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Petroleum pollution by Volgoneft-248 tanker accident occured on 29.12.1999 in İstanbul, Florya-Küçükçekmece area [1]

Volgoneft-248 tanker kazası sonrası İstanbul, Florya-Küçükçekmece bölgesinde 29.12.1999' da meydana gelen petrol kirliliği [1]

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Abstract

In this work petroleum pollution of Volganeft-248 tanker accident was investigated in Florya and Küçükçekmece area in Sea of Marmara. After the accident 4365 tones oil spill in this area. The analysis was made by UVF and GC/MS during the 40 months survey. After the accident the oil pollution was 14.05 g/L at S_3 seawater and 441 µg/g at A_4 sediment. The oil pollution has decreased to 0.94 µg/L in seawater and to 9.6 µg/g in sediment in April 2003.

Keywords: Volgoneft-248, accident, Florya, Küçükçekmece

Introduction

Russian flagged tanker VOLGONEFT-248 (4,039 DWT) loaded 4365 tons of fuel from Bourgas/Bulgaria and anchored off Ambarlı fuel oil terminal by passing through the Istanbul Strait in order to discharge his cargo. On the 29.12.1999 around the morning hours, firstly chain cable of the vessel came

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of due to the heavy South Wind storm and the vessel split into two about 1km away from shore. Bow part sank at once and aft side of vessel drifted and grounded at shore of Küçükçekmece, Menekşe District. As a result 1279 tons of fuel oil existing in fore tanks No: 5 and 6 spilled into the sea. Due to the 2073 tones existing in four tanks at fore side and 1013 tones of fuel oil existing in tanks No: 7 and 8 at aft side spilling into sea until the divers closing the holes at fore side, thus totally 4365 tones of fuel oil spread to the accident area.

The fuel oil spilled into the sea spread to around 7 km area of Florya Shore rapidly in a few hours due to heavy wind blowing storm and relevant waves. Wideness of fuel oil at shore is between 2 to 10 meters in some areas, thickness of fuel oil on sea surface reached 5 cm. Barriers were laid around the vessel in order to avoid leakage of remaining fuel oil.

There is sandy rock, concrete platform at shore close to the accident area and there are a lot of restaurants, sea side cafes, summer houses in that area. The fuel oil, which is thick and adhesive in low temperatures during winter months, filled in the spaces between sand grains at sea bottom and as a result, sand sheets saturated with fuel occurred at the sea bottom. Thus, great part of the fuel oil floating at shore was covered up with sand and spread in sheets over the sea bottom along the shore. It was observed that fuel oil accumulation was high in the area between Engelliler Kampı and Marmara Motelleri. The mussel shell smeared to the fuel oil came to shore. Thus, a great many districts in vicinity were affected by fuel oil pollution. The sea birds were affected badly by the pollution and died.

Operations were carried out in order to remove the pollution by the relevant commission and Crisis Committee constituted by Istanbul Governorship. Thus, the whole shore affected by pollution and smeared with petroleum was cleaned many times and after discharging remaining bunker in the sunken part of VOLGONEFT-248, the wreck was removed.

In this paper the petroleum pollution of seawater and sediments were reported after tanker VOLGONEFT-248 accident on the 29/09/1999 in Florya– Küçükçekmece area, Sea of Marmara.

Material and Methods

The sampling was made by R/V ARAR on the date of; 30 December 1999, 3 January 2000, 23 February 2000, 23 May 2000, 15 August 2000, 26 January 2001, 10 August 2001, 25 January 2002, 10 April 2003 and continued yearly until 2006.

The sampling stations in the accident area are shown in Figures 1 and 2.

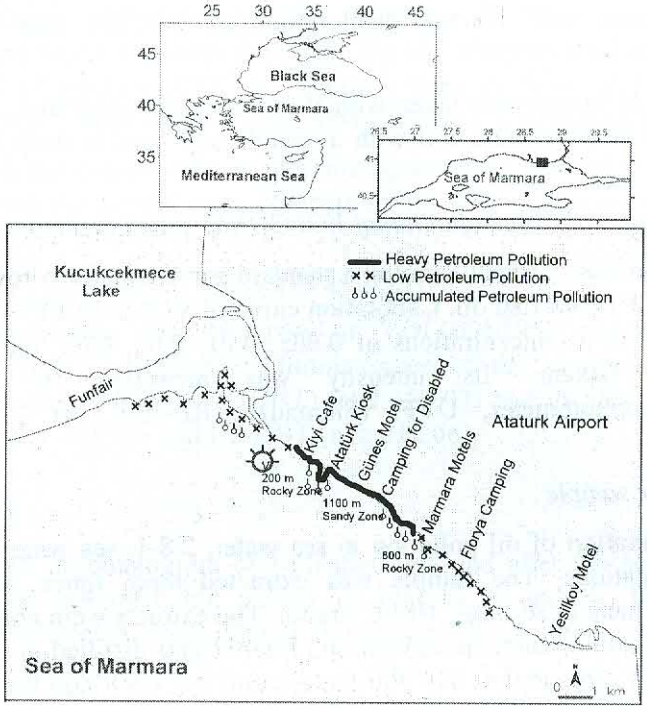

Figure 1. The map of accident area

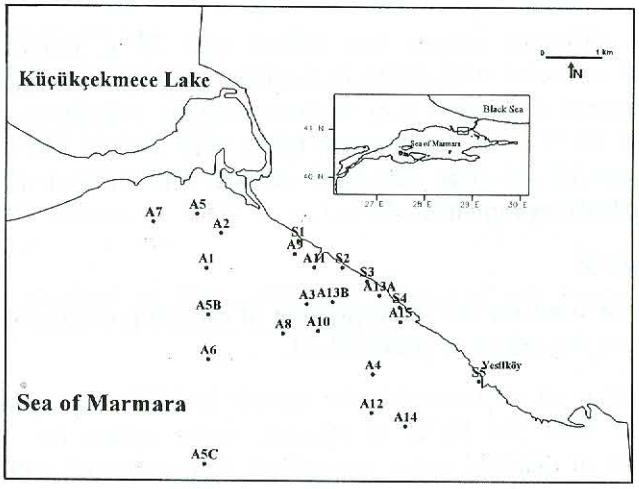

Figure 2. Sampling stations in the accident area

Sea water sample was taken from surface by special apparatus, at 10 m and depth water by Niskin apparatus. The sample was transferred to 3 L cleaned brown flacon and 15 ml dichloromethane (DCM) was added for preservation.

The sediment sample was taken with Van Veen grap apparatus. The sample was placed in aluminium foil with a spatula and kept in deep freeze until analysis.

The Standard curve and equation of VOLGONEFT-248 fuel oil

Oil pollution was determined using a standard curve equation drown with the VOLGONEFT-248 fuel oil. Calibration curve of VOLGONEFT-248 fuel oil was plotted in a concentrations of 0.005, 0.01, 0.02, 0.03, 0.04 and 0.05 µg/ml in hexane. Its intensity was measured by Ultraviolet fluorospectrophotometer, UVF, (Shimadzu, RF-1501) at 310/360 nm (ex/em).

1. Sea water sample

For determination of oil pollution in sea water, 2.8 L sea water was taken from the stations. The sample was extracted three times with 50 ml dichloromethane (Lab Scan, HPLC grade). The extracts were combined and dried over sodium sulphate anhydrous, filtered and distilled at 36 °C. The intensity was measured at 310/360 nm (ex/em) by UVF and the amount of oil level was calculated by using standard curve equation.

2. Sediment sample

20 g of wet sediment sample was mixed with 25 g sodium sulphate anhydrous and extracted with DCM in Soxhlet apparatus for 8h. The DCM extract was filtered and dried over sodium sulphate anhydrous, re-filtered and distilled at 36 °C. The residue was taken with hexane and the volume was adjusted to 10 ml with the same solvent and the oil amount was determined by UVF as indicated above.

3. GC/MS analysis

This method was used for the determination of oil components subsequently and also to prove the origin of pollutant oil.

After determination of oil amount in the sample by UVF, the remaining part was hydrolyzed with 5% KOH in ethanol, under reflux for 2 h. After hydrolysis 50 ml of distilled water was added, then extracted with 25 ml of pentane. The pentane phase was separated and distilled. The residue was taken with hexane and analyzed by GC/MS.

GC (HP 6890) coupled to mass spectrophotometer HP 5972 A. A split/splitless injector was used, injection; 2 µl split time: 1 min, flow 60 ml min^{-1}. Column; HP-5MS: 30 m x 0.25 mm x 0.25 µm, The injector temperature was maintained at 280^0C. The GC temperature programme was: from 50^0C (1 min) to 320^0C at 5^0C min^{-1}. The carrier gas was helium, flow rate 1 ml min^{-1}. Mass spectral data: SIM (Selective Ion Monitoring Mode).

The petroleum components on chromatogram were identified by using HP memory and the results were compared with the petroleum components of VOLGONEFT 248 fuel oil.

4. Fingerprinting method (Boehm et al., 1983)

The fingerprinting chromatogram of VOLGONEFT 248 fuel oil was compared with fingerprinting chromatogram of the samples. The markers used were dibenzothiophene (DBT) (m/z 184.03) and its alkylated derivates C1-DBT (m/z 198.05) and C2-DBT (m/z 212.06).

Results

The GC/MS chromatogram of Volganeft-248 and after the accident the oil extracted in seawater are shown in Figures 3 and 4. The petroleum component detected by GC/MS in Volganeft-248 fuel and seawater sample are shown in Table 1.

1. UVF analysis

The standard curve equation of VOLGONEFT 248 fuel oil is:

F_1= 1304.7xC+79.149 r^2: 0.99

F_1: Fluorescence intensity, C: Concentration

2. Oil pollution of seawater

Oil pollution levels in sea water samples and on coast-line of examined stations are shown in Table 2 and 3 and their graphical representation in Figures 5-7.

After the accident on 29.12.1999, the surface of sea water was completely covered by oil at the stations S_1, S_2 and S_3.