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Oil pollution of Golden Horn seawater

Haliç deniz suyunda petrol kirliliği

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Abstracts

The oil pollution was investigated in Golden Horn in February, April and May 2005. The analysis was made by ultraviolet fluorospectrophotometer and gas chromatography – mass spectrometer. The maximum oil pollution was found in the seawater under Haliç Bridge 174.50 µg/L in 04/2005, 130.50 µg/L in 05/2005, in the seawater under Unkapanı Bridge 104.90 µg/L in 02/2005 and in the seawater under Galata Bridge 56.45 µg/L in 05/2005. Many linear aliphatic (C_8-C_{44}), (C_5, C_{14}, C_{24} derivates), cycloalkane and alkene (C_{11}-C_{16}) were detected. Aromatics 1-ring (benzene derivatives), 2-rings, benzofuran, 3-rings (anthracene, phenantrene) were identified by GC/MS analysis.

Key words: Oil, Golden Horn, seawater, analysis

Introduction

Golden Horn is a narrow inlet of the Bosphorus, separating İstanbul from Eyüp, Eminönü and Hasköy - Karaköy. It is 8 km long and 200-700 m wide. The deep is 1-2 m Eyüp-Sütlüce, 40 m at Atatürk Bridge and 50 m at Galata Bridge. Its area is 2.6 km^2, two streams exist as Alibeyköy and Kağıthane are falling into the Golden Horn.

Special symposium were organized to discuss of the problems of Golden Horn and were held in İstanbul in December 1975 by Technical University of İstanbul, in February 1976 by Bogazici University and

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ISKI (Istanbul Water and Sewerage Administration) in 18-20 November 1998 and in May 2001.

The studies made on the Golden Horn seawater are:

- Chlorophyl (Coluk, 1989)

- Detergent (Tunca, 1976; Güven and Sungu, 1993)

- Dyes (Guven and Süngü, 1993)

- Gres (Yunder and Çalışkan, 1976)

- pH (Artuz and Korkmaz, 1976; Güven and Süngü, 1993)

- Turbidity (Baykut, 1976; Artuz and Korkmaz, 1976).

- Salinity (Güçlüer and Dogusal, 1976; Artuz and Korkmaz, 1976).

- Heavy metal (Baykut, 1976; Tunca, 1976; Ergin et al., 1991)

- Mercury (in mussel and fish) (Carden et al., 1976; Tuncer et al., 2001).

- Oxygene (Baykut, 1976; Artuz and Korkmaz, 1976; Güven and Süngü, 1993)

- BOD (Tunca, 1976; Pancaroğlu et al., 1976), TOC, Ammoniac (Tunca, 1976)

- H_2S (Baykut, 1976)

Meanwhile the oil and detergent pollution was investigated from 1996 until 2007 in the project by İSKİ (Güven et al. unpublished data.)

The other investigations are:

- Physical oceanography (Güçlüer and Dogusal, 1976; Artuz and Korkmaz, 1976)

- Exhausted gas pollution from diesel boat near Galata Bridge (Cumalı and Güven, 2007)

In this paper, we reported the oil pollution in Golden Horn seawater.

Material and Method

The seawater samples were taken in various stations: Bridges of Haliç, Unkapanı Galata and Adalar Sonrası in Golden Horn on 13.04.2005 and 25.04.2005.

The seawater samples were extracted three times with 50 ml dichloromethane (DCM). The extracts were combined, dried over anhydrous sodium sulphate and distilled at 36 ^{0}C. The residue was dissolved in hexane and analyzed using ultraviolet fluororescence spectrophotometer (UVF) and gas chromatography – mass spectrometer (GC/MS).

Oil determination by UVF

Oil amount was determined using Russian crude oil equivalent. This oil reference was supplied from TÜPRAŞ. The standard curve was plotted in a concentration of 0.6-1.8 μg/mL at 310/360 nm (ex/em) by UVF (Shimadzu 1501).

GC/MS analysis

The instrument used is a gas chromatography-mass spectrometer (HP6890 Series GC System; Hewlett Packard, Wilmington, DE, USA) fitted with an electronic pressure control and mass selective detector (HP5972A with ionization energy, 70 eV; source temperature, 280°C) using a HP-5MS capillary column (30 m x 0,25 mm i.d., 0,25 μm film thickness). The chromatographic conditions were as follow: sample size 2 μl, injection port temperature 280°C configured for split injection; initial oven temperature 40°C rising to 280 °C at 8 °C/min, final hold of 20 min. Helium was used as the carrier gas (1 ml/min).

The oil components were identified by the comparison of the mass spectra of the samples with spectra of HP memory was used.

Results

The oil amounts in sea water of Golden Horn are shown in Table 1.

Oil level in seawater varied in 2005 at examined stations are :

Haliç Bridge: 20.92 – 174.50 μg/L

Unkapanı Bridge: 17.17-117-10 μg/L

Galata Bridge: 1.16-56.45 μg/L

Eminönü boat station: 6.70-144.33 μg/L

Table 1. Oil amount in Golden Horn water (μg/L)

Stations	02/2005	04/2005	05/2005
Galata Bridge-1	21,59	-	53,81
Galata Bridge-2	21,17	-	56,45
Galata Bridge-3	12,16	-	21,42
Galata Bridge-4	18,07	-	28,26
Galata Bridge-5	24,83	-	43,88
Eminönü boat station	6,70	-	144,33
Unkapanı Bridge-1	117,10	-	52,65
Unkapanı Bridge-2	24,39	-	61,86
Unkapanı Bridge-3	17,17	-	48,72
Unkapanı Bridge-4	104,90	-	55,36
Unkapanı Bridge-5	79,69	-	63,89
Unkapanı Bridge-6	41,68	-	72,55
Haliç Bridge-1	90,31	174,50	130,56
Haliç Bridge-2	57,42	21,25	42,39
Haliç Bridge-3	66,30	31,90	41,08
Haliç Bridge-4	59,40	20,92	23,44
Haliç Bridge-5	61,63	22,48	28,36
Haliç Bridge-6	66,37	25,36	31,87

The identified oil compounds in golden Horn water using GC/MS are listed in Table 2 and 3.

Tablo 2. Petroleum hydrocarbon components in Golden Horn water

Hydrocarbons	**Galata Bridge**	**Unkapanı Bridge**	**Haliç Bridge**	**Adalar Sonrası**
1. Aliphatic				
1.1. Linear				
Octane	-	+	-	-
Decane	+	+	+	+
Undecane	-	-	-	+
Dodecane	+	-	-	-
Tridecane	+	-	+	-
Tetradecane	+	+	+	-
Pentadecane	+	+	+	+
Hexadecane	+	+	+	-
Heptadecane	+	+	+	-
Octadecane	-	+	+	-
Nor pristane	+	+	+	-
Nonadecane	+	+	+	+

Table 2 continued.

Eicosane	+	+	+	+
Heneicosane	+	+	+	+
Docosane	+	+	+	+
Tricosane	+	-	+	+
Tetracosane	+	+	+	+
Pentacosane	+	+	+	+
Hexacosane	-	-	+	+
Heptacosane	+	-	+	+
Octacosane	+	+	+	+
Nonacosane	-	-	+	+
Triacontane	+	-	+	+
Hentriacontane	+	-	-	-
Dotriacontane	-	+	+	+
Pentatriacontane	-	+	+	-
Hexatriacontane	+	+	+	+
Tritetracontane	+	-	+	+
Tetratetracontane	+	+	+	-
1.2. Branched				
2,3,3-trimethyl pentane	-	-	-	+
2-chloro-2-methyl pentane	-	-	+	-
3,3,4-trimethyl hexan	-	-	-	+
3-ethyl-2-methyl heptan	-	-	-	+
2,3,4-trimethyl hexan	-	-	+	-
4-methyl octane	+	-	-	+
2,3,3-trimethyl octane	+	-	-	-
5-ethyl-2-methyl octane	+	-	-	-
3,7-dimethyl nonan	+	-	-	-
2-methyl decane	+	+	-	-
3-methyl decane	+	-	-	-
3,8-dimethyl decane	-	-	+	+
2,3,7-trimethyl decane	+	-	-	+
2,5,9-trimethyl decane	-	-	+	-
2,6,10-trimethyl decane	-	+	-	-
2,5-dimethyl undecane	-	+	-	-
3,6-dimethyl undecane	-	+	-	-
2-methyl-6-propyl dodecane	-	+	-	-
2-cyclohexyl dodecane	-	-	-	+
4,6-dimethyl dodecane	-	+	-	-
2,6,10-trimethyl dodecane	-	-	+	-
2,6,11-trimethyl dodecane	-	-	+	-
2-methyl tridecane	-	-	+	-
5-methyl tridecane	+	-	-	-
6-methyl tridecane	+	-	-	-
7- hexyl tridecane	-	-	+	-
4-methyl tetradecane	+	-	+	-
5-methyl tetradecane	-	-	+	-

Table 2 continued.

2,6,10-trimethyl tetradecane	-	-	+	-
5-methyl pentadecane	+	-	+	-
6-methyl pentadecane	-	-	-	+
2,6,10,14-tetramethyl pentadecane	-	+	+	-
3-methyl hexadecane	-	-	-	+
2,6,10-trimethyl hexadecane	-	+	-	-
2,6,10,14-tetramethyl hexadecane	+	+	+	-
2,6,10,14-tetramethyl heptadecane	+	+	-	+
9-octyl heptadecane	+	+	-	-
4-propyl heptadecane	-	-	+	-
2-methyl octadecane	+	-	-	-
5-methyl octadecane	+	-	-	-
Farnesane	-	-	+	-
4-methyl nonadecane	-	-	+	-
10-methyl nonadecane	+	+	+	-
3-methyl eicosane	-	-	+	-
7-butyl docosane	+	-	-	-
3-ethyl tetracosane	+	-	+	+
2,6,10,15,19,23-hexamethyl tetracosane	+	+	+	-
3,5,24-trimethyl tetracontane	-	-	+	-
2- methyl squalene	-	-	+	-
11- methyl squalene	-	-	+	-
1.3. Alkene				
1-dodecene	+	-	+	-
1-heptadecene	-	-	+	-
5-oktadecene	-	-	+	-
3-eicosene	-	-	+	-
5-eicosene	-	-	+	-
11-tricosene	+	-	-	-
1-hexacosene	-	-	+	-
1.4. Cyclo alkane				
Undecyl cyclopentane	+	-	-	-
Heneicosyl cyclopentane	+	-	+	-
Pentadecyl cyclohexan	+	-	+	-
Propyl cyclohexan	-	-	+	-
Heptadecyl cyclohexan	-	-	+	-
Eicosyl cyclohexan	+	-	+	-
Heneicosyl cyclohexan	-	-	+	-
Cyclo tetracosane	-	-	+	-
2. Aromatics				
2.1. Benzene derivates				

Table 2 continued.

Toluene	+	-	-	-
m- xylene	+	-	-	-
o-xylene	+	-	-	+
p- xylene	+	-	-	+
Seconder-butyl benzene	-	-	+	-
Ethyl benzene	+	-	-	-
2.1.1. Phenol				
Phenol	+	+	+	-
2-(1,1-dimethyl) phenol	-	-	+	-
4-tert butyl phenol	-	-	+	-
o-tert butyl phenol	+	-	-	-
p-tert butyl phenol	+	-	+	-
di-tert-butyl phenol	-	+	-	-
2,4-ditert-butyl phenol	+	-	+	-
5,6-indoldiol	-	+	-	-
Benzofuran	-	+	+	-
2.3 Three ring				
Anthracene	-	-	+	-
Phenantrene	-	+	+	-

Table 3 shows phthalate esters of Golden Horn seawater.

Table 3. phthalate esters of Golden Horn seawater

Phthalate				
Ethyl phthalate	-	+	-	-
Diethyl phthalate	-	-	+	-
DEHP	+	+	+	+
Butyl phthalate	+	-	-	+
Mono butyl phthalate	+	+	+	-
Isobutyl phthalate	+	+	+	+
N-butyl,isobutyl phthalate	+	-	-	-
Di-(2-ethylhexyl) phthalate	-	+	-	-
Isooctyl phthalate	-	+	-	-

The oil pollution comes from Alibey and Kağıthane stream which flow to Golden Horn. Our earlier studies showed that these streams are highly polluted.

The highest oil pollution was found in Haliç Bridge seawater in April 2005 and in Galata Bridge seawater in May 2005.

The pollution level in the intermediate stations of Golden Horn was changed two times depending on ships and boats traffic. The pollution of the streams of Alibeyköy and Kağıthane affected to pollution under Haliç Bridge.

Table 2 and 3 show the oil components determined in Golden Horn seawater contain many aliphatics linear, branched, alkene and cycloalkene.

Finally oil pollution in Golden Horn seawater is high when compared with Bosphorus water.

Özet

Haliç suyunda petrol kirliliği incelenmiştir. Bu tayinler UVF ve GC/MS aletinde yapılmıştır. Suda bulunan petrol kirliliği miktarı Haliç'teki köprü altı sularında aylara gore farklılık göstermiştir. En yüksek petrol kirliliği Haliç Köprüsü altında 04/2005'de 174.50 µg/L, 05/2005'de 130.52 µg/L, Unkapanı Köprüsü altında 02/2005'de 104.90 µg/L, Galata Köprüsü altında 05/2005'de 56.45 µg/L bulunmuştur. Bu sonuç o andaki motor trafiğine bağlanmıştır. Haliç girişinde saptanan petrol kirliliği Alibeyköy ve Kağıthane deresinden gelen petrol kirliliği sonucudur. GC/MS analizi sonucunda pek çok alifatik linear hidrokarbon ile sikloalkan ve alken saptanmıştır. Aromatiklerden tek halkalılardan benzene deriveleri 2 halkalılardan benzofuran, 3 halkalılardan antrasen ve fenantren teşhis edilmiştir. Haliç köprüleri arasında petrol komponentleri en fazla olan Galata Köprüsü çıkışı (Sarayburnu yönünde) saptanmıştır. Bunun sebebi bu bölgedeki motor trafiğine bağlanmıştır. Evvelce bu bölgede yapılan çalışmaların mukayesesinde petrol kirliliğinin devamlı değiştiği ve yüksek olduğu tespit edilmiştir.

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