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Oil and Detergent Pollution of Sea Water in Dardanelles in 2001 – 2002

Çanakkale Boğazında 2001- 2002 Yıllarında Petrol ve Deterjan Kirliliği

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Abstract

Pollution by oil and detergent was investigated in sea water of Dardanelles in this work. The highest pollution in surface water was found for oil 232.24 µg/L in Gelibolu and 15.38 µg/L in Kilitbahir and for detergent 62.05 µg/L in Gelibolu, 105.8 µg/L in Lapseki and 44.38 µ/L in Kilitbahir. The pollution level was high near seawage point of Çanakkale as 226.27 µg/L for oil and 148.56 µg/L for detergent. The pollution was found higher in 10 m depth than in surface water.

Key Word : Oil, detergent, pollution, Dardanelles

Introduction

Turkish Straits are composed of Istanbul Strait (Bosphorus), Sea of Marmara and Çanakkale Strait (Dardanelles). They are on tanker route of Russian, Azeri and Kazakh oil coming from the north. Apart from this, oil of Arabian Gulf, İran,

Iraq, Syria, Libya and Egypt arrives to the rafinery of Izmit through the Dardanelles and Sea of Marmara.

Dardanelles has a transit traffic of 42.000 ships / a. The high traffic of vessels and especially tankers have caused oil pollution in this area.

Dardanelles is 62 km long, 1.2 – 6.5 km wide and max. 105 m deep. Two water currents exit in the strait. The upper current flows in NS direction at the rate of 1.6 knots and under current of 0.4 knot counter-wise. Water exchange between the Sea of Marmara (The Black Sea water, upper layer) and Aegean Sea (The Mediterranean water, under stream) produces a characteristic layer within the strait (Annon, 1942).

Petroleum pollution is an important subject of the Turkish Straits. The sources of oil pollution in sea water have been discharge of ballast water, tankers accidents and shipping activities etc. The oil is composed of various aliphatic and aromatic compounds. It contains toxic compound for marine life (Miranov, 1991, Glegg *et al.*, 1999). Even very low concentration of oil hinders photosynthesis. Especially following oil spills from tanker accidents, zooplankton biomass fell dramatically for about five days by the death of animals.

Oil pollution was determined in marine environment by spectrofluorometric methods (IOC, 1982, Law *et al.*, 1987).

Detergent is a composition of various compounds as suspension agents, stabilizer and phosphates etc. and contains mainly surface active agents especially linear alkylbenzene sulfonate (LAS). It contains mainly $C_{10} - C_{14}$ alkylgroups and is largely used in household products and cleaning industries. LAS poses a special problem in the pollution of rivers and seas is a toxic compound for marine life (Alabaster, 1978 ; Tsai and Makee , 1978; Sing and Devi, 1989; Topçuoğlu *et al.*, 1992, Koç *et al.*, unpublished data). LAS is not a stable

compound. Its degradation in distilled, tap, river and sea water depends on temperature, light and microroganism contents (Black and Howes, 1980; Okpokvasili and Olisa, 1991; Terzic *et al.*, 1992 a,b ; Hon – Nami and Hanya, 1980; Gonzalez – Mazo and Gomez, 1996; Koç *et al.*, 2002).

LAS was determined by various methods as spectrophotometric (Standard Methods), metachromatic (Güven *et al.*, 1994) and HPLC method (Marcomimi and Grigen, 1987, Terzic and Ahel, 1993, Koç *et al.*, 2001).

In this work the oil and detergent pollution was determined in Dardanelles sea water.

Material and Methods

3 L sea water sample was taken in Dardanelles montly in Apr. 2001 – March 2002 from the northern entrance, Gelibolu – Lapseki, and the city of Çanakkale and Kilitbahir.

The sampling stations are shown in Fig. 1.

The sea water samples were extracted twice with 100 ml DCM. The extracts were combined, dried over anhydrous sodium sulphate, filtered and distilled at 40 °C. The residue was dissolved with hexane and the volume adjusted to 10 ml with the same solvent.

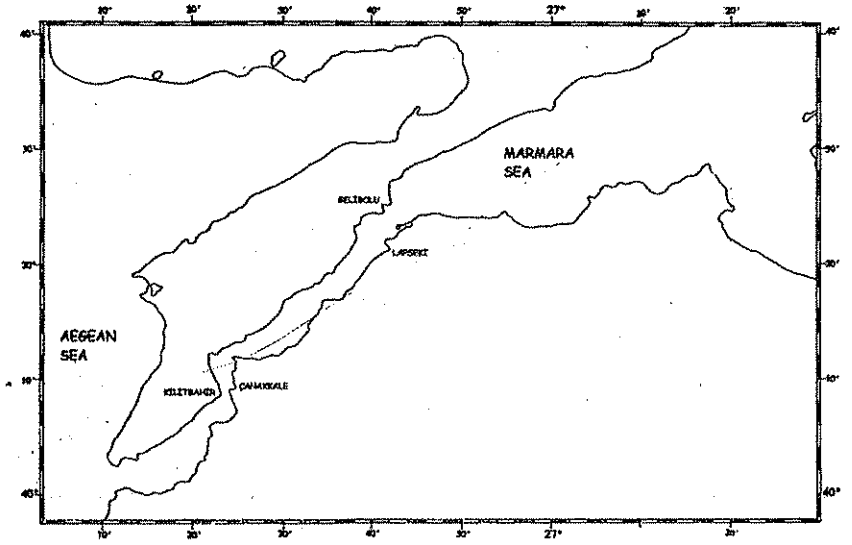

Fig. 1. Sampling stations

The oil analysis was made by fluorospectrophotometer (UVF) (Shimadzu, RF – 1501). The calibration curve was plotted by using each crude oil of Arabia, Egypt, Libya, Syria and Russia. The oil samples were obtained from the İzmit Rafinery. The oil concentrations were 0.25, 0.50, 1.00 and 1.50 µg/ml in hexane. The intensity of oil samples were measured by flourospectrophotometer and the oils levels determined by using a correlation equation calculated from the equations of standard curves for each crude oil (Güven and Çetintürk, unpublished data).

Detergent pollution (LAS) was determined by MBAS method (Standard Methods) by using 3 L sea water samples. The standard curve was plotted for LAS (Lever, Turkey) in concentration of 10 – 100 µg/ml against blank prepared with ‰22 NaCl in distilled water, simulating Marmara Sea water. Thus the influence of salt concentration in sea water on the assay of LAS was eliminated (Çetintürk and Güven, unpublished data).

Results and Discussion

The results of oil pollution in sea water are shown in Table 1.

The highest oil pollution was found as 226.27 µg/L at Çanakkale near the discharge of urban seawage in June 2001. The pollution level of surface water in Gelibolu was also high as 148.36 µg/L and 107.14 µg/L in mid. point of the strait in June. The level was high in the same area of Gelibolu in April. Oil pollution in surface water of Çanakkale was 87.23 µg/L and in Kilitbahir as 15.38 µg/L in June 2001. No appreciable difference was observed for pollution levels in Sept. 2001 – March 2002. Pollution amount was generally below 10 µg/L in Dec. 2001 – March 2002.

These results are compared with those of 1996 (Güven *et. al.*, 1999) and 1997 – 1999 (Güven *et. al.*, unpublished data). The maximum levels were 5.24 µg/L in 1995 and 43.50 µg/L in 1996 and 0.88 – 85.79 µg/L in 1997 – 1999 at Gelibolu,

5.29 µg/L in 1995 and 40.9 µg/L in 1996 and 0.93 – 110.31 µg/L in 1997 – 1999 at Çanakkale.
The results showed that the oil pollution in Dardanelles increased appreciably since 1995.

Detergent pollution was the highest as 148.56 µg/L at near seawage point of Çanakkale. The pollution was also high at Lapseki in Feb. 2002 as 105.80 µg/L. The levels were high at Gelibolu in Apr. 2001 and Feb. 2002 and at Lapseki in Feb. 2002

The detergent pollution level in sea water is shown in Table 2.

The detergent level in the strait was high in Apr. 2001 but decreased till Dec. 2001 and then rose again from Dec. 2001 to March 2002. The pollution was found high at all stations in Apr. 2001 and Dec. 2001 – March 2002. These findings showed that detergent levels were high in winter than in summer.

The detergent pollution in coastal area of Dardanelles was 50.23 and 50.51 µg/L in Gelibolu and Lapseki respectively. Comparison of these results with those of shipping route of Dardanelles show that the coastal area were more polluted than of mid. point of sea which were 61.84 µg/L in exit (Çanakkale) for 1996 and 80.08 µg/L for 1998 (Güven and Ilgar, 2002). This can be attributed to the urban sewage

The highest pollution was noted as 148.56 µg/L at Çanakkale sewage.

Max. levels found at the stations examined in Sea of Marmara varied as 28.98 µg/L at surface water, 31.40 µg/L at 5 m deep, 45.64 µg/L at 10 m deep, 31.16 µg/L at 20 m deep, 29.21 µg/L at 30 m deep, 34.74 µg/L at 40 m deep, 52.29 µg/L at 50 m deep, 27.59 µg/L at 80 m deep and 41.38 µg/L at 100 m deep.

Table 1. Oil pollution levels in Dardanelles in 2001 – 2002 (µg/L).

Month / Years Stations	04/01	06/01	07/01	09/01	10/01	11/01	12/01	02/02	03/02
Gelibolu surface	87.92	148.36	-	-	1.63	2.59	3.21	13.26	-
Gelibolu mid. surface	59.03	107.14	5.63	14.88	3.73	232.24	5.67	4.92	3.43
Gelibolu mid. 10m. deep	-	-	6.24	5.48	3.74	27.41	2.45	2.83	3.63
Lapseki surface	-	-	-	-	3.16	1.48	1.98	7.87	5.17
Lapseki 10m deep	-	-	-	-	-	-	-	-	2.56
Çanakkale surface	-	87.23	-	-	1.87	0.69	5.76	4.69	-
Çanakkale mid. surface	-	-	9.01	3.51	1.12	1.68	3.08	9.01	3.98
Çannakale mid. 10m	-	-	2.70	1.92	1.04	6.25	3.38	6.06	1.59
Çanakkale sewage	141.42	226.27	16.87	5.70	2.35	2.61	1.92	9.55	-
Kilitbahir surface	-	15.38	-	-	6.31	0.50	2.12	7.21	5.76
Kilitbahir 10m deep		-	-	-	-	-	-	-	3.34

(-) : Not examined.

Table 2. Detergent pollution levels in Dardanelles in 2001 – 2002 (µg/L).

Month / Years Stations	04/01	06/01	07/01	09/01	10/01	11/01	12/01	02/02	03/02
Gelibolu Surface	38.67	-	-	-	12.91	7.60	42.17	62.05	-
Gelibolu Mid. Surface	43.18	19.94	2.88	2.96	6.84	8.08	31.24	61.84	39.25
Gelibolu Mid. 10m.	-	14.20	2.99	-	7.25	8.28	27.39	45.49	50.34
Lapseki Surface	-	-	-	-	10.49	3.16	25.01	105.80	36.82
Lapseki 10m		-	-	-	-	-	-	-	44.98
Çanakkale Surface	37.08	-	-	-	14.11	5.18	28.40	31.15	-
Çanakkale Mid. Surface	-	-	9.73	26.80	22.12	10.85	32.20	28.31	36.01
Çannakale Mid. 10m	-	-	7.84	8.83	15.61	7.40	38.43	42.95	56.52
Çanakkale Seawage	35.10	13.76	148.56	16.25	20.41	4.14	41.06	26.90	-
Kilitbahir Surface	-	22.89	-	-	17.84	4.23	33.67	30.74	44.38
Kilitbahir 10m	-	-	-	-	-	-	-	-	42.49

(-) : Not examined.

The comparison of the results obtained from the Sea of Marmara and Dardanelles showed that the detergent pollution increased during the years.

In general detergent level was higher at 10m depth than in surface water.

Özet

Bu çalışmada Çanakkale Boğazı' nda Nisan 2001 – Mart 2002 yılında petrol ve deterjan kirliliği araştırıldı. En yüksek kirlilik miktarı petrol için Gelibolu'da 232.24 µg/L, Kilitbahir' de 15.38 µg/L ve deterjan için Gelibolu yüzey suyunda Şubat 2002 de 62.05 µg/L, Lapseki de Şubat 2002 de 105.80 µg/L, Kilitbahirde 44.38 µg/L bulundu. Genelde 10 m. derinlikteki deterjan kirlilik miktarı yüzey suyundan fazla bulundu. Deterjan kirliliği Nisan 2001 ve Aralık 2001 – Mart 2002 arasında yüksek bulunmuştur. Yaz aylarında ise deterjan miktarı düşüktür. Marmara Denizi ile mukayesede deterjan miktarı Çanakkale Boğazından yüksektir. Bu üzerinde durulacak bir husustur.

Bu sonuçlardan Çanakkale Boğazının petrol kirliliği Aralık 2001 ile Mart 2002 arasında 10 µg/L' nin altındadır, buna karşın aynı tarihlerde deterjan kirliliği genelde 30 µg/L – 60 µg/L arasında değişmiştir.

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