Effects of Oil Pollution on Bio Ecology and Fisheries on Certain Enclosed Coastal Regions of Arabian Sea

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The long coast line of Arabian Sea along the west coast of India has numerous enclosed areas and inlets where there has been a threat of crude oil pollution of increasing severity for the last few years. The oil pollution generally originates from (1) harbours and marine terminals (2) off-shore oil wells (3) oil tanker disasters and (4) land sources. On analysis it was found the enclosed regions of inlets were heavily exposed to the crude oil pollution by tankers carrying oil from the middle east oil fields to the South West Asia and far east. The degradation of oil involved both bacterial utilisation and partial dissolution. It was found that the low boiling saturated hydrocarbon fractions of crude oil caused mortality in a wide variety of fish and shrimp fry. The worst affected ones were the larvae that had deformed bodies and abnormal flexures of the tail which were unable to swim normally and most died within one day. The hydrocarbon content of the Indian seafood ranges from 0.6 to 3.0 mg/kg of wet.wt.

India as a maritime state occupies a pivotal position flanked by the Arabian Sea, Indian Ocean and the Bay of Bengal. The west coast of India of Arabian sea has a coastline of 3700 KM and is exposed to the risks of oil pollution on account of the heavy transportation of crude oil by Tankers from the middle east oil fields to the South East Asia and far east. Added to this, these are the exploration of offshore oil wells, the movement of country's own imports of the refineries and the movements on the coasts. Besides affecting human health through contaminated sea foods the pollution also reduces the recreational utility of coastal waters especially the beaches. Hence oil pollution is currently a problem along the west coast of India especially in the enclosed coastal regions.

Marine Pollution Bulletin, Vol. 23, pp. 239–245, 1991.
Printed in Great Britain
0025-326X/91 $3.00+0.00

REVIEW OF PREVIOUS WORKS ON PETROLEUM HYDRO CARBONS IN ARABIAN SEA OF INDIAN OCEAN

Studies on the Petroleum hydrocarbons along the coast of Arabian Sea, are very scanty. Some of the important studies in the recent years pertaining to the distribution of tarball and petroleum hydrocarbons are mentioned below:

Ayyappan Nair et al.(1972) studied the tarball distribution in some of the sandy beaches along the central west coast of India. Qasim (1975) made a general review of tarball deposition along the beaches of west and east coast of India. Sen Gupta et al.(1980) studied dissolved petroleum hydrocarbons in some regions of Northern Indian Ocean.

Ramamurthy and Sreenivasan (1983) studied the fate of degraded oil and its toxic nature in certain endemic regions and recovery.

The present paper deals mainly on effects of oil pollution on bio ecology and fisheries on certain enclosed coastal regions of Arabian Sea.

MATERIAL AND METHODS

To study large oil spills for a preliminary visual assessment mechanised boats and fishing trawlers were used. The mortality of fish was estimated on the basis of visual observation and only representative samples were collected on board the vessels. Tar was sampled using methods sepcified by UNESCO (1976) in which all tar lumps on 1 m wide transacts between high tide mark and water edge were collected and weighed. For long term monitoring fishes were caught by trawl and purse seine nets and immediately dissected into liver and muscle samples. Tissues for organic analysis were packed in solvent washed aluminium foil. All sampling gear and dissection instruments were precleaned and procedures were designated to minimize contamination from boats, gear or handling. Frozen samples were defrosted and analysed. Analytical methods used for hydrocarbons which are detailed in Burns & Smith (1981) was followed. Other precautionary methodological details given in UNEP(1981) were also followed.

SOURCES OF OIL POLLUTION

Oil pollution in the Indian Ocean in general originates from

1) Oil tanker disasters
2) Offshore oil wells
3) Harbours and marine terminals
4) Land sources

1) Oil tanker disasters: On 4th August 1970 in North West Coast of India, the greek oil tanker 'Ampuria' went aground off Kutch with a full load (15,622 tonnes) of furnace oil. There was a positive danger to fishing grounds if the oil had spilled out. However, the Indian Navy mounted an emergency operation and save about 12,000 tonnes of oil. Only 3,500 tonnes of oil leaked out. Again on 18th June 1973 another oil tanker "M T Cosmos Poineer" went aground in the same north west coast of India of Arabian Sea and broke into two releasing 18,000 tonnes of LDO. This resulted in mortality of marine life around North West Coast of India. On 26th September 1974 an American Oil tanker 'Transhuron' carrying 18,500 tonnes furnace oil ran aground at Kiltan in the Lakshadweep area of North West Cost of India of Arabian Sea spilling 3,325 tonnes of furnace oil and adversely affecting the marine life in the vicinity of Kiltan and South West Coast of Arabian Sea.

2. Offshore oil wells: The source of oil pollution from the offshore oil wells in the west coast of India off Arabian Sea in the coming decade will pose a serious threat to the Sea Food Industry in general and to the shrimp industry in particular. With the extensive reach for oil in the continental shelf and offshore regions, and enclosed coastal regions, the chances of spills from the oil wells during the drilling operations or subsequently from permanent structures are going to be greater. An instance of blow out of the mishap of the offshore drilling ship 'Sagar Vikas' in the Bombay high which was operating from platform No.5th offshore well that caught fire after a blow out on July'82. The well had a capacity to produce around 5,000 barrels per day corresponding to an around production of ¼ million tonnes which at international price was worth about US $ 53 million. Considerable amount of spill was taken place when extinguishing the fire of the well. The fall out debris from the liberated gas and crude oil caused a widespread damage to larval and planktonic forms in about 150 kilometers radius from Bombay high along the west coast of India.

3. Oil ports and terminals: In India shipping and trawling activities have increased 10 to 15 fold in recent years. Handling losses at oil terminals in the west coast of India of Arabian sea in the recent years also shown there have been a phenominal increase in the oil traffic. There are five major ports and numerous minor ports having oil terminal facilities to handle average of 4,000 tankers and 20,000 fishing vessels per year.
Though some tankers followed 'LOT' System but majority of the tankers do not observe the internationally prescribed conventions. The oil carrying vessels, after unloading the oil cargo seldom get completely empty. There is always some oil left in the tanks. In order to clear up their storage tanks,these tankers pump in sea water and then pump out the residual oil along with sea water. Such cleansing of the storage tanks are unlawfully done especially in the west coast of India off Arabian sea.
Though the oil tankers are instructed to discharge their residual oil in large storage tanks provided in ports but the recent trend in building super tankers largely dictated by economic considerations pose several serious problems. Similar problems, although smaller in magnitude, develop in fishing harbours which provide berthing facilities to fishing trawlers and landing jetties for small mechanised fishing boats and coastal barges. There are about 30,000 mechanised fishing trawlers are playing in and around the coastal belt. In addition to this equal number of ferries, cargo ships, barges and out board motors are playing all along the coast. In these harbours a thick film of oil is always present as a discharge from bilge over the water and very often it covers several kilometers around the harbour.

4. Land sources: The land source of oil and petroleum by-product enter the Indian coastal water as a waste material from land sources through drain pipes, open channels, rivers etc. india is importing an average of 19.0 million tons of crude to her coastal and inland refineries. This is in addition to its own production of 32 million tons including an offshore production of 21.0 million tonnes.
In conjunction the shore based refineries also contributed to oil pollution as a coolant and as a process water mixed with oil.

DISCUSSION

Crude oil or oil is a mixture of many different organic compounds, differ markedly in composition and physical properties as well as

in the relative concentrations of their individual components. Hydrocarbons are the most important constitutents of petroleum and form up to 98% of certain crude oil. Some oil components such as lower aromatics, paraffins and nonhydrocarbon constitutents are soluble in water and while oil spreads over the surface of the sea, gets dissolved into water rapidly. Other oils like fuel oil, motor oil are very thick and heavy gets mixed up with decayed plant and animal materials remained in the water column for a period of 8 to 14 months.

All crude oils contain compounds toxic to marine organisms. Some form extensive and widespread slicks, and others settle on the bottom and incorporate large amounts of sand in globules. The residues which remains after the evaporation of volatile substances are generally much denser than this oil originally spilled. In deeper areas those readily sunk to the bottom and never reappeared but in shallow areas the slicks deposited at the bottoms are stirred up by the wave action during monsoon season and these are washed ashore frequently - particularly along the enclosed coastal regions of Cambay, Karwar, Kasargod, Beypore and the back water regions of Cochin, Alleppey and Quilon.

In case of large spill caused by'Cosmos poineer' disaster in North west coast of India and 'Trans huron' disaster in South west coast of India invariably I noticed two distinct series of events within first few hours or days after the accident. There was a heavy kill of organisms that come into contact with the oil, the effect extended over all phyla and over benthic, pelagic and intertidal organisms (Nammalvar & Ramamurthy 1976). Next within weeks after the spill, the oil spread to areas that had not been affected initially and the kill extended although in some cases more slowly than the spread of the oil. For a considerable time after the spill, the oil prevented resettlement of the sediments by the original fauna. It was also observed the degradation of the oil in and around the locality of the disaster areas. The degradation of oil appears to involve both bacterial utilization and partial dissolution.

In the present investigation the bacterial degradation of crude oils were mainly done by the following strains of bacteria, Pseudomonas, Bacillus, and Flavobacterium and the biodegradation was in the following order alkanes cycloalkanes aromatics. Consurrently with the chemical changes in the oil

the immediate toxicity of the oil in the sediment was reduced due to evaporation of lighter fractions (Ramamurthy 1976). This reduction in the toxicity permitted to some extent resettlement of the polluted region first by most resistant fauna and later by more varied and normal fauna. Apart from the above short term effects the long term effects like the tar ball deposition occurred intensively either just before the monsoon or during the early part of the monsoon (June-July) in west coast of the Arabian Sea. The magnitude of deposition varied from coast to coast. Maximum depositions were generally found at the high water marks, where the tar lumps were also larger and heavier. In certain areas the layer of tar was more than 4 cm deep. The average concentration measured was 2.8 kg/m^2. About 6000 to 7000 tonns of tar residues were produced annually along the west coast of India. Many marine creatures ranging from fish, crustaceans, echinoderms response to chemical stimuli due to tar ball deposition that trigger numerous kinds of behavioural response including feeding. Blumer and Saas (1972) described detailed experiments on the sub-lethal effects of crude oil on the lobster (Homrorus americanus) in which they noted changes in the sensing movements, feeding behaviour and gill operation in presence of 10 mg dm-3 of insoluble crude oil components. As a result they foresaw more serious effects caused by chronic low levels of contamination competing with normal 'Feeding smells' and other chemical messengers than by direct damage to animals or other receptor organs.

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