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Tar Loads on Omani Beaches

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Owing to Oman's geographic position and long coastal line, the coastal areas of Oman are particularly vulnerable to oil pollution from normal tanker operations, illegal discharges, and accidental spills as well as local sources of oil input (Burns et al 1982). UNEP (1980) carried out a survey on the coasts of Oman to determine the major sources of oil pollution and concluded that the major shoreline pollution problems in Oman arose from operational discharges of oil from passing vessels traffic. The oil, because of the high sea and air temperatures in the area, was subjected to relatively high rates of evaporation and photo-oxidation and tended to arrive at the coast as heavy petroleum particulate residues (tar balls). The aim of the present study was to measure the loads of tar balls in Omani coastal areas and to identify the source of oil pollutants on beaches.

MATERIALS AND METHODS

Tar loads were assessed using standard methods specified by UNESCO (1984) in which all tar lumps on a transect 1 m wide between high tide and the water's edge were collected by hand and weighed to the nearest 0.5 g. These methods have been shown to give an accurate assessment of the quantity of tar on beach transects regardless of the level of the tide or width of the beach face.

A known weight (100 g) of each oil sample was dissolved in n-hexane to participate asphaltenes. An aliquot of each supernatant (2 mL) was then charged to a column of 5% aluminum oxide, deactivated with 5% distilled water, packed over 5 g silica gel (5% water). The hydrocarbons were eluted with one column volume of pentane (Farrington and Meyer 1975). The resulting aliphatic fraction (F1) was reduced to about 5 mL by rotary evaporation. The extract was transferred to a vial, blowed down using gentle stream of pure nitrogen, and subjected to FID gas chromatograms.

Analysis of hydrocarbons were carried out on Pye Unicam GC (made in England) equipped with FID detector and 25 m WCOT SE-54 column. The initial column temperature was 80°C. After initial hold for 3 min, the temperature was programed to rise at 8°C/min to 280°C for 10 min. The injector and detector temperatures were 300°C and

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Figure 1 : Coastal Stations Sampled in the Sultanate of Oman.

350°C, respectively. Helium was used as a carrier gas, at a flow rate of 2 mL/min.

The quality control program included the following steps: **1.** A blank was run with each set of analysis. **2.** The calibration program was verified on each working day by the measurement of one or more standards. **3.** A random sample was run in triplicate. Quality control sample was analysed with each series of actual samples to verify the adequate recovery of the n-alkane compounds. The relative standard deviations ranged between 15% to 20% of the mean.

RESULTS AND DISCUSSION

Beach tar surveys are recognised as an important aspect of coastal oil pollution monitoring programs for assessing the level of oil pollution in offshore waters and the relative threat posed to coastal resources. They also provide information in support of coastal oil pollution regulatory measures and provide some indications as to where oil would accumulate in the event of an accidental spill in offshore waters.

Several general features were noted regarding the loads of tar ball on Omani beaches. The color of tar was usually indicating the age. The fresh tar was usually pitch black and older tar beached to greyish color by exposure to the sun. On Omani beaches most tars were pitch black and accumulated in bands along with high tide mark. On scalloped beaches, the highest concentrations of tar were mainly found on the windward side of sand cups or obstructions such as rock outcrops. Tar balls in this area were

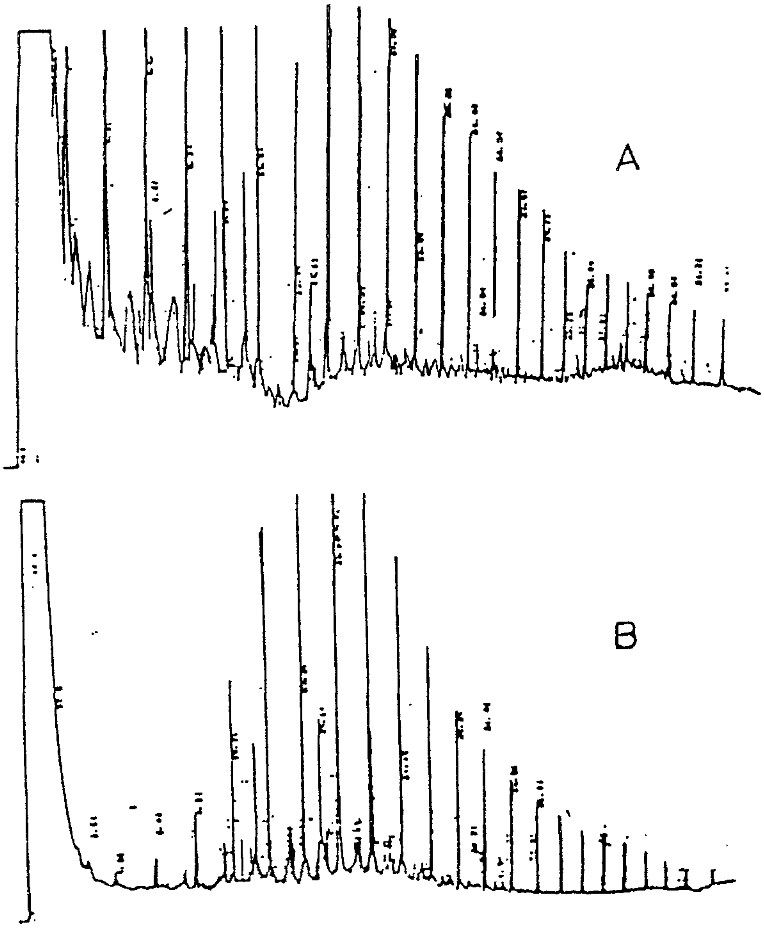

Figure 2. Gas chromatograph of (A) Omani crude and (B) Oil samples collected from Mina Al-Fahal beach.

Table 1. Average values of tar on Omani beaches.

Site	Value, g/meter shore							
	Oct 1985	Apr 1986	Oct 1986	Apr 1987	Oct 1987	Apr 1988	Oct 1988	Mean
Lima	227	480	227	94	6	50	78	166
Al-Qurum	47	34	47	59	10	22	30	35
Mina Al-Fahal	55	55	55	64	10	22	32	42
Masirah	82	95	82	161	80	70	90	94
Taqah	1	6	1	3	32	15	10	10
Maghsail	1	6	1	1	16	12	8	6

Figure 3. Hydrocarbon compositions of oil samples collected from (A) Al-Qurum, (B) Masirah and (C) Lima sites.

often extremely small and semi solid. At other sites, in particular in Northern Oman near Bukha, large hard tar lumps were found high on the beach above the high tide mark.

The location of beach sites are shown in Figure 1. The average quantities of tar were calculated and presented as g/m in Table 1. The highest concentration was found at Lima site, while the lowest level was observed in samples from Taquah site, Southern Oman. Generally, where comparison can be made, it appears that during all the periods of survey (1985-1988) there was considerably less tar on the beaches in Southern Oman in Salalah area, except at Taquah in October 1987, during the upwelling period, when it amounted to 32 g/m. As a general trend the levels of tar were as follows: Lima > Masirah > Mina-Al-Fahal > Taquah > Maghsail. The high loads at Masirah site were mainly due to discharge of ballest waters. At Northern Oman the highest level of tar could be attributed to oil spills in the vicinity of Hormuz and the discharging of ballast waters as tankers approach the Straight of Hormuz (Burns et al 1982).

However, during spring of 1987 the loads of tar were lower than the levels recorded previously (Burns et al 1982; Fowler 1985). It is significant that, with the exception of Southern Oman the values of tar balls found on Omani beaches were among the highest values recorded for any World area (Burns et al 1982; Oostdam 1984).

To distinguish between the different types of crudes and to identify the areas from where they come, Oman crude oil and four beached oil samples collected from Lima, Al-Qurum, Mina Al-Fahal and Masirah were analysed by using FID Gas Chromatograph.

The gas chromatograms (GC's) of fraction number one (F1) for Omani crude oil and four beached oil samples were given in figures 2 & 3. Gas chromatographic analysis revealed that the Omani crude oil was a light crude with a n-alkanes distribution from C9 to C35 maximizing in the range of C11-C15 and with a pristane/phytane ratio of 1:2.

The analysis of oil samples collected from Mina Al-Fahal and Al-Qurum sites show reduced quantity of low molecular weight saturated hydrocarbons compared to Omani crude due to weathering or degradation of those compounds in environment (Albaiges and cuberes 1980). The n-alkanes distribution in samples from Al-Qurum and Mina-Al-Fahal ranged between C-12-C35 with low concentraiton of unresolved complex mixture (UCM) and pristane/phytane ratios of 1:1 and 1:58 respectively.

Lima and Masirah samples analysis indicated that n-alkanes distribution was between C12-C36 with heavy n-alkanes more prominent than Omani crude. Pristane/phytane ratios were 1:43 and 1:45 for Lima and Masirah samples respectively. The UCM was more apparent in Masirah and Lima chromatograms than in Omani crude. Generally, increase in UCM in beached oil samples is associated with biodegradation of oil (Ferrington and Meyer 1975).

Figures 2 and 3 compare the FID chromatograms of Omani crude and Al-Qurum oil sample which indicated that the oil sample was probably a weathered Omani crude. In contrast, GC analysis of samples collected from Masirah and Lima sites indicated a large difference in the shapes of chromatograms obtained and the distribution of n-alkanes as well as the pristane/phytane ratio. In case of Mina Al-Fahal sample, the chromatogram (Fig. 3) is similar to Omani crude chromatogram, meanwhile the pristane/phytane ratio is more than in Omani crude (1:85). The difference in oil compositions of all beached samples and in the distribution of n-alkanes suggests that all oil samples were from different origins and the samples from Masirah and Lima were completely derived from foreign sources.

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