BLUE WATERS

Newsletter

On Marine Environment Protection

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A Publication of the Indian Coast Guard

From the Director General's Desk

Publication of the Blue Waters is a continuing effort on part of the Indian Coast Guard to keep our community apprised of developments on the national front and the international arena. It also serves to inform the stakeholders of our collective efforts to strengthen capacity and capability for marine oil spill response.

The Coast Guard's oil spill response capability has been strengthened by the induction of three indigenously built Pollution Control Vessels (PCV). The utility of PCV has certainly enhanced the oil spill response considerably.

Validating oil spill response preparedness is an important part of our calendar of activities. On 20-21 Dec 16, NATPOLREX – VI was conducted with participation of 26 stakeholders and resource agencies and international participants from Australia, Bangladesh & Sri Lanka as observers.

Marine Environment Protection is a wholesome concept for the Indian Coast Guard. I am happy to note that nearly twenty thousand volunteers across all the coastal states of India participated in Coastal Cleanup Day organized by us on 17 Sep 2016 under the aegis of South Asia Co-operative Environment Programme. In consonance with ICC, Indian Coast Guard also organized 'Swachh Sagar Abhiyan' on 02 Oct 2016 in an endeavour of preventing marine pollution in coastal areas.

I am confident that the Indian Coast Guard, being the Central Coordinating Agency for combating Marine pollution in Maritime Zones of India, with consolidated efforts of marine Stakeholders and users of Marine environment, will improve the marine environment especially close to coast. This will not only facilitate better marine environment on our beaches but also support enhanced recreational facilities. Further, enhancing the pollution response preparedness at all levels through information sharing, consolidation of assets, training and simulated drills will continue to be the focal point in achieving oil free Marine environment. I am also confident that all Government agencies and other stakeholders will continue to work together as a team to achieve the common goal of making our seas pollution free.

I wish all the readers and stakeholders a 'Happy Reading'

Vayam Rakshamah. Jai Hind.

(Rajendra Singh)
Director General
Indian Coast Guard

15 Feb 17
New Delhi

Editorial

Nature has gifted our Country with some of the rarest Marine Species and Corals. Industrial development and increased dwelling along the Coast has resulted in exponential increase in marine pollution, which in turn has created adverse affect on traditional fishing and recreational activities along the Coast.

Need exists for spreading awareness for preservation and protection of marine environment from all forms of pollution, so that the natural beauty of the vibrant coastline can be restored to its original form, in the years to come.This goal can be achieved by connecting the masses with this drive and a self discipline inculcated, so that the Marine environment is treated as part of every individual life.

Further, the Central/ State regulators and monitoring authority in Maritime domain are the backbone in this drive, as they have to ensure that the existing laws are implemented in letter and spirit. The citizens of this Country have shown their determination in the past, to achieve the national goals, I am sure this time too **"we will do it"** for the Marine Environment.

The issue highlights some of the critical threats posed by tar ball and microplastics pollution. Other articles emphasize on the conservation of coral reefs, impact of marine debris-waste management plan, cleaner coast through 'Swachh Abhiyan' and produced water management from oil exploration activities. The grounding incident of MV Infinity has been considered for India Watch.

A warm thanks to all contributors to this edition of "Blue Waters" and valuable contributions in future from stakeholders towards this newsletter on marine environment protection is solicited.

Happy reading!

(Bhim Singh Kothari)
Commandant
Director (FE)

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ARTICLES

Tar ball pollution: research effort and management strategy

*Suneel. V, B. G. Naik and P. Vethamony**

The consumption of petroleum and its derivatives as a source of energy has been growing all over the world with time. Accidental spillages during transportation of crude oil, release of ballast water from ships and operational discharges from offshore drilling, pipeline leakages and spills due to tanker accidents are some of the major source of oil for the formation of tar balls (TB). The natural seepage from the ocean floor also cannot be ignored as a source. Finally, a major portion of the oil released in the marine environment end up as TB after various physical, chemical and biological processes known as 'weathering'. Tar balls are oil fragments that have a solid or semi-solid consistency whose formation mechanisms are less known. The oil residues that are roughly spherical in shape and >10 cm in diameter are termed as tar balls (TBs), <10 cm in diameter are called tar patties (Wang and Roberts, 2013) and submerged in the water column as tar mats. The emulsified oil interacts with suspended solids in the coastal waters, sinks to the sandy bottom to form immobile submerged oil mats (SOMs) and mobile surface residual balls (SRBs), called tar balls (Hayworth and Clement, 2011). TBs are categorized into two types based on the buoyancy: pelagic for floating or shallow submerged tar residues and benthic for sunken TB (Bernabeu et al., 2013).

Deposition of tar balls along the west coast of India, particularly Goa and Gujarat coasts, is a common phenomenon; it occurs only during pre-monsoon to southwest monsoon season every year, and it is a major concern to the stake-holders. Typical TB deposition on the Goa beaches is presented in Fig 1.

Fingerprint of tar ball for source identification

Oil pollution is often classed as point source or

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Fig 1. Deposition of tar balls on Goa coast (a) is on 02/09/2010 at Candolim, (b) is on 25/05/2011 at Mandrem, (c) is on 26/05/2013 at Mobor, (d) is on 08/06/2014 at Candolim, (e) is on 05/06/2015 at Benaulim, (f) is on 23/03/2016 at Majorda beaches.

nonpoint source pollution. When there is a single, identifiable and localized source of the pollution, where the source is known (Eg. collision/accident of tankers), it is termed as 'Point source pollution'. Nonpoint source pollution is when the pollution comes from undefined and diffused sources (Eg. tar ball deposition).

Fingerprint of tar balls /oil spill has been widely used throughout the world, but less explored in India. After knowing its importance, with the funding of Department of Science & Technology, Govt. of India, the CSIR-National Institute of Oceanography has set-up the Lab to identify the source of oil spill / tar balls. We are extensively using this facility to analyse the source of tar balls depositing on the west coast of India. Biomarkers play a key role in environmental forensics such as oil spill source identification, because they are derived from the dead bodies of formerly living organisms present in the source rock of oil produced and have the same structure of parent organic molecules. The Diagnostic Ratios (DRs) of pentacyclic triterpanes, n-alkanes and Polycyclic Aromatic Hydrocarbons (PAHs) are widely used in oil fingerprinting studies. The homohopane Index C_{29}/C_{30} and ΣC_{31}-C_{35}/C_{30} is a more reliable source identifier for oil spill fingerprinting. Other widely used DRs are tricyclic terpanes C_{23}/C_{24}, pentacyclic triterpanes $C_{29}\alpha\beta/C_{30}\alpha\beta$ hopane, Oleanane/$C_{30}\alpha\beta$ hopane and Ts/Tm. The combination of biomarkers and isotope ratios provides very accurate results. The cross plot between the DRs C_{29}/C_{30} and ΣC_{31}-C_{35}/C_{35} clearly indicate that MECO, SEACO and MSC (red, pink and green circles in Fig. 2) do not correspond with the TBs. Nevertheless, BHM and BHH crude oils meticulously match with the TBs (black circle in Fig 2). The ranges of CRN and NIK are also very close to the TBs (orange circle in Fig 2). The Homohopane index cross plot conspicuously reveals that MECO, SEACO and MSC crudes are not the sources for the formation of these TBs. The compound specific isotope analysis (CSIA) is a powerful tool to confirm the source. CSIA is widely used in marine environmental studies mainly to track the sources because the isotope ratios cannot alter by weathering effects.

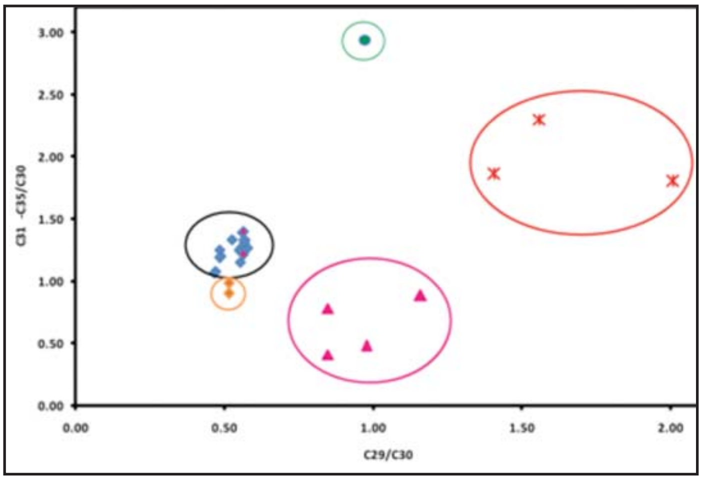

Fig 2. Cross plot of homohopane index. The red circle represents Middle East Crude Oil, pink-South East Asian Crude Oil, orange-Cairn and Niko oil, green-MSC Chitra crude oil; black circle represents tar balls of Gujarat coast (blue color) and Bombay High Hut (pink color top) and Bombay High Mut (pink color down) (courtesy: Suneel et al., 2014).

Mathematical modeling to study the tar ball trajectories

A large number of oil spill models are in use in the world today. But, no suitable model is exclusively developed for tar ball trajectory prediction. However, an attempt has been made by Suneel et al (2013a, 2014 and 2016) to predict the trajectories of tar ball transport from sea to coast using a hydrodynamic model coupled with the particle tracking model, and coast to sea using backtracking model. The results show that winds, currents and tides are the major forces that transport the tar balls to the coast in which wind is the major driver. This is the reason for the transport of tar balls to the coast only during pre- monsoon and southwest monsoon seasons, when the winds and wind-induced currents are conducive. The backtrack simulation trajectories are shown in Fig 3.

Ecological and socio-economic losses

Crude oil contains a range of hydrocarbons in which PAHs are of great concern due to their pervasive nature. Therefore, tar balls that form from crude oil also contain PAHs. They are ubiquitous in the environment and are included in the list of persistent organic pollutants of United Nations Environment Program (Anonymous, 1999). PAHs, found in crude oil, are very difficult to clean up, and last for years in the sediment and marine environment. The International Agency for Research on Cancer (IARC) has classified PAHs as possible and probable carcinogen to human (Anonymous, 2010). PAHs tend to accumulate in marine organisms because of their lipophilic and hydrophobic nature (Mashroofeh et al., 2015). The Deepwater Horizon spill had far-reaching effects on marine biodiversity, affecting coral reefs and dolphins, among many other species. As accounting of all the oil lost in the water or sediment is very complex, the extent of impacts can remain unknown for many more years.

The beautiful beaches get contaminated when tar balls reach the coast, and this leads to nuisance to the beach-lovers and stake-holders. When it is stuck to the feet, it becomes difficult to clean due to its sticky and greasy nature and creates an unpleasant picture of pollution. The presence of tar balls also impacts the fisheries, adding more economic loss. Animals and plants can die due to suffocation by ingesting the fumes released from the tar balls and also due to toxicity of tar balls - leading to disturbance in food chain. In addition, the cleaning drives of tar balls can disturb many marine niches. The toxic content from less weathered tar balls can be lethal to marine organisms like bivalves and shrimps which serve as food for bottom feeding fishes, and thus indirectly affects fisheries as well.

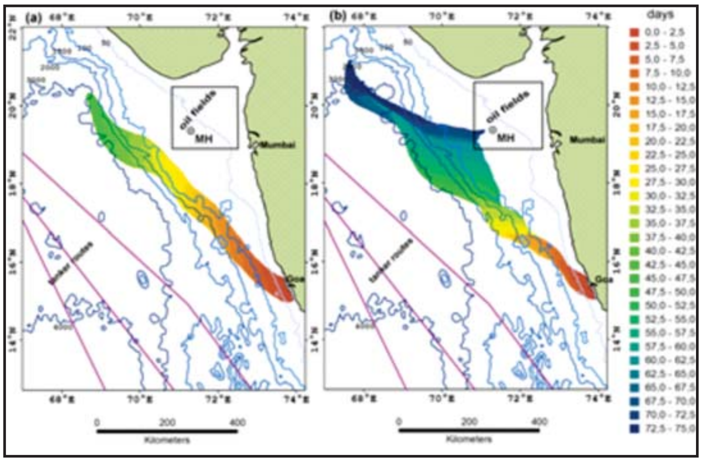

Fig 3. Trajectories of tar balls using backtracking simulation for May 2013 and 2014 (Courtesy: Suneel et al. 2016).

The high molecular weight compounds of tar balls are carcinogenic and may affect human beings and marine organisms on long term exposure (Abha et al., 2012). Their surface serves as a substrate for developing bacteria, unicellular algae and other microorganisms. (Tao et al. 2011) found higher total bacterial count and higher number of human pathogen, *Vibrio vulnificus* on tar balls. The pathogen was ten times more on tar balls than the sea water and sand.

Management

• Source identification

Balanced information on sources and harmful effects of marine pollution need to become part of general public awareness, and our ongoing research should focus on finding out solution for such issues. Though oil is organic and formed from dead plants and animals buried long years ago in the earth, its complete recycling in marine ecosystem is a complex process. It needs well planed strategic management to mitigate tar ball pollution. Major processes involved in mitigation are location identification, source identification and dilapidation. At operational level, regulations and government participation are needed. However, they do not significantly target the problem. CSIR-National Institute of Oceanography, Goa has established a 'Finger-printing Lab', which is fully equipped with instruments and manpower to handle fingerprinting of tar balls and oil spills; also, has forward and backward tracking models and particle-tracking models to predict oil spill and tar ball trajectories.

Non-point oil spill is quite difficult to identify, and we notice it only when it reaches the shoreline either as spill or as tar balls. However, remote sensing (Synthetic Aperture Radar) offers the advantage of being able to observe events in remote and often in-accessible areas. It can provide information on the rate and direction of oil movement through multi-temporal imaging, input to drift prediction modeling and facilitate in targeting clean-up and control efforts.

• Dilapidation

Tar Balls are persistent in the marine environment; difficult to break down. At present, the technology available for cleaning the beach is through manual only. If the impact is severe, the top layer of sand containing the tar balls may be removed and replaced with clean sand. Normally there is no health concern associated with tar balls. As with some heavy oils, prolonged skin contact may cause an allergic reaction. Such a reaction is usually manifested as a skin rash (dermatitis) which is local in most cases. In cases where fresh water or a removing agent is not available the bulk of the tar may be removed by rubbing the area with beach sand. The products to remove tars from foot called "Taraway" had been sold in some places (Warnock et al., 2015).

• Biodegradation

Several microorganisms from the sea water are capable of partially or completely degrading the oil to water soluble compounds and in the end into carbon dioxide and water. Many marine microorganisms like bacteria, fungi and yeast feed on the components that make up the oil. Though they are present in low numbers, their population size seems to increase in oil spilled areas. Twenty five marine bacterial genera are supposed to be active in oil degradation (Kimes et al., 2014). The biodegradations would be cheapest, convenient and environmental friendly technology. But, effect of this technique is practically to be proved in actual oil spill cases.

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Microplastic pollution: a serious threat to the marine ecosystem

*Dr. S. Veerasingam, Mahua Saha, Dr. V. Suneel and Dr. P. Vethamony**

Introduction

Fig 4. Classification of microplastics (Source: Veerasingam et al,., 2016a) Primary microplastics

Plastic pollution will be one of the most challenging ecological threats for the next generation. A recent research study estimated that 4.8–12.7 million metric tons (MMT) of plastic waste enter the world ocean (Jambeck et al., 2015). Of the top 20 countries releasing waste into the oceans, 10 have shores on the Indian Ocean, the third largest ocean in the world. Until now, all studies have focused on the environmental and the economic impact of macro-sized plastics. These plastics can be visualized, collected and studied. We do not have much information on the impact of microplastics in the marine environment.

Microplastics are tiny plastic fragments in the environment with size of less than 5 mm in diameter. The following two types of microplastics are currently existing: (i) primary microplastics which are made to carry out certain functions (e.g. toothpaste, skin cleansers and cosmetics) and microplastic pellets used

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Fig 5. Classification of microplastics (Source: Veerasingam et al., 2016a) Secondary microplastics

for the manufacturing plastic material and (ii) secondary microplastics, which are generated when macro-sized plastics in the marine environment are physically (wind, wave and current), chemically (UV light radiation) and biologically (microbial activity) degraded and fragmented into micro-sized (<5 mm) particles (Fig 4 & 5).

Sources and controlling factors

The sources of microplastics in marine systems are both sea and land based sources. Sea based sources could be from accidental and/or unintentional spillages from ships during their voyages or handling of raw materials in harbours.

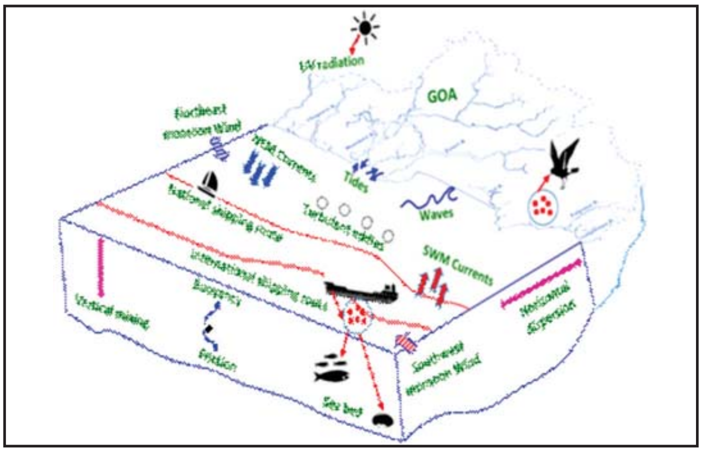

Fig 6. Sources and factors influencing the transportation and distribution of microplastics in the marine environment (Source: Veerasingam et al., 2016b).

Microplastics may also enter into the coastal waters through rivers, streams, storm water drains and sewerage systems following spills at inland processors or during transport (Fig 6). (Jambeck et al. 2015) estimated that 80% of plastics in the sea originates from land based sources and is transported by rivers to the oceans. The catastrophic events including tsunami and flood can also transport plastics into the marine environment (Veerasingam et al., 2016c). Winds, tides, waves and currents can carry the floating plastic debris over long distances from their original point.

Oceanographic modelling of floating debris has shown accumulation of floating plastics in five ocean gyres, and the distribution of microplastics within the water column appears to be dependent on the composition, density and shape of plastic polymers affecting their buoyancy (Eriksen et al., 2014). Modelling studies in the Indian Ocean shall help to identify and predict regions with ecological communities and fisheries, which are vulnerable to the potential consequences of plastic contamination.

In India, Polyethylene (PE) and Polypropylene (PP) are the most largely used plastic raw materials. As per the report of FICCI (2014), ~ 2.3 MTPA (million tonnes per annum) of PE was produced, while domestic consumption was ~ 3.4 MTPA. Therefore, PE is imported from Saudi Arabia, Qatar, UAE, Korea, USA, Singapore, Thailand, Germany, Spain and Malaysia. In India, the production of PP is 2.5 MTPA, while demand is 2.1 MPTA only. Therefore, the excess PP materials are exported to China, Egypt, UAE, Turkey, Vietnam and Indonesia (FICCI, 2014). These products are imported/exported through sea-routes (Fig 7).Recently, Duhec et al. (2015) found that the Southeast Asia is the main source of the plastic debris and Somalia is another potential primary source of marine debris in the Western Indian Ocean. Therefore, there is a possibility for an increase in the accidental/ unintentional spill of MPPs in the ocean. Recent studies found that the deposition of sea-based microplastics are more during the northeast monsoon along the east coast of India, whereas those plastics are abundant during the southwest monsoon along the west coast of India (Veerasingam et al., 2016 a,b,c).

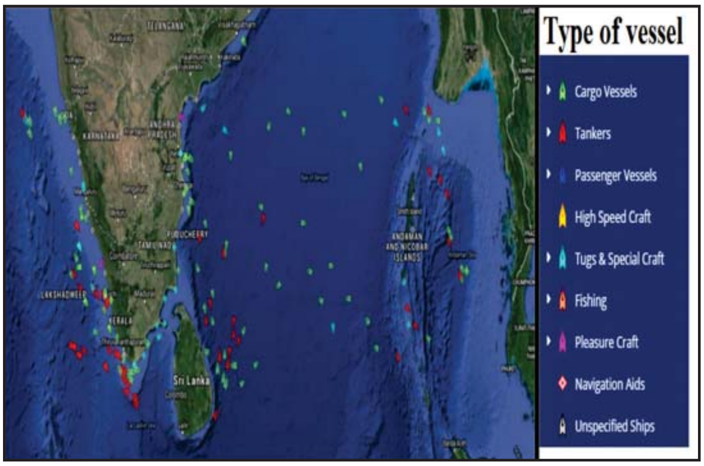

Fig 7. The Automatic Identification System map shows the shipping traffic in the Arabian Sea and Bay of Bengal.

Ecological and chemical risks of microplastics

Microplastic pollution is a global issue, which affects everything from the environment to economy. Microplastics are small enough to be ingested by many marine species. For example, filter feeders ranging from plankton to baleen whales and basking sharks. Sea birds are also very vulnerable to microplastic litter, especially floating plastics, which will be easily confused for prey like fish eggs. In addition, organisms breathing with gills such as fish and crabs as well as other filter feeders such as mussels and barnacles are also likely to be affected by microplastics (Fig 8). Ingestion of microplastics by species in aquacultures or fisheries may potentially pose a risk for human food safety. Sea salt is typically produced by crystallization due to the combined effects of wind and sunlight. A recent research study found that the abundance of microplastics in sea salts is significantly higher than that in the lake salts (Yang et al., 2015).

Microplastic itself a pollutant, since it contain additives and may potentially be an exposure route of harmful chemicals. Microplastics can also act as vectors for transporting persistent organic pollutants (POPs) from the environment to the biota. The harmful substances within the microplastics include antimicrobials, hydrocarbons and flame retardants, which often persistent and may reduce health and biodiversity.

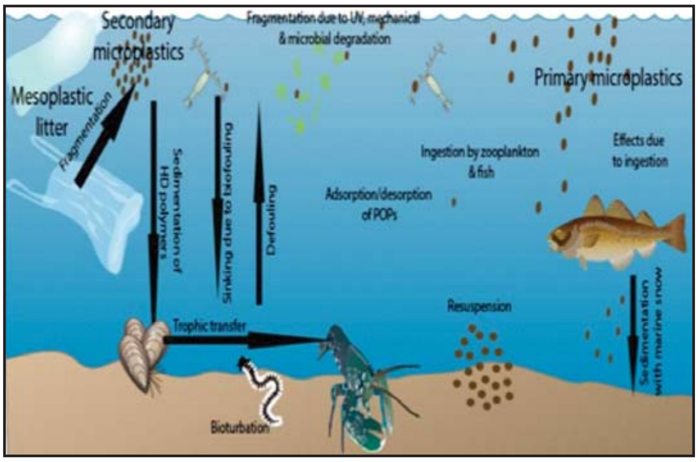

Fig 8. Potential fate and pathways and biological interactions of microplastics (modified from Wright et al., 2013)

Anticipated future trends

Global production of plastics has increased from around 5 million tons per year during 1950s to over 300 million tons today. However, majority of these plastics are used to make single-time use items, which are disposed of within a year of production. The amount projected by 2050 is about 40 billion tons, which is enough to wrap 6 layers of cling film around the planet (Zalasiewicz et al., 2016). Considerable quantity of end-of-life plastics is getting accumulated in landfills and in the natural environment. The quantity of end-of-life plastics in the marine environment is substantial, but only a few reliable estimates of the total amount or, the relative proportions of different types of debris such as microplastics is available at present. Recent studies attempted to assess global plastic distributions (Cozar et al., 2014; Eriksen et al., 2014), and the logical next step could be to estimate total production, current tonnage in use and disposal of accumulated plastics via approved waste management in order to establish a mass balance of the amount of plastics that is missing in the environment (Jambeck et al., 2015).An initial survey suggested abundance in the deep sea than in shallow water habitats (Van Cauwenberghe et al., 2013). Recent evidences show that the deep sea could be a substantial sink for microplastics. However, detailed investigations are required to confirm that deep sea is a sink for microplastics, and understand their long-term fate in the deep sea and the extent of any subsequent deterioration or biodegradation over extended time scales (Thompson, 2015).

Policy development and management

Worldwide, microplastic contamination and accumulation on beaches and oceans have been identified as a serious environmental issue and several research programs have been initiated. Despite the difficult task of avoiding plastic consumption and reducing the pollution, it is time to involve industrial manufacturing, shipping and harbour stakeholders to make a step forward in preventing the microplastics entering into the marine environment from land and/or ocean based sources. Finally, it is suggested that government can play an active role in addressing the issue of plastic waste by introducing legislation to control the sources of plastic debris and the use of plastic additives. In addition, plastic industries can find the possibility of shouldering the responsibility for the end-of-life of their products by introducing plastic recycling or upgrading programmes.

Reduce, reuse and recycle are the current solutions to the overuse of plastics. Solutions to ensure materials are recycled or disposed off properly need to be developed. Even with research, recycling, and new technologies, alternate packaging material should be utilized to reduce the dependence on plastic goods. There should be awareness of the threats posed by microplastics to marine ecosystems and human health to prevent plastic littering.

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Need for Conservation and Management of Indian Coral Reefs in Light of Changing Climate

Dr. T. Shunmugaraj, Dr. T. Usha, Dr. K. Ramu,
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Coral reefs cover only about 0.2% in area of the marine environment but are among the most biologically diverse and economically important ecosystems. They are important breeding, spawning, nesting and feeding areas for many economically important fishes and other marine organisms.

Corals and coral reefs all over the globe are in an ecological crisis due to a multitude of anthropogenic activities such as coastal development, agricultural runoff, tourism, pollutants, sedimentation, overfishing

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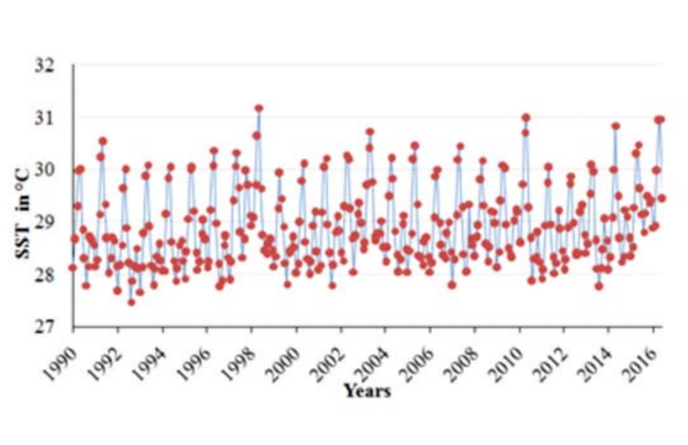
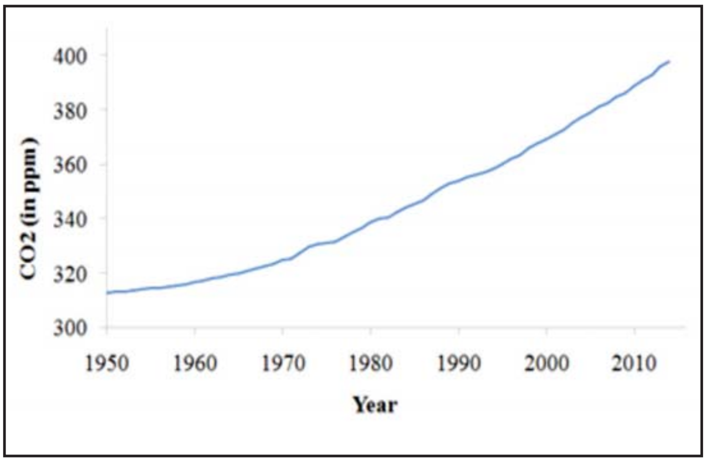


Source: http://apdrc.soest.hawaii.edu/data/data.php

Fig 9. Monthly average sea surface temperature (SST) from 1990 to 2016 over the Lakshdaweep region.



Source: http://www.co$_2$.earth/historical-co$_2$ datasets

Fig 10. Graph showing rising levels of carbon dioxide (CO_2) in the atmosphere. (Data from

etc. In addition, rising temperatures and ocean acidification are important emerging threats to the future of coral reefs and related marine ecosystems (Fig. 9 & 10).

Coral bleaching defined as the loss of coral's symbiotic dinoflagellates is triggered by high sea surface temperatures (SSTs) (Hoegh-Guldberg O, 1999). These ecosystems are vulnerable to climate change, due to the temperature sensitivities of corals, which bleach and die when sea temperatures exceed normal limits by as little as 1.0°C (Ateweberhan et al., 2013). There are differences in the bleaching prevalence among the coral genera. The most susceptible genera to bleaching are the branching corals, *Acropora sp*. and *Pocillopora sp*. While the least susceptible genera are the massive and encrusting growth forms, *Porites sp*. and *Favia sp*. Mass coral bleaching events have been reported throughout the world's coral reefs during the past few decades coinciding with the increase in global SSTs resulting in the loss of coral coverage and changes in the habitat structure. With the predicted rise in SSTs, the frequency and severity of coral bleaching is expected to increase in the coming decades. Further, the changes in the seawater chemistry due to the increase in atmospheric CO_2 concentrations has resulted in decreased calcification rates subjecting the coral reefs to additional stress.

Status of Coral Reefs in India

The Indian coastline extending over 8000 km consists of four major coral reef zones (Gulf of Kachchh, Gulf of Mannar, Lakshadweep Islands and the Andaman and Nicobar Islands). The vast stretch of Bay of Bengal except for the Andaman and Nicobar Islands is devoid of any coral reefs. The coral reef zones are unique and distinct in their diversity. Fringing reefs in (Gulf of Mannar and Palk Bay), platform reefs in (Gulf of Kachchh), patchy reefs in (Ratnagiri and Malvan coasts), fringing reefs in (Andaman and Nicobar Islands) and atoll reefs

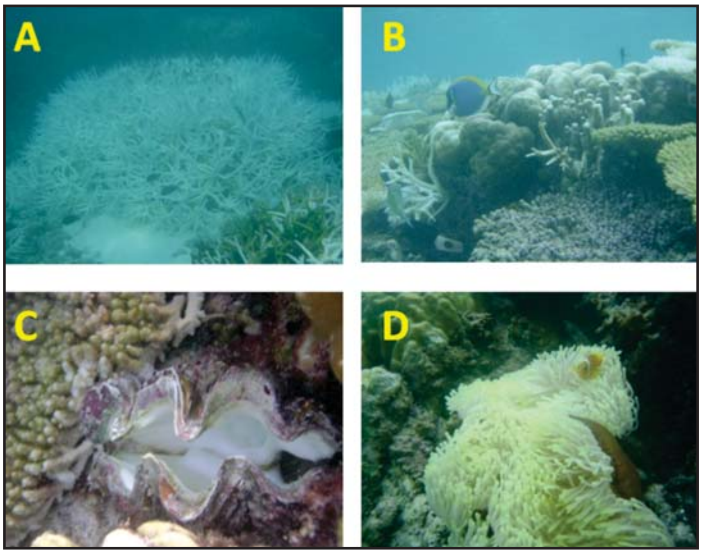


Fig 11. Bleached corals and associated reef organisms observed during the mass bleaching event in Lakshdweep Islands in 2011. A) Branching coral (Acropora sp.); B) Massive coral (Porites sp.); C) Giant clam (Tridacna sp.) and D) Partially bleached tentacle sea anemone.

in (Lakshadweep). The coral reefs of India have an important role in supporting the rich marine biodiversity. As observed worldwide the Indian seas too experienced severe warming in 1998 and 2002 resulting in large scale bleaching and mortality of corals. Sporadic events of coral bleaching at local scale have been reported from several coral reefs of India in 2005 and 2010 (Fig 11).

The continued threats from natural and anthropogenic stressors jeopardize the existence of coral reefs. Coral reefs degraded due to bleaching and anthropogenic disturbances at many locations of the globe have taken several years to decades to recover. Therefore, significant conservation and management interventions are required to enhance the recovery potential of coral reefs. There are several management interventions that include reducing the harvest of herbivorous fish, establishment of marine reserves for controlling local stressors, managing water quality, minimising other direct anthropogenic impacts etc. In light of the challenges to coral reef ecosystems conservation planning and restoration efforts are necessary for the preservation of reef ecosystems.

Assessment of Coral Reef Status through Monitoring and Mapping

Realising the importance of coral reefs the Ministry of Earth Sciences (MoES), Government of India had taken steps to conserve and manage the reefs from the early 2000. The Integrated Coastal and Marine Area Management-Project Directorate (ICMAM-PD) an attached office of the MoES conducted monitoring and mapping of the coral resources for the Gulf of Kachchh, Gulf of Mannar, Lakshadweep Islands and the Andaman and Nicobar Islands from 2000 to 2005. The studies revealed that the coral reefs of India had a live coral cover of less than 40% (Fig 12).

Some of the causes of degradation are dredging, coastal reclamation, over-exploitation of biological resources and unplanned tourism activities (Fig 13).

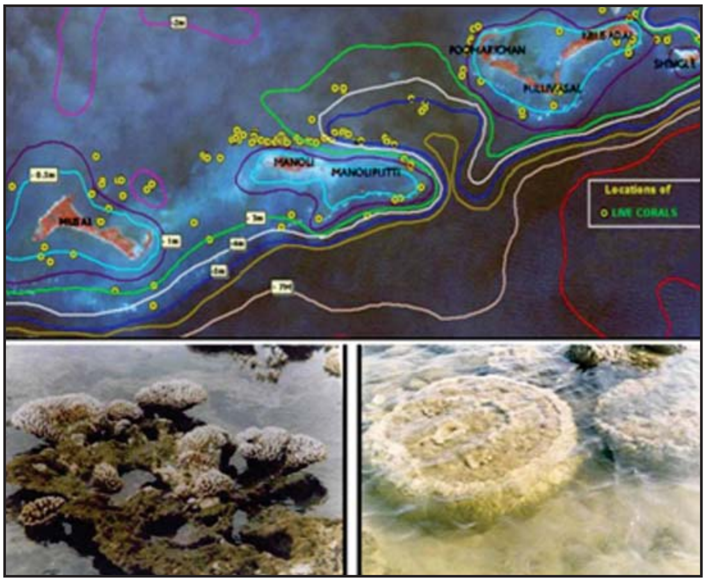


Fig 12. Map showing the distribution of live corals in Mandapam group of islands, Gulf of Mannar during 2000-2002. The survey was done by ICMAM-PD, MoES as part of the Coral Reef Assessment and Monitoring Program under the World Bank Project.

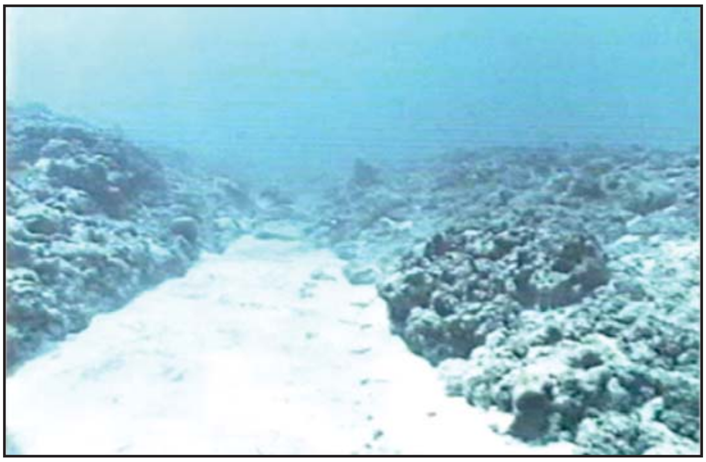


Fig 13. Dredging of corals in western side of Kadmat island, Lakshadweep

Coral Reef Restoration Activities

The Lakshadweep Coral Reef Monitoring Network (LCRMN) with the funding support from the Ministry of Environment, Forest and Climate Change (MoEF & CC), Government of India started the program of restoration of coral reefs in some islands of Lakshadweep as a pilot study in 2004.

The restoration of degraded coral reefs is one of the major reef management strategies. Coral transplantation has been widely accepted as a coral reef restoration approach. The method of restoration involves removal of actively growing tips or parts of coral colonies or fragments from healthy reefs and planting them to hard substrata. Once the coral colonies are restored they are transplanted from the metal frames into degraded areas. The *Acropora sp*. and *Pocillopora sp*. which have high growth rates as well as capacity for asexual propagation showed rapid recovery. The average growth rate for the branching coral, *Acropora sp*. was 25cm in 3 years, while for the sub massive coral, *Pocillopora sp*. it was 15cm in 3 years (Fig.14).

Source: Lakshadweep Coral Reef Monitoring Network

Fig 14. Restored and transplanted live corals over time in the Lakshdweep Islands. The recovered reef showed high coral cover

The coral transplantation procedure had clear benefits like immediate increase in coral coverage and diversity, re-introduction of corals to areas where they were destroyed. Recovery of coral reefs is a complex process influenced by multiple factors. Without a integrated approach at the local, regional and global level to reduce local stress factors and combat climate change, there will be a continual decline of coral reefs.

Future Activities – Coral Reefs as Green Infrastructure

Climate change has led to increase in natural hazards from coastal storms, flooding, and rising sea levels and coral reefs can provide risk reduction benefits comparable to artificial defenses, and reef restoration and enhancement is a cost-effective alternative to manmade structures. It is well documented that during the Indian Ocean tsunami of December 2004, some coastlines were spared from further damage as a result of healthy reefs. The coral reef structure buffers shorelines against waves, storms, and floods, helping to prevent loss of life, property damage, and erosion. When reefs are damaged or destroyed, the absence of this natural barrier can increase the damage to coastal communities from normal wave action and violent storms. Studies are being carried out world-wide recognising the role of coral reefs as green infrastructure in coastal protection.

With a GIS based database of the extent of live coral cover mapped along the major Corals reefs along Indian Coast developed in 2000, ICMAM-PD an attached office of the MoES has now has proposed to conduct studies on the monitoring of coral reefs in Lakshadweep Islands, Gulf of Kachchh, Gulf of Mannar and Andaman and Nicobar Islands to observe the decadal changes in the habitat structure and percentage of live coral coverage specially in view of the changing climate. After identifying areas of extensive degradation, coral restoration would be taken up to increase the coral reef coverage, restoration and transplantation of corals on a pilot scale along Lakshadweep Islands. In addition to enhance the resilience of the coral reefs of Lakshadweep Islands training on hatchery technology of reef ornamental fishes will be imparted to the islanders as the island communities of Lakshadweep depend on the coral reefs for their livelihood and sustenance.

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The Impact of Marine Debris-Waste Management Plan and Strategy

Aadesh J Srivastava*

Marine litter can be classified into land- or ocean/waterway-based, depending on how the debris enters the water. Land-based sources include dumps/landfills, revering transport, untreated sewage and storm water discharges, industrial and manufacturing facilities, tourism, and beach-goers. Sea-/ocean-based sources of marine litter include fishing vessels, cruise liners, merchant shipping, military and research vessels, pleasure crafts, oil/gas platforms, and fish farming.

Beach debris including the non-biodegradable waste materials which find their way either through river runoff, beaching of floating litter or directly through anthropogenic interventions reach sea in different proportions. It is estimated that beach debris in ten of the inhabited islands show mean quantity of 10.7 g/m2 which includes PET, and glass bottles, plastic bags, HDPE and nylon ropes etc.

Upon exposure to heat and light from sun over a period of time, these plastics can be fragmented and become micro-plastics. These tiny particles of plastics can enter into the food chain of fragile atoll ecosystem as well as can settle on the coral polyps which may lead to their mortality.

Fig. 15 . Impact of debris floating in the sea

Plastics also bring toxins into the food chain. When plastics break down, they produce toxic products. They also aggregate pollutants in the environment. Both are released when animals digest the plastic. Globally more than 200 species are known to be affected by marine rubbish including whales, seals, dugong, seabirds, turtles, crabs, sea snakes, sharks, rays and other fish.

Waste management is one of ten economic sectors highlighted in UNEP's recently published Green Economy Report. The report highlighted enormous opportunities for turning land based waste - the major contributor to marine debris - into a more valuable resource. It also marked the first step in the development of a comprehensive global platform for the prevention, reduction and management of marine debris, to be known as the Honolulu Strategy. Improvements to national waste management programmers' not only help reduce the volume of waste in the world's seas and oceans, but can also bring real economic benefits. The key to solving the marine litter problem in terms of waste management is action at source, including the widespread adoption and implementation of Zero Waste strategies entailing waste prevention, minimization, re-use and recycling. Until such initiatives are widely and effectively implemented, measures available to address the problem of marine litter and debris will inevitably remain extremely limited.

Fig 16. Debris depositing on the seabed

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"Cleaner Coast " and the "Swachh Abhiyan"

*Sameer Sagvekar**

Safe Seas and Cleaner Oceans

Maritime Industry has been promulgating Safe Seas and cleaner oceans for decades. Further, to the London Convention, the International maritime organisation has initiated several regulations considering disposal of ship generated wastes under MARPOL and has even introduced new annexes to the MARPOL 73/78 to cover disposals of various types of wastes generated on board so as to regularise & control the pollution of the seas and keep the oceans clean & SWACHH.

Marine litter is a global concern, affecting all the oceans of the world. Every year millions and millions of tons of litter end up in the ocean worldwide, turning it into the world's biggest landfill and thus posing environmental, economic, health and aesthetic problems. Indeed it is one of the gravest and a growing threat to our oceans and our coastlines. Poor practices of solid waste management, lack of infrastructure and a lack of awareness of the public at large about the consequences of their actions aggravate the situation substantially.

London Convention

The "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972", the "London Convention" for short, is one of the first global conventions to protect the marine environment from human activities and has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter. Currently, 87 States are Parties to this Convention.

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In 1996, the "London Protocol" was agreed to further modernize the Convention and, eventually, replace it. Under the Protocol all dumping is prohibited, except for possibly acceptable wastes on the so called "reverse list". The Protocol entered into force on 24 March 2006 and there are currently 47 Parties to the Protocol.

The objective of the London Convention and Protocol in line with the SWACHH campaign is to promote the effective control of all sources of marine pollution. Contracting Parties shall take effective measures to prevent pollution of the marine environment caused by dumping at sea.

Widely the purpose of the London Convention is to control all sources of marine pollution and prevent pollution of the seas through regulation of dumping into the sea of waste materials. A so-called "black and grey-list" approach is applied or wastes, which can be considered for disposal at sea according to the hazard they present to the environment. For the blacklist items dumping is prohibited. Dumping of the grey-listed materials requires a special permit from a designated national authority under strict control and provided certain conditions are met. All other materials or substances can be dumped after a general permit has been issued.

The purpose of the Protocol is similar to that of the Convention, but the Protocol is more restrictive: application of a "precautionary approach" is included as a general obligation; a "reverse list" approach is adopted, which implies that all dumping is prohibited unless explicitly permitted; incineration of wastes at sea is prohibited; export of wastes for the purpose of dumping or incineration at sea is prohibited.

Cleaner coast and the issues

Approximately 10 million tonnes of litter end up in the world's oceans and the seas each year. The term "marine litter" covers a range of materials which have been deliberately discarded, or accidentally lost on shore or at sea, and it includes materials that are carried out to sea from land, rivers, drainage and sewerage systems or the wind.

What we find on our beaches is not the full extent of the marine litter load in the environment. It is estimated that 70% of marine litter is on the seabed, 15% is floating in the water column and 15% is what we find on our shores.

Sources of Marine Litter

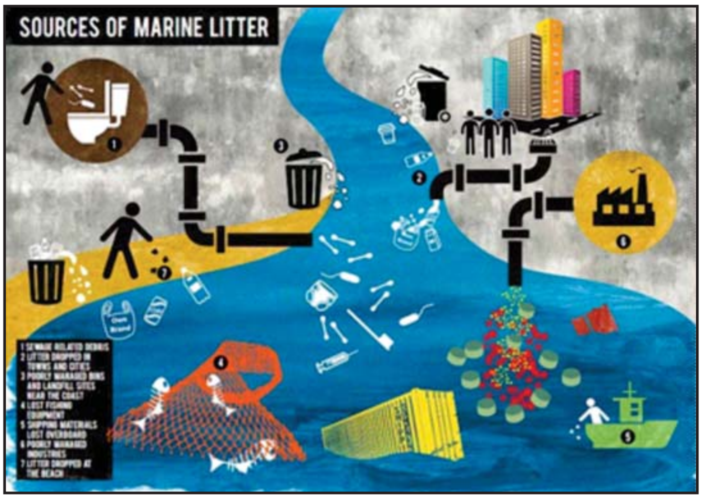

Fig 17. Sources of Marine Litter

- Litter discarded in towns and cities
- Litter dropped at the beaches
- Poorly managed industrial waste & discharges
- Dumped or Lost shipping goods & containers
- Lost/discharged fishing gear
- Litter blown by the wind
- Micro beads from domestic & personal care products
- Sewage related litter

Types of Marine Litter

Marine litter includes a wide variety of different types of debris and these can be classified into several distinct categories:

- Plastics including moulded, soft, foam, nets, ropes, buoys, monofilament line and other fisheries related equipment, smoking related items such as cigarette butts or lighters, and micro plastic particles;
- Metal including drink cans, aerosol cans, foil wrappers and disposable barbeques;
- Glass including buoys, light globes, fluorescent globes and bottles;
- Processed timber including pallets, crates and particle board;
- Paper and cardboard including cartons, cups and bags;
- Rubber including tyres, balloons and gloves;
- Clothing and textiles including shoes, furnishings and towels;
- Sewage related debris (SRD) including cotton bud sticks, nappies, condoms and sanitary products.

Impacts of Marine Litter on coast & the sea

Economic loss

Marine debris is an eyesore along shorelines around the world. It degrades the beauty of the coastal environment and in many cases, may cause economic loss if an area is a popular tourist destination.

Habitat Damage

Marine debris can scour, break, smother and otherwise damage important marine habitat, such as coral reefs. Many of these habitats serve as the basis of marine ecosystems and are critical to the survival of many other species.

Wildlife Entanglement and Ghost fishing

One of the most notable types of impacts from marine debris is wildlife entanglement. Derelict nets, ropes, line, or other fishing gear, packing bands, rubber bands, balloon string, six-pack rings, and a variety of marine debris can wrap around marine life. Entanglement can lead to injury, illness, suffocation, starvation, and even death.

Ingestion

Many animals, such as sea turtles, seabirds, and marine mammals have been known to ingest marine debris. The debris item may be mistaken for food and ingested. Debris ingestion may lead to loss of nutrition, internal injury, intestinal blockage, starvation, and even death.

Vessel Damage and Navigation Hazards

Marine debris can be quite large and difficult to see in the ocean, if it's floating below the water surface. Encounters with marine debris at sea can result in costly vessel damage, either to its structure or through a tangled propeller or clogged intake.

Alien Species Transport

If a marine organism attaches to debris, it can travel hundreds of miles and land on a shoreline where it is non-native. Invasive species can have a devastating impact on fisheries and local ecosystems and can be costly to eradicate.

Environmental impact of shipping

The environmental impact of shipping includes greenhouse gas emissions, acoustic, ballast water discharges and oil pollution. The International Maritime Organization (IMO) estimates that Carbon dioxide emissions from shipping were equal to 2.2% of the global human-made emissions in 2012 and expects them to rise substantially by 2050 if no action is taken.

Ballast water

Ballast water discharges by ships can have a negative impact on the marine environment & coast. Ballast water discharge typically contains a variety of biological materials, including plants, animals, viruses, and bacteria. These materials often include nonnative, nuisance, invasive, exotic species that can cause extensive ecological and economic damage to aquatic ecosystems along with serious human health problems.

Fig 18. Marine litter on environmental impact

Oil spills

Most commonly associated with ship pollution are oil spills. While less frequent than the pollution that occurs from daily operations, oil spills have devastating effects. While being toxic to marine life, polycyclic aromatic hydrocarbons (PAHs), the components in crude oil, are very difficult to clean up, and last for years in the sediment and marine environment. Marine species constantly exposed to PAHs can exhibit developmental problems, susceptibility to disease, and abnormal reproductive cycles.

Sewage

The cruise line industry dumps 255,000 US gallons (970 m3) of grey water and 30,000 US gallons (110 m3) of black water into the sea every day. Black water is sewage, wastewater from toilets and medical facilities, which can contain harmful bacteria, pathogens, viruses, intestinal parasites, and harmful nutrients.

Solid waste

Solid waste generated on a ship includes glass, paper, cardboard, aluminium, steel cans and plastics etc. It can be either non-hazardous or hazardous in nature. Solid waste that enters the ocean may become marine debri and can then pose a threat to marine organisms, humans, coastal communities and industries that utilize marine waters.

Bilge water

On a ship, oil is often found to leak from engine and machinery spaces or from engine maintenance activities and mixes with water in the bilge and being discharged.

Challenges

Marine litter is not a problem that can be easily solved. Even if no additional litter entered the sea today, the problems of yesterday's debris will still be washing ashore in hundreds of years' time.

Implementing the following recommendations could save thousands of lives each year, ensure cleaner coastal air and reduce ecological damage from shipping.

Strong Legislations

Discharge and disposal of litter into water be sea, rivers, canals, nallahs or waterways be prohibited with heavy penalties and fines. Patrolling and continuous monitoring would be essential.

Clean up ship recycling

Ratify and follow Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships – 2009 at an early date.

Improve port management.

Port authorities should review their policy towards handling of marine litter and how to control and monitor same. Environmental non-governmental organizations should campaign to increase public awareness to control marine litter and of port development. Port reception facilities which are grossly inadequate at most of the Indian ports are in need to be urgently reviewed and updated.

IMO and Environment policies

The International Maritime Organization (IMO), which regulates international shipping, is actively looking at several issues involving environment, global warming and overall safe operation of ships and must be complimented for the hard work being put in by the member states.

Measures already taken have shown to be successful in reducing ship sourced pollution, litter and illustrate the commitment of the Organization and the shipping industry towards protecting the environment.

The work of the IMO Marine Environment Division is directed by the Marine Environment Protection Committee, the MEPC in short, which is IMO's senior technical body on marine pollution related matters. It is aided in its work by a number of IMO's Sub-Committees, in particular the Sub-Committee on Pollution Prevention and Response (PPR).

The original focus of its work was the prevention of marine pollution by oil, resulting in the adoption of the first ever comprehensive antipollution convention, the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1973. This has undergone some amendments over the last few years to include a much wider range of measures to prevent marine pollution and now includes regulations addressing pollution from chemicals, other harmful substances, garbage, sewage, air pollution and emissions from ships.

Other Global Initiatives on Marine litters to keep cleaner coast are:

- Monitoring systems of marine litter;
- The management of abandoned and lost fishing gear;
- Reception facilities for marine garbage and waste;
- The development of economic instruments to better control the problem;
- Addressing the tourist, diving sectors and industries;

- Cooperation with global and regional beach clean-up campaigns;
- The development of outreach and educational material.

Also there are three additional and different projects which it is felt will make good improvement. they are:

- Dive against Debris project for scuba divers, whilst it is still in its infancy, the project aims to provide critical information on underwater marine litter.
- Take Your Trash Home: Beach users are responsible for any waste they generate and members of the public be required to take all their litter home when visiting rural beaches or to ensure they provide easy and appropriate recycling facilities across their site.
- Littering Penalties: Raise awareness that littering is an offence and levy penalties to act as a deterrent to would be offenders.

"Key to survival is the environmental protection and involvement with the SWACHH campaigns".

Produced Water Management from Offshore Petroleum Platforms

*Dy Commandant Rakesh Kumar**

Introduction

Oil is a major global energy source and its exploration and production is extremely important. While oil production is desirable, it results in some unfavourable effects to the environment. In underground structure, rocks that occur normally are accompanied with fluids (water, hydrocarbon, or a combination of the two). These less dense hydrocarbons drift to trap sites, shifting some of the formation water in hydrocarbon reservoirs. This conforms why hydrocarbon reservoirs contain water as well. This water might have arrived from the flow from within the hydrocarbon zone, flow from below or above the hydrocarbon zone, or flow from injected solutions and chemicals for the purpose of managing the reservoir by the producers. The oil reservoir is the main source of this produced water, which may as well include sea water that has been injected to sustain the reservoir pressure. The large quantities of formation and injected water, which is eventually produced along with the oil and gas, is one of the most crucial sources of unfavourable effects to the environment. Handling of produced water is therefore critical in petroleum exploration and production operations because of its significant contribution to capital cost of operating oil or gas reservoir.

Produced water formation

Considerable amounts of liquid waste streams are regular outcomes within onshore and offshore oil production (much higher in offshore locations). After some treatments on the platform, these wastes are discharged usually into the aquatic environment. During the early years of production, the amount of liquid wastes produced beside the oil is generally low; however, as the reservoir becomes older, the amount increases perhaps several times more than the produced oil. In general, the produced water is seven to eight times greater by volume than oil produced at any particular oil field. Separation of oil, gas, and water from produced hydrocarbon stream on an offshore platform is by addition of certain chemicals; these chemicals that include corrosion inhibitors, de-emulsifiers, deformers and biocides are toxic to the marine environment. This depends on several factors such as allowed fraction of each chemical in the mixer with the produced water and the quantity of discharged produced water in each batch.

Produced water components

Produced water contains a wide variety of constituents such as organic and inorganic pollutants, suspended solids and iron. Produced water is a complex

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Source:http://109.4iranian.com/uploads/prodwaterpaper_1270.pdf

Fig 19. Water management from offshore platforms

mixture of dissolved and particulate organic and inorganic chemicals in water that ranges from essentially freshwater to concentrated saline brine. The most abundant organic chemicals in most produced waters are water-soluble low molecular weight organic acids and monocyclic aromatic hydrocarbons. Concentrations of total PAH and higher molecular weight alkyl phenols, the main toxicants in produced water, typically range from about 0.040 to about 3mg/L. The metals most frequently present in produced water at elevated concentrations, relative to those in seawater, include barium, iron, manganese, mercury, and zinc.

Discharge impact on environment

The chemicals that are present in produced water, individually or collectively, could have significant impact on the environment. Some of the impacts include disruption of physiological and behavioural activities of the aquatic life, bioaccumulation and deterioration of physical environment (amenity beach). The impact of produced water on marine life depends on the constituents and concentration of the chemicals present in the produced water. For offshore operations, the impact is also dependent on the discharge point, physical properties as well as hydrology of receiving environment.

Produced water management options

Globally, the oil and gas industry generates more than seventy billion barrels of produced water per annum. This represents huge volumes and requires economical and environmentally friendly methods of treatment. The management of produced water represents the single largest waste stream challenge facing the industry worldwide. A variety of management options for produced water exists, however the selection of any option is largely dependent on certain factors such as regulatory acceptance, site location, technical feasibility, cost as well as availability of infrastructure and equipment. The management options that can be adopted are-

- **Water minimization**

For this management strategy the reduction in volume of water produced from oil production well is envisaged. For this the technological modifications to existing processes is required to ensure less generation of water from the well.

- **Water reuse**

In this management strategy the water is reused by reinjection into a producing reservoir to enhance oil recovery.

- **Water treatment**

In this strategy the produced water is treated prior to discharge to make it safe for discharge.

Absence of regulatory mechanism to manage produce water

At present, over seventy international conventions and agreements directly relate to protecting the marine environment. However, not one of these conventions and agreements is exclusively devoted to regulating offshore oil production. Discharges to the ocean from offshore platforms have not been regulated as yet. It is important to highlight that regulation of offshore oil production in most countries require that technology based limits are consistent with cost effective best available treatment technology. It is expected that new conventions, agreements, and other international mechanism may be foreseen in a future not too far, but there still remains a need now to address environmental issues with the best approach and with a more detailed and strict environmental legislation regarding offshore platform discharges.

Handling of wastes arising from produced water treatment

The major objective of treating produced water is to remove the impurities in the water and make the water good for either drinking or discharge into the environment. Considering the volume of produced water generated in oil production, the volume of impurities and contaminants extracted from the produced water will also be high.

Conclusion

Produced water management poses the single largest waste stream treatment challenge facing the petroleum industry worldwide. The huge volumes of produced water generated per annum from oil and gas exploration and production require economical, effective and environmentally friendly methods of treatment. Characteristics of the produced water coupled with environmental factors, economic considerations and local regulatory framework need to be considered for the optimal option for treatment of produced water in an offshore oil and gas exploration.

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EVENT

International Coastal Cleanup Day (ICC-2016)

International Coastal Cleanup-2016 (ICC-2016) day was organized on 17 Sep 16 by the Coast Guard alongwith school/ college children and State Administration in all the nine Coastal States and four U/Ts along the Indian Coast.

Okha Beach, Gujarat | *Chowpatty Beach, Mumbai* | *Belapur Beach, Mumbai* | *Girgoan Beach, Mumbai*

Fig 20. Panorama of ICC 2016 across India

The International Coastal Cleanup day is conducted in the 3rd week of Sep every year in various parts of the world under the aegis of United Nations Environment Programme (UNEP) and South Asian Cooperative for Environment Programme (SACEP) in the South Asian Region. The Coast Guard has been coordinating the ‘Coastal Cleanup Day’ programme on behalf of SACEP since 2006.

Nationwide, a total of 20,062 volunteers participated in the ICC-2016 campaign conducted by the Coast Guard.

Various Govt. and civil agencies including NCC cadets, NSS, school and college students formed the

Mandapam Beach

Vizag Beach

Millenium Park, Kolkata

Marine Drive, Haldia

Carbyn's Cove Beach, A&N

Fig 21. Panorama of ICC 2016 across India

largest proportion of volunteers. Mumbai and New Mangalore witnessed the highest participation of volunteers. The nationwide campaign resulted in the collection of 72.8 tons of marine litter.

This year 'ICC-2016' is also being seen as a drive, that the Govt. of India has launched through its "**Swachh Bharat Abhiyan**". It was the ICG's endeavor to extend this noble drive to the outer limits of Maritime Zones of India through its "**Swachh Sagar Abhiyan**".

An overwhelming participation has been observed from coastal states administration, NGOs and school/ college children. The objective of organizing the ICC is to generate greater awareness for the conservation and protection of the Marine Environment, especially amongst the youth and school children. Apart from other armed forces, ICC-2016 received good support from the civil authorities, central and state government organisations, municipal corporations, NGOs, fisheries associations, ports, oil agencies and other private enterprises. Chief Guests for ICC-2016 included Hon'ble Lieutenant Governors, Ministers of state legislative assembly, Mayor, Deputy Chairman Port Trust, General Manager and Sub-Divisional Officers in smaller locations.

National Level Pollution Response Exercise (NATPOLREX-VI)

The Indian Coast Guard demonstrated its preparedness in containing oil spill disaster at the sixth edition of the National Level Pollution Response Exercise (NATPOLREX-VI) titled '**Swachh Lehar**', conducted at sea off Mundra on 21 Dec 16. The exercise was preceded by a table top exercise on 20 Dec 16. The objective of the exercise was to ascertain preparedness of the Indian Coast Guard, resource agencies and other stakeholders in responding to a major oil spill in line with the provisions of NOS-DCP. The highlight of the exercise was participation of two ICG Pollution Control Vessels (PCVs) and integration of Indian Air Force C-130J Super Hercules aircraft into the Oil Spill Disaster Management System for aerial assessment/ delivery of Oil Spill Dispersant (OSD) for mitigation of the spilled oil. Officers from Sri Lanka (02), Bangladesh (01) and Australia (01) also participated

Fig 22. Hon'ble Chief Minister of Gujarat addressing media

Fig 23. Hon'ble Chief Minister of Gujarat witnessing NATPOLREX-VI from ICG Ship

in the exercise as international observers. The preparedness of all agencies during the exercise was reviewed by **Shri Vijaybhai R Rupani, Hon'ble Chief Minister of Gujarat** embarked onboard Coast Guard Ship alongwith the Chairman NOS-DCP, **Director General Rajendra Singh, PTM, TM,** Director General Indian Coast Guard.

Fig 24. Stakeholders in table top exercises

The Gulf of Kutch (GoK) region handles 70% of the oil imported by India and 11 Single Point Moorings (SPMs) out of total 27 SPMs (i.e. 41%) in the country are located in this area. Thus, the exercise was planned to evaluate the preparedness for Pollution Response Operations for any such incident in this highly sensitive area. The support and cooperation provided by all stakeholders, is indicative of the resolve and firmness in combating oil spills in such sensitive areas. The exercise was conducted in two phases. A table top exercise was conducted on 20 Dec 16. A scenario was

Fig 25. Table Top Exercise

given to the participants and different situations were injected during the table top exercise. The participants undertook mapping of sensitive areas and prioritized their response.

Fig 26. Threat assessment

A real time exercise of oil spill scenario was conducted on 21 Dec 16 off Mundra. The exercise

Fig 27. Demonstration of Fire fighting System by PCV

Fig 28. Demonstration of high current boom

evolutions included mobilisation of pollution response resources by various stakeholders in the GoK region, exercising reporting procedures, testing of communication links and threat assessment, recovery

Fig 29. Demonstration of Heli Skimmer

of distressed crew from sea, fire fighting assistance by PCVs to disabled merchant tanker, deployment of pollution response equipment for containment and

Fig 30. Demonstartion of TC-3 Bucket

Fig 31. Demonstration of off shore boom

recovery of spilled oil by GoK stakeholders, transfer of recovered oil to barges for transportation to port/ shore, reception facility by Pollution Control Boats of PCVs and demonstration of Dispersant Spray capabilities by the Coast Guard Interceptor Boats, Fast Patrol Vessels, Pollution Control Vessels, Chetak Helicopter, Dornier and Indian Air Force C-130J aircraft.

Nine ICG ships including two PCVs, two Chetak helicopters, two Dornier aircraft, one IAF Super Hercules C-130J aircraft, one Indian Naval Ship, one SCI tanker, three Tugs/ OSVs from Adani Port Special Economic Zone (APSEZ), Mundra Port and five Offshore Support Vessels (OSV) from other stakeholders in GoK region participated in NATPOLREX-VI. Further, a total of 40 participants from 26 stakeholders and Resource Agencies participated in the table top exercise. 64 representatives from the resource agencies,

Fig 32. Demonstration of OSD spray by IAF Herculies C-130 J aircraft

Fig 33. Coordinated demonstration of OSD spray system

stakeholders and foreign observers embarked Coast Guard Ship Sarathi, Samudra Prahari and Samudra Pavak for witnessing the sea exercise. The participation of IAF Super Hercules C-130J during NATPOLREX-VI, validated the capability of undertaking large marine oil spill response operations by India and facilitating extended Pollution Response support to littoral States, if needed.

Fig 34. Transportation of recovered oil through barges

Exercise **'Swachh Lehar'** validated and reinforced response mechanism for Oil Pollution incidents and enabled Indian Coast Guard to fine tune the actions required in such eventualities by improving coordination and communication with different agencies. All out efforts are being made with the synergy of stakeholders through such exercises to extend GoI policy of **"Swachh Bharat Abhiyan"** to Maritime Zones of India through **"Swachh Sagar Abhiyan"**.

IMO NEWS

IMO Secretary-General supports India's active maritime growth policy

IMO Secretary-General Kitack Lim shared a platform with India's Hon'ble Prime Minister Narendra Modi at the launch of the first Maritime India Summit in Mumbai held on 14-16 Apr 16. The event brought together the stakeholders from diverse sectors of India's maritime community to explore opportunities to promote growth and investment in the sector. Mr Lim said that a successful shipping and port sector signified that a country was thriving. A policy to support these areas would be of great benefit to the country as a whole, not just to the maritime industry itself, he added. He stressed the need for collaborative planning and praised Hon'ble Prime Minister Modi for the positive steps he and his government have taken to encourage investment and development throughout India's maritime sector.

Source: www.imo.org

Fig 35. IMO Secretary-General Mr. Lim at India Summit in Mumbai

IMO Certificate of Commendation for exceptional bravery at Sea

Fig 36. Bhrigo Muni Das, an Uttam Navik from Indian Coast Guard awarded IMO Bravery Award

Bhrigo Muni Das, an Uttam Navik (ME) of Indian Coast Guard, has been awarded Certificate of Commendation by IMO Secretary General on 21 Nov 16 for exceptional bravery at Sea. The Enrolled Personnel was nominated as the free diver for a SAR mission for MV Coastal Pride's crew and rescued 06 survivors and helped them in getting winched up from sea on 24 Jun 15, despite the squally weather and stormy winds. The individual operated liferaft while ensuring safety of remaining crew in abandoning ship.

Workshop raises awareness of waste dumping regulation

Dumping wastes and other matter at sea was discussed at a Pacific region workshop in Suva, Fiji. The event aimed to increase the knowledge of dumping of wastes at sea and the existing global regulatory framework amongst participating countries with the ultimate goal of strengthening capacity in the region to implement the London Protocol and thereby increase protection of the marine environment.

The workshop was attended by participants from the Cook Islands, Fiji, Kiribati, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu and a representative from the Secretariat of the Pacific Community (SPC). It was hosted by the Government of Fiji and carried out in cooperation with the Secretariat of the Regional Pacific Environment Programme (SPREP), with IMO in attendance.

Maritime lawyer to receive International Maritime Prize

The prestigious International Maritime Prize for 2015 is to be awarded to Dr Frank Lawrence Wiswall Junior, former Chair of the IMO Legal Committee and Vice-President (Honoris Causa) Committee Maritime International (CMI), for his contribution to the work of IMO over many years.

The IMO Council decided to award the Prize, noting Dr Wiswall's personal contribution to the work of IMO, leading IMO's Legal Committee as it developed a number of key international treaties and holding important roles at various international IMO legal and diplomatic conferences.

As a lecturer at the International Maritime Law Institute (IMLI) in Malta and as a Member of its Governing Board from 1992 to the present, Dr Wiswall has also made a significant contribution to the training of lawyers from around the world.

In nominating his candidature for the International Maritime Prize, the CMI said Dr Wiswall had contributed greatly to the establishment of the uniformity of maritime law during his long and distinguished career as a practicing maritime lawyer, academic and Vice-President of the CMI.

Marine Accident Investigator' International Forum

A week-long meeting 25 Aug- 02 Sep 16 to foster cooperation and communication between international marine accident investigators has taken place in Hamburg, Germany.

The meeting examined the skills and tools necessary to carry out marine safety investigations and encouraged participants to share lessons learned from the many investigations carried out over the years. Topics of discussion included: safety on passenger cruise vessels; challenges associated with very large container vessels (VLCVs); best practice developments in accident investigation; bridge communications; and the man machine interface.

Source: www.imo.org

Fig 37. Ashok Mahapatra, Director Maritime Safety Division, IMO

Ashok Mahapatra, Director of IMO's Maritime Safety Division, delivered a keynote address to some 60 members representing 35 national marine investigation organizations. The meeting, which is also celebrating its 25th year, was hosted by the German Federal Ministry of Transport and Digital Infrastructure.

Together towards cleaner oceans

IMO contributed to a United Nations meeting covering marine debris, plastics and microplastics in New York 13-17 Jun 16. Discussions focused on information exchange between key players involved in the protection of the marine environment – in the context of the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which establishes rules governing all uses of the oceans and their resources.

Source: www.imo.org

Fig 38. Together towards cleaner oceans

Stefan Micallef, Director of IMO's Marine Environment Division, took part in a panel on the environmental, social and economic dimensions of marine debris, plastics and microplastics. He provided an overview of the progress made in preventing, reducing and controlling pollution in this field, including an overview of IMO's work to address this issue. This includes IMO's MARPOL convention for the prevention of pollution from ships, which bans the disposal of plastics into the sea from ships and generally prohibits the discharge of all garbage into the sea, except in certain very specific circumstances, and the London Convention/Protocol which, in effect, bans the dumping of plastics at sea.

The Organization is also a co-lead for sea based litter in the Global Partnership on Marine Litter and manages the GESAMP group of scientific experts, which studies the impact of microplastics in the marine environment.

Legal framework of wreck removal

The legal and operational aspects of wreck removal incidents were on the agenda at the "Wreck Removal Contracts & Operations Seminar" in London, United Kingdom on 20-21 Jun 16. IMO's Jan de Boer gave an insight into the Organization's Nairobi Wreck Removal Convention, which provides the legal basis for States to remove, or have removed, shipwrecks that may threaten the safety of lives, goods and property at sea, as well as the marine environment. It also provides uniform international rules for the prompt and effective removal of wrecks located beyond territorial seas, and optional application of the rules in countries' territories, including territorial seas.

Fig 39. Legal framework for wreck removal

Mr. De Boer covered the operational actions which led to the need for international ruling, the necessity of a unifying legal framework for States to act upon, and the duties of the ship owner and rights of the authority under the convention. He also covered the process of filling in the legal gaps and complementing the prior legal framework. The event was organized by Lloyd's Maritime Academy.

Regional oil and chemical spill contingency plan

A meeting to update South Asia's regional plan for oil and chemical pollution preparedness and response was held in Male, Maldives on 22-25 Aug 16. Senior officials from Bangladesh, India, Maldives, Pakistan and Sri Lanka shared their national experiences and consolidated updates to the plan with a view to finalizing it. The event included a regional training workshop on hazardous and noxious substance spill preparedness and response. Participants also identified future training needs and developed a three-year training programme to enhance the region's spill preparedness and response capacity.

Source: www.imo.org

Fig 40. A meeting on Regional oil and chemical spill contingency plan held on 22-25 Aug 16 at Male

FORTHCOMING MEETINGS AT IMO

Sl	Meeting	Date
(1)	Sub-Committee on Pollution Prevention IMO and Response (PPR) – 4th Session	16 - 20 Jan 2017
(2)	Sub-Committee on Human Element, Training IMO and Watchkeeping (HTW) – 4th session	30 Jan - 3 Feb 2017
(3)	Sub-Committee on Ship Design and IMO Construction (SDC) – 4th Session	13 - 17 Feb 2017
(4)	Sub-Committee on Navigation, Communications IMO and Search and Rescue (NCSR) – 4th Session	6 - 10 Mar 2017
(5)	Sub-Committee on Ship Systems & Equipment IMO (SSE) – 4th session	20 - 24 Mar 2017
(6)	Facilitation Committee (FAL) – 41st session IMO	4 - 7 Apr 2017
(7)	Legal Committee (LEG) – 104th session IMO	26 - 28 Apr 2017
(8)	IOPC Funds (24-25, 28)† IMO	24 - 28 Apr 2017
(9)	Maritime Safety Committee (MSC) – 98th session IMO	7 - 16 Jun 2017

REPORTS

INDIA WATCH

Grounding off MV Infinity

A Liberian flag Bulk Carrier MV Infinity, built in 1985 ran aground with 10 Indian crew onboard on 02 Sep 16 off Dahej after the stbd anchor cable parted. The vessel arrived at Alang on 04 Oct 2015 for breaking/ demolition. However, due to financial dispute between M/s Vital Ventures Ltd. Nevis and M/s Beben Tasimacilik Turkey, the vessel was issued arrest warrant by Hon'ble High Court of Gujarat. 12 MT diesel with 90 Ltrs lub oil was held onboard, however, no leakage of oil from the vessel was reported. Indian Coast Guard Pollution Control Vessel Samudra Pavak was kept standby for meeting any emergent pollution response requirements.

Fig 41. MV Infinity stranded off Danti Valsad

The local agent, Mr. Hashim from M/s Ashit Shipping Services Pvt. Ltd Bhavnagar mobilized tug 'Time Trader' and 'Safe Cat' for salvaging the vessel. However, the tugs were unable to control the drift view strong flood/ Ebb current in the Gulf of Khambhat.

The vessel initially grounded on 02 Sep 16 and refloated on the same day, thereafter, the vessel got grounded/ refloated thrice and ran aground again on 20 Sep 16. Frequent floating of vessel posed threat to other vessels anchored nearby and also jeopardised navigational safety of vessels operating in the area.

The Hon'ble High Court of Gujarat directed Port and Customs Authority, Alang/ Bhavnagar to secure the vessel and submit a report on or before 13 Sep 16.

A new anchor with 3 shackles cable was provided to the vessel and the same was fitted on port side. The vessel was then anchored at grounded position off Danti Valsad.

Fig 42. MV Infinity grounded after anchor cable parted

An early materialisation of the case for early disposal of vessel through legal proceedings needs immediate attention as the response received from the owners is negligible/ poor. The vessel is presently grounded off Danti Valsad, with nil oil spill reported.

Water Pollution off Mumbai

A suspected oil spill in redish colour was sighted on 22 Nov 16 off Mumbai about 06-09 NM from position 19 deg 07.07 N 072 deg 52.31 E between radials 270-310 and was reported to Maritime Rescue Coordination Centre, Mumbai by the Watch Suptd Officer, ATC Mumbai.

The ICG Helo undertook initial survey and found a rectangular Red/Brown coloured (2 nm x 5 nm) patch, spread over 07-09 NM in east-west direction from coastline, in position 330 Prongs Lt 15. The patch initially appeared as water contamination due iron ore/mineral ore or discharge from dredger. ICGS Sangram was directed for further investigation and collection of water samples for testing by NIO, Mumbai for analysis. On analysis, NIO, Mumbai concluded that the sample does not have any bloom count and thus oil contamination was ruled out.

Fig 43. A rectangular Red/Brown coloured patch off Mumbai

WORLD WATCH

Oil Spill near Port Isabel

An oil spill was reported into the Intracoastal Waterway near South Padre Island, Port Isabel, Texas, after a towing vessel collided a dock at the facility of Subsea 7 on 11 Oct 16.

Source: http://gcaptain.com/diesel-spill-on-texas

Fig 44. 5,000 gallons oil spill near Port Isabel

The USCG initially said the incident resulted in the release of approximately 20,000 gallons of low sulpher diesel fuel into the waterway, but later downgraded the spill estimate to 5,000 gallons. Unified command consisting of the USCG, Texas General Land Office and Kirby Inland Marine was established in response to the allision and diesel spill.

The USCG had carried out an over flight with pollution responders to get an accurate assessment of the impact to the waterway and surrounding areas for ensuring a robust and thorough cleanup. Oil recovery operations by deploying boom and air monitoring was conducted by the oil spill response organization, Miller Environmental.

The source of the spill was secured and no impact to wildlife was reported.

Bay Long Oil Spill in Louisiana

Source: http://worldmaritimenews.com

Fig 45. 5,300 gallons oil spill near Bay Long, Louisiana

Approximately 5,300 gallons of crude oil was discharged from a pipeline owned by Harvest Pipeline Company after it was stuck by a Great Lakes Dredge and Dock Company vessel near Bay Long, Louisiana in Gulf of Mexico on 05 Sep 16.

The USCG had conducted aerial assessments of the site and surrounding areas. ECM Maritime Services, an oil response organization, was contracted by the vessel's owner to manage clean-up operations. Further, Environmental Safety & Health has deployed 3,000 feet of hard-boom, while OMI Environmental Solutions and Clean Gulf Association have used sorbent material and skimmers for collection of oil.

National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration has provided scientific support including trajectories and fate of oil, resources at risk, information on tides and currents, and technical guidance towards the response. Other roles provided by NOAA are guidance on Shoreline Cleanup and Assessment Technique (SCAT), a systematic method for surveying an affected shoreline after an oil spill, as well as data management

Source: *http://response.restoration.noaa.gov*

Fig 46. Overseeing cleanup operations

and updates through Environmental Response Management Application (ERMA).

The USCG and Louisiana Department of Wildlife and Fisheries are also helping supervise the response. 74 personnel, 21 boats, eight skimmers and about 10,000 feet of hard boom were deployed to contain and recover the spilled oil. About 560 gallons of oil and water mixture had been recovered.

The Louisiana Department of Wildlife and Fisheries reported two oiled birds in the area, and a shoreline impact assessment have been conducted by the State Department of Environmental Quality. The pipeline was reported as secured.

Indian Coast Guard

Annual Calendar of Pollution Response Training and Exercise: 2017

Date	Venue	Event	Coordinator
17 Jan	Ratnagiri	Mock Drill	Coast Guard Station Ratnagiri
17 Jan	Kavaratti	Mock Drill	Coast Guard Dist. Headquarters-12, Kavaratti
07 Feb	Paradip	Mock Drill	Coast Guard Dist. Headquarters- 07, Paradip
07-08 Feb	Vizag	PR Seminar/ Mock Drill	Coast Guard Dist. Headquarters 06, Vizag
08 Feb	Kochi	Area level Exercise	Coast Guard Dist. Headquarters- 04, Kochi
13 Feb	GoK Area	Area Level Exercise	Coast Guard Station Vadinar
13 -17 Feb	AMET University, Chennai	Level – 2 Course	Pollution Response Team (East), Chennai
06-10 Mar	Vadinar	Level – 1 Course & Mock Drill	Coast Guard Station Vadinar
20-24 Mar	Chennai	Level – 1 Course & Mock Drill	Pollution Response Team (East), Chennai
20- 24 Mar	Mumbai	Level – 1 Course & Mock Drill	Pollution Response Team (West), Mumbai
06 Apr	Goa	Area Level Exercise	Coast Guard Dist. Headquarters- 11, Goa
19-20 Apr	Tuticorin	PR Seminar/ Mock Drill	Coast Guard Station Tuticorin
24- 28 Apr	Port Blair	Level – 1 Course & Mock Drill	Pollution Response Team (A&N), Port Blair
02-03 May	Haldia/ Kolkata	Area Level Exercise	Coast Guard Dist. Headquarters- 08, Haldia
12 May	Karaikal	Mock Drill	Coast Guard Station Karaikal
15 May	GoK Area	Area Level Exercise	Coast Guard Station Vadinar
17 May	Kavaratti	Mock Drill	Coast Guard Dist. Headquarters– 12, Kavaratti
07 Jun	Karwar	Mock Drill	Coast Guard Station Karwar
13 Jul	Kakinada	Mock Drill	Coast Guard Station Kakinada
09 Aug	Murud Janjira	Mock Drill	Coast Guard Station Murud Janjira
22 Aug	GoK Area	Area Level Exercise	Coast Guard Station Vadinar
28 Aug- 01 Sep	AMET University, Chennai	Level – 2 Course	Pollution Response Team (East), Chennai
07 Sep	Haldia	Mock Drill	Coast Guard Dist. Headquarters- 08, Haldia
11-15 Sep	Mumbai	Level – 1 Course & Mock Drill	Pollution Response Team (West), Mumbai
12 Sep	Krishnapatnam	Mock Drill	Coast Guard Station Krishnapatnam
18-22 Sep	Chennai	Level – 1 Course & Mock Drill	Pollution Response Team (East), Chennai
18-22 Sep	Port Blair	Level – 1 Course & Mock Drill	Pollution Response Team (A&N), Port Blair
25 Sep	Vizhinjam	Mock Drill	Coast Guard Station Vizhinjam
09-13 Oct	Vadinar	Level – 1 Course & Mock Drill	Coast Guard Station Vadinar
10 Oct	Beypore	Mock Drill	Coast Guard Station Beypore
09 Nov	Mumbai	Regional Level Exercise	Pollution Response Team (West), Mumbai
13 Nov	GoK Area	Area Level Exercise	Coast Guard Station Vadinar
22-23 Nov	New Mangalore	Area Level Exercise	Coast Guard Dist. Headquarters- 3, New Mnglr
27 Nov	Port Blair	Regional Level Exercise	Pollution Response Team (A&N), Port Blair
28-29 Nov	Paradip	Mock Drill	Coast Guard Dist. Headquarters– 07, Paradip






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