of white paraffinic wax was scooped using draining pumps. Investigations by competent authorities ascertained that the material was discharged from a ship during tank-cleaning operations. Local authorities subsequently reported that the clean-up intervention cost approximately 20 000 euros to the involved municipalities, highlighting the considerable implied economic costs from these events to local businesses and taxpayers, which are not indemnified by the polluters and inappropriately burden the local communities.”

d) Ref. [17]. In Hawaii, “Over 200 000 gallons of thick molasses leaked in the Honolulu harbour, leaving behind a drifting brown plume and numerous dead fish. The spill is unlike other chemical leaks that response crews have handled to date, and according to researchers, mopping up the mess will require a combination of ocean currents, bacterial digestion, and perhaps even a little deep-sea vacuuming. Molasses in seawater can form a soup that clogs the gills of sea life and may otherwise smother plants and animals living on the seafloor”.

e) Ref. [19]. In Portugal along the Silver coastline, “On the morning of Wednesday, 22 July 2015, in Baleal near Peniche, a large amount of congealed palm oil washed up on the beach. The palm oil was sourced from ships flushing their tanks, and the oil was congealed after mixing with seawater. The oil, which appears as large lumps of wax in this solidified form, is extremely toxic to dogs, causing vomiting and diarrhoea, plus possible pancreatitis, kidney and liver failure, and death.”

11. Probable opportunities if MARPOL 73/78 amendments - Resolution MEPC.315(74) are implemented in Arabian sea and Bay of Bengal.

The enforcement of Resolution MEPC.315(74) will provide an opportunity to:

a) Constantly maintain a clean Indian coastline.

b) Avoid any unexpected impact of marine pollution on the tourism Industry.

c) Create general awareness among all stakeholders regarding the risks and hazards associated with the import and export of persistent floater cargo.

d) Preservation of the marine ecosystem and biodiversity of the Indian coastlines.

e) Draft a law for the import of persistent floater cargo, where the importer will be completely responsible for the environmentally friendly disposal of persistent floater cargo residues generated during prewash operations at Indian ports.

f) Warn and limit international ships in the vicinity of the Indian coastline not headed toward any Indian port and perform persistent floater cargo tank cleaning.

g) Exchange information and awareness among neighbouring countries such as Sri Lanka, Pakistan, Maldives, Bangladesh, Myanmar, Thailand, Indonesia, and Malaysia to act on persistent floater cargo hazards and risks to marine life. Owing to wind and weather, the probability of marine pollution from neighbouring countries affecting the Indian coastline is high.

h) Ref. [16]. Support the initiatives of the 2021–2030 United Nations Decade of Ocean Science for sustainable development and work on the 10 challenges mentioned in this initiative.

i) Ref. [11]. The IMO sustainable development goals include clear water and sanitisation (No. 6), industry, innovation, and infrastructure (No. 9), sustainable cities and communities (No. 11), responsible production and consumption (No. 12), and life below water (No. 14).

j) Ref. [14]. Assist the Government of India in fulfilling the Maritime Vision of India 2030 in context of analysing current and future challenges to define initiatives and benchmarks for understanding the current standing and adopt best-in-class practices and explore ideas to achieve “Waste to Wealth”.

12. Suggestions for authorities in India

a) Ref. [20]. [5]. Persistent floater chemical/oil cargo pollution is a global problem and is not limited to only North European waters or Baltic Sea. If a Particular Sea, Landlock area or region approach is to be adopted, the marine areas where the new prewash requirements as per MEPC.315(74) would apply should be extended to include other Marine sensitive areas in India, such as the major marine national parks and sanctuaries of India, ecologically sensitive areas, marine eco-sensitive zones, and critical vulnerable coastal areas.

b) Ref. [6]. Notification under Sections 3(1) and 3{2)(v) of the Environment (Protection) Act, 1986 and Rule 5(3)(d) of the Environment (protection) Rules, 1986, should be amended to declare coastal stretches as coastal regulation zones (CRZ) and regulate activities in the CRZ to include prohibition of discharge of persistent floater cargo at least up to 50 nautical miles away from the outer limit of the CRZ.

c) The inland waterway transportation of persistent floater cargo should be controlled and monitored by the government’s centralised agencies.

d) A list of persistent floater cargo trade names in India, their synonyms, and proper technical names, as per IBC Code CH 17, should be prepared and circulated among all concerned parties for awareness.

e) The government should devise a policy for environmentally sound management of persistent floater cargo residues and waste.

f) In several cases, the amount of persistent floater cargo residues that remain on-board after stripping the cargo tanks frequently exceeds the limits stipulated by Annex II; hence, government officials should be physically present on the ship during the prewash and the cargo record book should be endorsed for physical attendance and compliance verification of the entire prewash operation.

g) Imports of persistent floater cargo should be allowed only if the

port has reception facilities for persistent floater cargo residues, as per MARPOL Annex II.

h) Ref. [9]. [20]. Solidifying substances and persistent floaters present the same risks and hazard characteristics as prohibited waste such as plastic. A few risks can include potential ingestion by marine organisms, aesthetically detrimental long residence times, progressive fragmentation, etc., thereby allowing favourable regulations or guidelines that allow dumping of persistent floater cargo residues is not environmentally sound when dumping of plastic or domestic waste (solid waste) is already prohibited. Hence, Resolution MEPC.315(74) amendments should be enforced for all Indian Ports.

i) Ref. [8].[13].[15]. [20]. The current definition of marine litter should be amended to include solidifying and persistent floaters within the framework of the Marine Litter Policy of the Government of India, so that the objectives set by Maritime vision of India 2030 and IMO SDG, such as the monitoring and reduction of Marine Pollution by the CPCB or the Ministry of Environment/Shipping, can consider these cargoes similar to those in pollution Category X as defined in MARPOL Annex II.

j) Importers of persistent floater cargo should be legally responsible for the environmentally sound management of the resultant residues and waste.

k) The impacts of persistent floater cargo waste on the Indian coast in different contexts should be assessed regarding tourism, biodiversity, marine pollution, and so on.

l) Ref. [15]. Civic societies/bodies – local universities, institutes, and NGOs – should adopt beaches for their regular monitoring.

m) Ref. [15]. The deployment of low-cost traps in rivers, creeks, and canals, as well as cleaning and monitoring activities should be performed at regular intervals.

n) Awareness training should be imparted on the impact of persistent floater cargo on marine and human life by including all concerned parties, such as port officials, seafarers, government officials, fishermen, NGOs, importers, agents, and private shore reception facilities.

o) Ref. [21]. “Many studies point out that labels for sustainability and incentive programs can stimulate the market demand for a more sustainable sector. There are several active initiatives, such as the Clean Shipping Index, Green Award, and the Environmental Ship Index. These initiatives make it possible for ship owners and shippers to become frontrunners and distinguish themselves in the field of sustainability.”

p) Ref. [21]. To minimise a negative economic impact due to cleaning beaches and potential loss of income when tourist numbers are decreasing due to dirty beaches, the Separate Monetary Fund needs to be created, and contribution needs to be collected by the Indian government from the Persistent Floater Cargo Importer to deal with the above-mentioned issues when the cost of clean-up is very high.

q) Persistent floater-specific standard operating procedures need to be made by the Indian Coast Guard and all states with coastline to clean up operations considering the Material Data Safety Sheet of the Majority of Persistent Float Cargo imported in India, for example, Paraffin Wax and Palm Oils.

13. Conclusions

Persistent floater cargo residues discharged into the sea in the Indian Economic Exclusive Zone (EEZ) by oil/chemical tankers, as per MARPOL Annex II discharge criteria, can reach the Indian coast owing to wind, sea waves, and rough weather. After reaching the Indian coastline, they can create major health, social, economic, environmental, and marine life problems that need to be prioritised by Indian central, state, and local governments. In fact, it is an additional financial burden on Indian citizens, for whom they are not responsible. As European countries have already experienced these problems, they have requested that the IMO revise the MARPOL Annex II discharge criteria to make prewashing mandatory after the unloading of persistent floater cargo at European ports. Considering India’s coastline of 7517 km and the rising trend of persistent floater cargo imports, the Indian government should draft strong and strict regulations for all vessels performing tank cleaning in the Indian EEZ. Resolution MEPC.315(74) is applicable to all Indian ports.

16. References

[1] Chemical Tanker solutions. (n.d.). Hazards of carrying noxious liquid chemicals at sea and safety practice. Retrieved September 3, 2022, from http://www.chemicaltankerguide.com/safety.html

[2] ChemServe GmbH. (2021). WILL IBC 2021 PERSISTENT FLOATER RULE AVOID CONTAMINATED BEACHES? https://www.chemserve-marine.com/resources/new-persistent-floater-rule/

[3] Dahlmann, G., Timm, D., Averbeck, C., Camphuysen, C., Skov, H., & Durinck, J. (1994). Oiled Seabirds-Comparative investigations on oiled seabirds and oiled beaches in the Netherlands, Denmark and Germany (1990-1993). Marine Pollution Bulletin, 28(5), 305–310. https://doi.org/10.1016/0025-326X(94)90155-4

[4] DFPD GOI. (2021). Ministry of Consumer Affairs, Food and Public Distribution, Edible oil, 4.3 Quantity of Import. Website. https://dfpd.gov.in/imp.htm

[5] ENVIS - MoEFCC. (2015). Coastal Zone Management and Coastal Shelter belt. ISSN:2393-8978, Vol. 13 (3 & 4). http://www.iomenvis.in/pdfdocuments/23.06.15.pdf

[6] Declaring coastal stretches as Coastal Regulation Zone, Pub. L. No. [9] Notification under section 3(1) and section 3{2)(v) of the environment (protection) act, 1986 and rule 5(3)(d) of environment (protection) rules, 1986, 10 (1991). https://environmentclearance.nic.in/writereaddata/SCZMADocument/CRZ%20Notification,%201991.pdf

[7] IMO, M. (2019). List of persistent floating products. https://www.irclass.org/media/5085/attachment-1-list-of-

persistent-floating-products.pdf

[8] IMO MARPOL Annnex II. (2017). MARPOL Consolidated Edition, 2017 Annex II (IE520E) (2017th ed.). IMO. https://shop.witherbys.com/marpol-consolidated-edition-2017-ie520e/

[9] Resolution MEPC.315(74), 7 (2019). https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.315(74).pdf

[10] Annex 7 Resolution MEPC.318(74) Amendments to IBC Code, 133 (2019). https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.318(74).pdf

[11] IMO, S. (n.d.). IMO and the Sustainable Development Goals. Retrieved August 27, 2022, from https://www.imo.org/en/MediaCentre/HotTopics/Pages/SustainableDevelopmentGoals.aspx

[12] Members of the Environmental Group of Experts. (2014). No Pollution of the North and Baltic Seas with Paraffin Independent Environmental Group of Experts "Consequences of Pollution Incidents. https://www.bfr.bund.de/cm/349/pollution-of-the-north-and-baltic-seas-with-paraffin.pdf

[13] Ministry of earth scinence. (2022). Status of marine litter in the country, Ministry of Earth Science. PIB Delhi. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1797248

[14] Ministry of Ports Shipping and Waterways. (2021). MARITIME INDIA VISION 2030. Sagarmala. https://sagarmala.gov.in/sites/default/files/MIV 2030 Report.pdf

[15] Mishra, P., & Steiner, A. (2020). National Policy Workshop Webinar Series on Countermeasures for Riverine and Marine Plastic Litter in India. https://www.npcindia.gov.in/NPC/Uploads/file upload/3_Dr Pravakar Mishra _MoES_NCCR_Mishra_p_12May2028487.pdf

[16] Nations, U. (2022). 2021–2030, United Nations decade of ocean science for sustainable development, 10 Ocean Decade Challenges for collective impact. https://www.oceandecade.org/challenges/

[17] Nidhi, S. (2013). Lingering Hawaii molasses spill will create sticky situation for marine life. NEWS, Science News. https://www.nbcnews.com/sciencemain/lingering-hawaii-molasses-spill-will-create-sticky-situation-marine-life-8c11140163

[18] OEC. (n.d.). An observatory of economic complexity, Paraffin wax containing India. Retrieved August 27, 2022, from https://oec.world/en/profile/bilateral-product/paraffin-wax-containing-075-oil/reporter/ind#:~:text=Imports

[19] Silver Coast Dog walking. (2015). Palm Oil warning for dog walkers along the Silver Coastline in Portugal. Word Press. https://silvercoastdogwalking.wordpress.com/2015/07/22/palm-oil-warning-for-dog-walkers-along-the-silver-coastline-in-portugal/

[20] Suaria, G., Aliani, S., Merlino, S., & Abbate, M. (2018). The occurrence of paraffin and other petroleum waxes in the marine environment: A review of the current legislative framework and shipping operational practices. Frontiers in Marine Science. https://doi.org/10.3389/fmars.2018.00094

[21] Wenneker, B. (2018). Paraffin on the Dutch Coast. https://vdocument.in/rapport-paraffin-on-the-dutch-coast-noordzeeloket-experiencing-paraffin-pollution.html?page=1