

## INVESTIGATIONS ON OIL PATCHES AROUND 'M T LAJPATRAI' BOMBAY HARBOUR

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### ABSTRACT

Samples from three oil patches observed around the burning tanker *M. T. Lajpatrai* at Bombay Harbour were characterised using proton magnetic resonance spectroscopy (PMR). Two of them were found to be from used lubricating oils. As indicated by gas chromatographic fingerprint pattern, the third and the bunker oil sample was found identical with Bombay High Crude oil.

**Key-words :** Oil patch. *M. T. Lajpatrai*, Bombay Harbour.

The Bombay Harbour is getting increasingly polluted by a variety of petroleum products due to multifold increase in tanker traffic, enhanced activities in the offshore oil fields and industrial effluents and refineries wastes (Sen Gupta, Qasim, Fondekar and Topgi, 1980; Gill, 1984; Sood and Gottumukkala, 1984). Accidental spillage, tanker washing and leakages also contribute to the oil pollution load in the marine environment (Dwivedi, Desai, Parulekar, Josanto and George, 1974; Dwivedi and Parulekar, 1974; Dhargalkar, Kureishy and Bhandare, 1977; Clark and MacLeod, 1977; Costdam, 1984). The Govt. of India has introduced a legislation to penalise the culprits so as to conserve the environment (Chakraborty, 1984). The success of such stringent pollution control measures entirely depends upon the prospects of identification of the concerned oil spill. (Bentz, 1978; Jadamec and Klienberg, 1978). There is hardly any inventory of data pertaining to this aspect available in India. Hence, source identification studies become the basic requirement of oil pollution control programme.

Recently an accident occurred in the Bombay Harbour. A tanker '*M T Lajpatrai*' which was carrying 29 000 tonnes of crude oil and 800 tonnes of engine oil caught fire. It began to leak posing a grave threat of pollution and explosion in the harbour. As it was suspected that the spill might have polluted the environment, samples were collected from the area and the results obtained are presented here.

The area around the tanker was surveyed after six days of the accident on 31st Oct. 1984. Only two oil patches (A and B) of approx. 1 m 0.7 m were observed at locations 1 and 2 while a very small and thin patch (C) was seen at 3 (Fig. 1). They were collected by skimming, filled in pre-cleaned polythene bags and preserved in deep freeze. The sample (10 g) was dissolved in dichloromethane (200 ml, b.p. 39-41°C, Cat.No. 39643, Sarabhai). The orga-

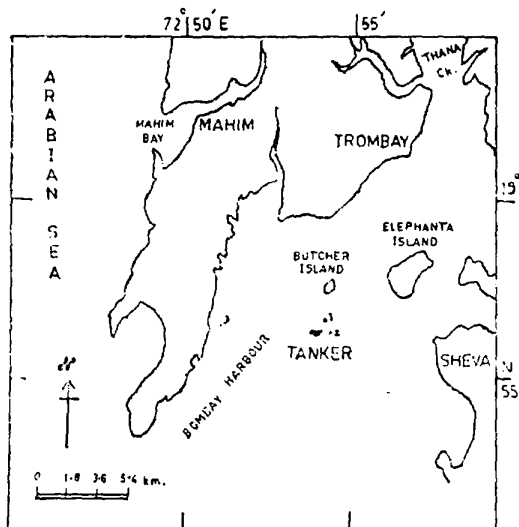


Fig 1. Map of Bombay Harbour showing Locations of the tanker and sampling

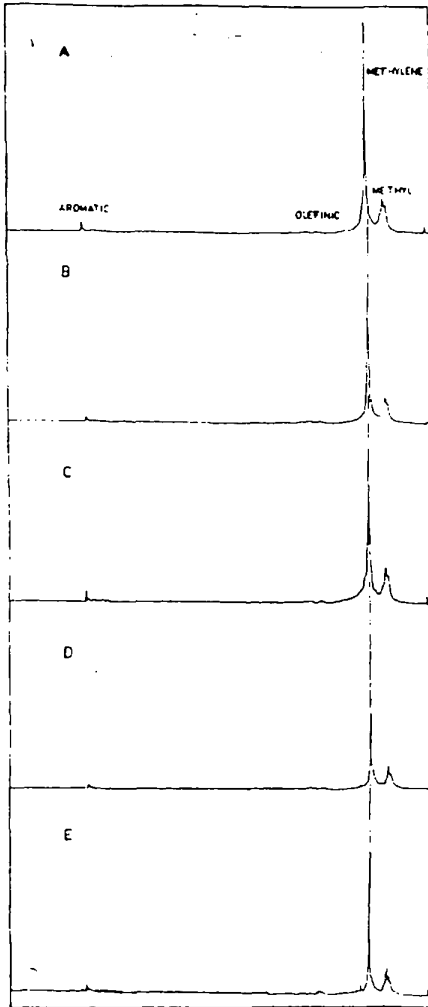
nic layer was separated, dried over anhydrous sodium sulphate and concentrated at 30°C/200 mm. to get a brown semisolid.

Bunker oil (D) and Bombay High Crude Oil (E) were obtained from Director General, Shipping, Bombay and Oil and Natural Gas Commission (ONGC), Bombay respectively.

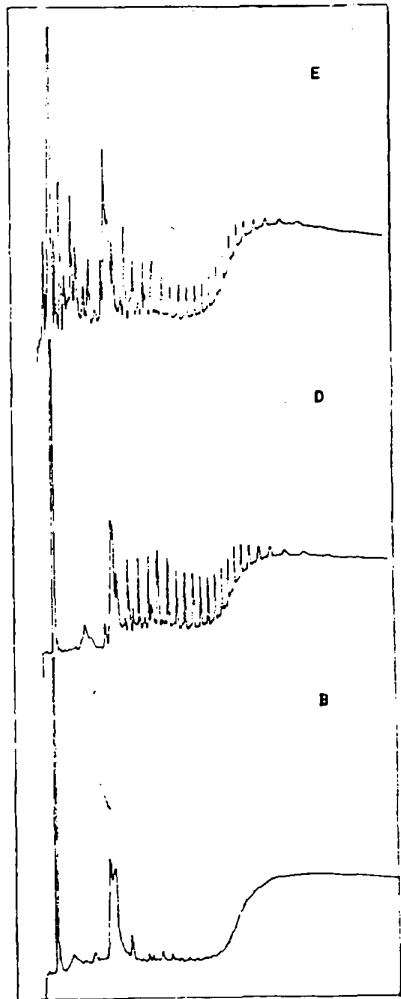
PMR spectra were scanned for 0-15  $\delta$  region in  $CdCl_2$  solution on Varian, XL100 FT using TMS as internal standard. Gas Chromatographic analysis was performed on Perkin Elmer, Sigma 3 B using OV 17(5%) stationary phase coated on chromosorb W-HP and flame ionisation detector (FID).

PMR of the samples were scanned to obtain preliminary information about samples (Fig. 2). All the samples gave complex patterns at 0.80-1.00, 1.32-2.80 and 6.80-8.00  $\delta$  and a sharp singlet at 1.28.  $\delta$  The alkyl signals (0.80-1.00  $\delta$ ) of A and C were more intense than that of B, bunker oil (D) and Bombay High Crude oil (E) (Silverstein, Bassler and Morrill, 1981). Additionally, spectra of A and C appear to have identical overlapping patterns which were similar to the PMR of used lubricating oil. The appearance, nature and mobility of the samples also indicate that they might have originated from used lubricating oil. Some notable features in spectra of B, D and E are as follows. Only aliphatic methyl (0.80-1.00  $\delta$ ) and methylene (1.28  $\delta$ ) signals of B were prominent while for sample D, additional signals of olefin

(1.32-2.8  $\delta$  ) were also observed. On the other hand, in case of E which is virgin Crude Oil not only all the above mentioned signals were intense but signals pertaining to aromatics (6.80-8.00  $\delta$  ) were quite distinct.



(Fig. 2)



(Fig. 3)

Fig. 2. PMR of field samples A, B and C, bunker oil (D) and Bombay High Crude oil (E)  
 Fig 3. Gas Chromatograms of Bombay High Crude oil (E), bunker oil (D) and field sample (B).

It has been reported that gas chromatography serves as an appropriate analytical tool to give positive evidence about origin of a spill sample (Ramsdale

and Wilkinson 1968; Cole 1968; Anonymous, 1970; Jadamec and Klienberg, 1978). A suspected source sample and a spill sample were analysed under identical instrumental parameters to get complex fingerprint patterns consisting of several peaks. The matching of profiles of gas chromatograms indicates an identity of origin of the samples. It is well known that after the spillage, oil is subjected to environmental transformations called weathering. Weathering is a complex process in which several physical and chemical factors act simultaneously to alter the composition of a spill (Clark and MacLeod, 1977). Due to this, several chemical characteristics of the spill change. However, gas chromatographic pattern of a sample does not alter even though the sample is weathered to a great extent (Bentz, 1978; Jadamec and Kleinberg, 1978). Therefore, it was decided to employ the gas chromatographic technique in this case. Some notable observations from the chromatograms (Fig. 3) are as follows.

In the chromatogram of E (fresh oil), all the peaks particularly those corresponding to the low boiling fractions were intense. Chromatogram of D shows very low boiling fractions in minor percentages. In comparison, intense peaks over the entire range have not appeared in chromatogram of B suggesting lesser percentage of compounds corresponding to the range of boiling points. Loss of the constituents seems to be due to weathering in which two vital factors namely evaporation and dispersion play a prime role in changing the composition of a spill (Clark and MacLeod, 1977). It has been reported that 60-90% of the spill is lost due to evaporation alone. low boiling fraction that boils below 150°C is lost at the end of one hour (Gearing, Gearing, Wode, Quinn, McCarty, Ferrington and Lee, 1979; Institute of Petroleum Oil Pollution Analysis Committee, 1974). Presence of intense peaks at intermediate position is surprising. However, in spite of low b. p. (60°C) of B, the chromatogram clearly indicates that it is a weathered sample. The profiles of B, D and E are superimposable revealing that they are of identical origin namely Bombay High Crude Oil. Any sample originated from the tanker and collected at a short distance from the tanker would be fresh containing compounds of very low boiling points. It may afford a gas chromatogram similar to that of virgin Bombay High Crude (E). But the sample (B) is substantially weathered, clearly suggesting that it has not originated from the fateful tanker.

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