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The Oil, Detergent and Heavy Metals Pollution of Ölüdeniz, Fethiye and Göçek, South West of Turkey

Ölüdeniz, Fethiye ve Göçek'de petrol, deterjan ve ağır metal kirliliği

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Abstract

Oil and detergent levels were determined in Ölüdeniz, Fethiye, Göçek and additionally heavy metal level in Göçek. Max. levels of oil pollution found were 1.99 mg/L in Ölüdeniz, 326,72 µg/L in Fethiye and 14,01 µg/L in Göçek. Oil level exceeded the limit (13 µg/L) in Ölüdeniz and some Fethiye stations and only one station in Göçek.

Max. detergent level was found in Ölüdeniz as 44.24 µg/L, in Fethiye as 37.04 µg/L and in Göçek as 25.29 µg/L. Detergent pollution was high in Ölüdeniz.

Heavy metals determined at Göçek are 1.58 mg/g, for chrome, 4.6 % for Ferrum, 790 µg/g for Mangane, 19 µg/g for lead, 48 µg/g for copper, 62 µg/g for zinc. Chrome level exceeded the limit value of 100 µg/g. Oil level in sediment of Göçek at station 2 (145 µg/g) is higher than limit value of sediment (10 µg/g).

Keywords: Oil, detergent, heavy metal, Ölüdeniz, Fethiye, Göçek, seawater, sediment.

Introduction

Fethiye and Göçek are two towns, 65 km apart situated on the Mediterranean coast South West of Turkey. They are within touristic areas. Göçek has one of the large marinas in the country. Attention was focused lately on the marine pollution in this region.

Attention was focused lately on the marine pollution in this region. Physical unit operation for sewage in the district is recently established in Fethiye. Pollution by detergents in Ölü Deniz was investigated by TÜDAV during 2003 and 2004 (Unpublished data).

Oil pollution was investigated in the Mediterranean Sea South West of Turkey (Güven *et al.*, 1998; Bıldacı *et al.*, 2000).

In this work investigation on oil and detergent pollution in sea water was carried out in Ölüdeniz, Fethiye and Göçek and additionally heavy metals in Göçek, South West of Mediterranean coast of Turkey.

Material and Methods

The sampling stations are shown in Fig 1 and Fig 2.

Sea water sample was taken from surface and sediment samples were taken using van Veen grab.

1. Sea water analysis

1.1.Oil level

2.8 L seawater samples were taken from surface and 15 ml of DCM was added for preservation of the sample.

The samples were extracted three times with 50 ml DCM according to Güven *et al.*, (1996; 2000). The extracts were combined and then dried over anhydrous sodium sulphate, filtered and distilled in a rotary evaporator. The residue was redissolved in hexane and the volume adjusted to 10 ml and then analysed by UVF (Shimadzu RF 1501).

1.1.1. Standard curve of oil

The standard curve was plotted as in an earlier work, and the references were Iranian and Iraqi oils. (Güven *et al.*, 1998). Oil determination was made by UVF plotted at 310/360nm (ex/em) in UVF (Shimadzu RF- 1501).

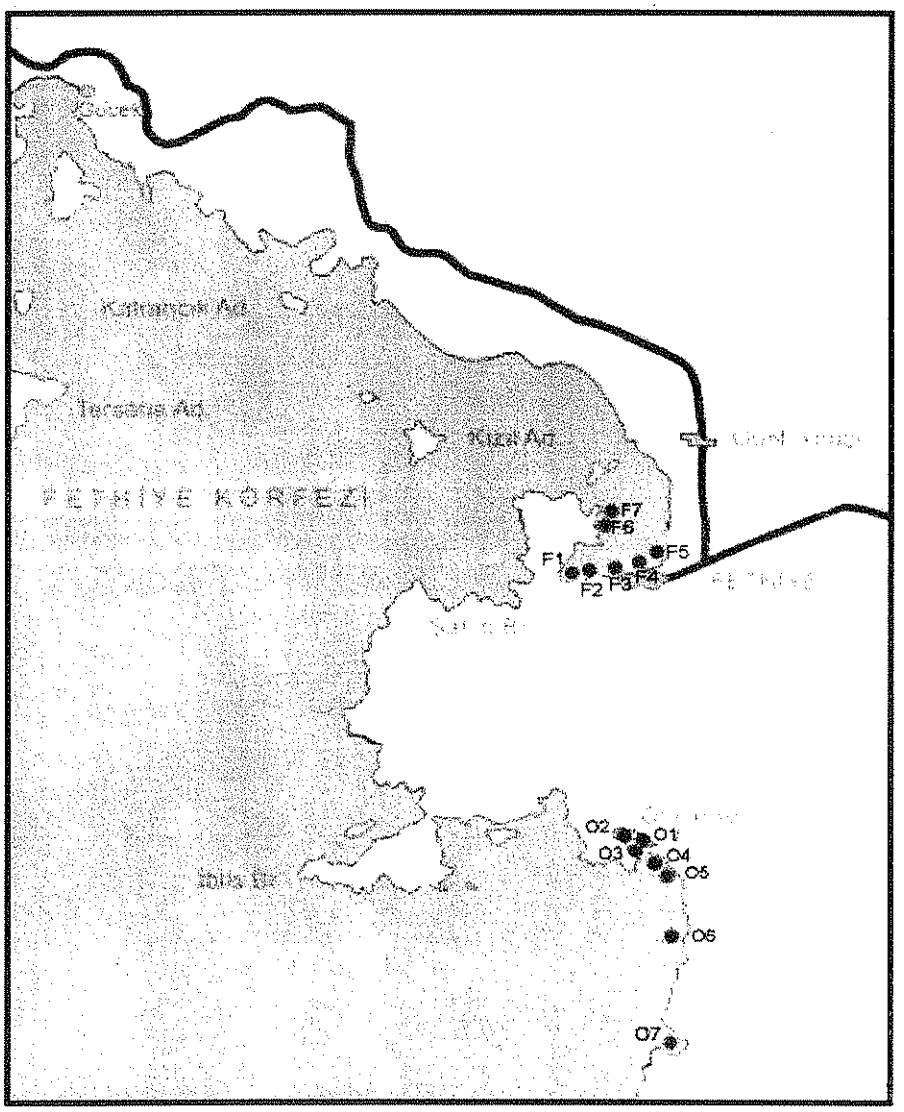

Fig. 1. Location of the sampling stations at Ölüdeniz and at Fethiye

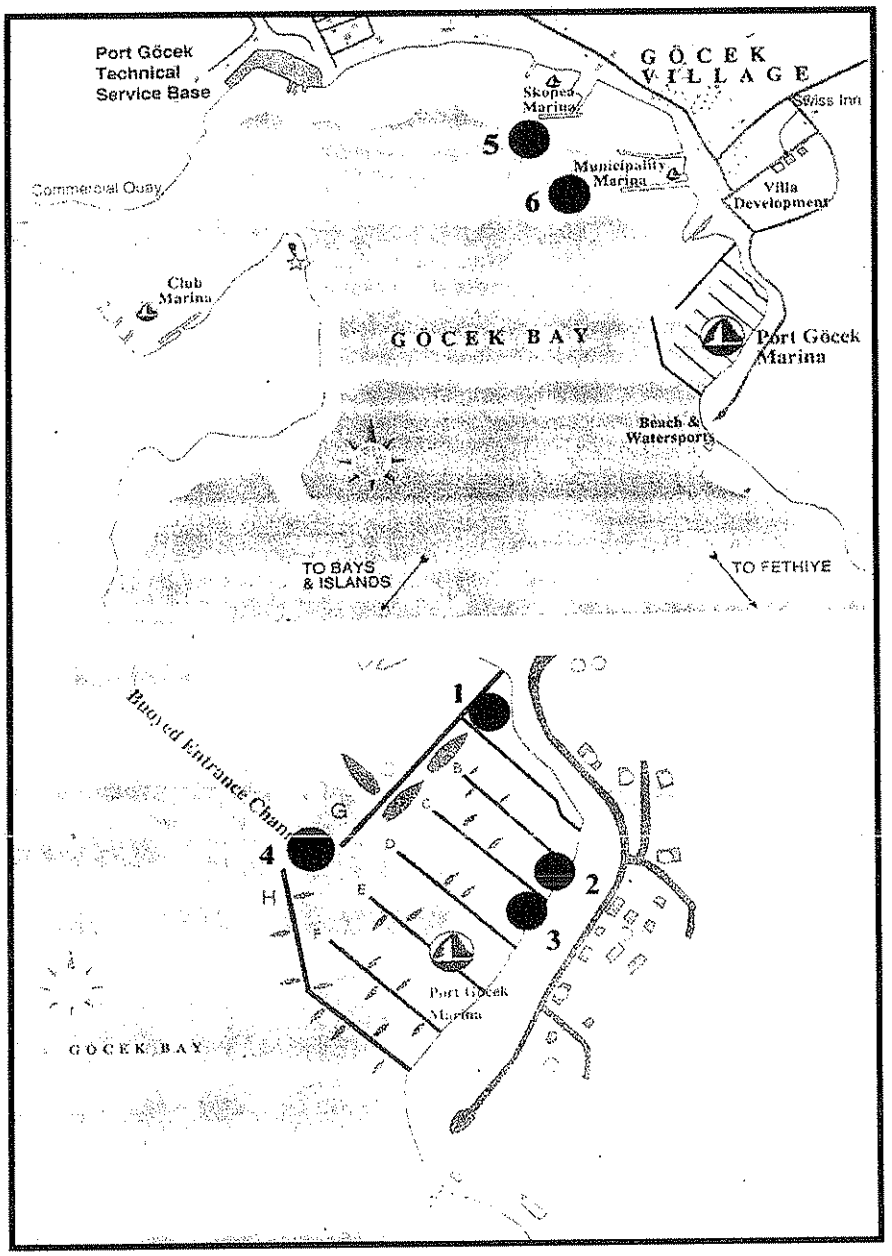

Fig 2. Sampling stations at Göçek

1.2. Detergent level

The determinations were made on the samples taken at surface and 10 m depth.

800 ml seawater was taken and the LAS (anionic detergent) content determined as described earlier (Güven *et al.*, 1999).

1.2.1. Standard curve of detergent (LAS)

The calibration curve was plotted for LAS (Lever, Gebze) in conc. of 10-100 µg/L. The Standard Method (1995) was used (Güven *et al.*,1999).

The absorption graph was drawn using a spectrophotometer (Shimadzu, UV – 1601) and the standard curves were plotted at 652 nm.

2. Sediment analysis

2.1. Heavy metal levels

The samples were kept in a refrigerator (~2°C) immediately after collection before drying and grinding. For chemical analysis, sediment samples were separated and dried at 105 °C and ground in an agate mortar. All metals were determined by atomic absorption flame emission spectrophotometer (AA- 6701 F, Shimadzu) after a total digestion (Loring and Rantala, 1992). 1 g of sample material was preoxidized with 10 ml HNO_3 in open teflon beakers and then heated with 5 ml HF and 5 ml $HClO_4$ in closed teflon beakers for 30 min. After a formation of dense white fumes, the cover was removed to allow the $HClO_4$ to evaporate. To further digest the resistant particles, 5 ml of HF was added and the mixture allowed to reflux for a further 30 min. The remaining solutions were evaporated on a hot plate at 180°C. It was dissolved with 10 ml of 1 M HCl, and then diluted to 50 ml with 1 M HCl.

Results and Discussion

1 – Standard equation of oil

The equations of standard curve used for oil are:

Reference crude oils	Equations
Iraqi	F_1=488.59 c + 49.758, r^2 = 0.99
Iranian (Heavy)	F1=387.68xC+13,181, r^2= 0.99

The standard curve equation of detergent is:

$$y= 0.0041 x +0.0195$$

The oil and detergent levels in the samples are

1. Ölüdeniz

1.1.Oil level

Oil levels in Ölüdeniz are listed in Table 1.

Table 1. Oil level in Ölüdeniz in 16.04.2004 (µg/L) through reference oil equivalent.

	Reference oil	
Station	Iranian	Iraqi
(O4)Jandarma önü	1699,20	1488,94
(O1) Lagün	1239,24	1070,36
(O6) Kıdrak	589,81	522,41
(O2) Lagün	3,81	3,33
(O5)Tur tekneleri	49,72	43,81
(O3) Lagün çıkışı	19,18	17,13

Oil pollution level was found highest in Jandarma önü than other stations and the level differs through reference oil equivalent used Iranian and Iraqi. Oil levels found in the stations were ~ 3 –1000 times as high as the limit value for oil.

1.2.Detergent

Detergent levels in Ölüdeniz are shown in Table 2.

Table 2. Detergent levels in Ölüdeniz stations

Stations	Date	Found
(O7)Kelebekler Vadisi	12/03/2004	12,38
(O1) Lagün	12/03/2004	28,90
(O1)Lagün	29/03/2004	8,84
(O4) Jandarma önü	29/03/2004	1,83
(O6) Kıdrak	16/04/2004	41,22
(O1) Lagün	16/04/2004	44.24
(O4) Jandarma önü	16/04/2004	36.61

The highest detergent level was found as 44.24 µg/L in Lagün followed by 41.22 µg/L at Kıdrak. The value found at the other stations were also high except at station Lagün in 29.03. 2004. It was observed that the detergent pollution had been increase with time.

2. Fethiye

2.1.Oil level

Oil levels in Fethiye are shown in Table 3.

Oil level was found 15-20 times as high as the limit at Fethiye station 5 in 16.04. 2003 and also in 10.09.2003 as 326.72 µg/L and 206.27 µg/L respectively. The pollution rose along the years.

The oil pollution was also high in Fethiye Liman, Fethiye 2 and Karagözler stations.

The values were below the limit at the stations; Letonya 2, Letonya 1, Liman and Karagözler.

Table 3. Oil level in Fethiye(μg/L), through reference oil Iranian / Iraqi equivalent.

		Reference oil	
Station	Date	Iranian	Iraqi
(F6) Letonya 1	29.04.2003	3,91	3,38
(F7) Letonya 2	29.04.2003	1,12	0,84
(F1) Liman içi	29.04.2003	8,53	7,58
(F2) Karagözler	29.04.2003	35,33	31,44
(F5) DSİ	29 04 2003	5,43	4,76
(F3) Liman içi	10.09. 2003	80,33	71,67
(F4) Liman içi	10.09. 2003	206,27	186,28
(F1) Liman içi	16.04.2004	33,47	29,74
(F4) Liman içi	16.04.2004	326,72	294,46

2.2.Detergent level

Detergent level at Fethiye are shown in Table 4.

Table 4. Detergent level in Fethiye (μg/L)

Station	Date	Found
(F1) Liman içi	29.04.2003	37,04
(F6) Letonya 1	29.04.2003	51.0
(F7) Letonya 2	29.04.2003	17.05
(F5) DSİ Kanalı açığı	29.04.2003	7.12
(F3) Liman içi	16.04.2004	11.5
(F2) Liman içi	04/09/2003	36,09

Max. detergent level was found at Letonya as 51.00 μg/L on 29.04.2003 followed by Liman içi as 37.04 μg/L.

3. Göçek

3.1. Oil level

Oil level in Göçek stations are listed in Table 5. Oil pollution level in Göçek was found lower than limit value of oil in sea water (13 μg/L) except surface water of station 3.

Table 5. Oil level in Göçek in 29. 04. 2003 (μg/L) through reference oil equivalent.

		Reference oil	
Station	Depth	Iranian	Iraqi
1-1	0 m	3,47	3,09
1-2	0 m	3,23	2,84
1-3	1 m	7,59	6,82
1-4	1 m	1,15	1,30
2-1	0 m	5,63	3,73
2-2	0 m	6,67	5,97
2-3	1 m	5,52	4,82
2-4	1 m	5,53	4,83
3-1	0 m	14,01	12,54
3-2	0 m	3,75	3,21
3-3	10 m	4,43	3,83
3-4	10m	3,72	3,18
4-4	10 m	1,62	1,27
5-2	10 m	4,42	3,82
6-1	0 m	7,65	6,76
6-2	10 m	2,97	2,50

The samples were taken twice the same stations as 1-1, 1-2 for surface and 1-3, 1-4 for 1 m depth.

3.1.1. Oil pollution in sediment

Oil level at Göçek sediments are as follows.....

Station	μg/g
1	2,15
2	145,00
3	73,00

Pollution level at station 2 and 3 are higher than limit value for sediments (10 μg/g)

3.2. Detergent level

Detergent level at Göçek stations are shown in Table 6.

2.3. (1 m.)	29/04/2003	2,80
2.4 (1 m.)	29/04/2003	2,59
3.1 (10 m..)	29/04/2003	< Eşik değer
3.2 (0 m.)	29/04/2003	4,90
3.3 (10 m.)	29/04/2003	< Eşik değer
3.4 (10 m.)	29/04/2003	< Eşik değer
4.4 (10 m.)	29/04/2003	< Eşik değer

The detergent pollution at Göçek was low.

3.3. Heavy metal level

Heavy metals level at Göçek are shown in Table 7 (μg/g)

Station	Cr	Fe (%)	Mn	Pb	Cu	Zn
1	675	3.2	678	8	17	23
2	894	3.4	790	11	30	45
3	1589	4.6	788	19	48	62

Shale mean*	100	4.7	850	20	50	90

*Through Krauskopf,1979

Amoung of heavy metal level only chrome level was found higher than limit value.

Conclusion

The highest oil level was found at station Jandarma önü, Lagün and Kıdrak of Ölüdeniz which the wessels trafic were high in these regions.

Oil pollution level at Göçek stations 2 and 3 are higher than limit value for sediments (10 µg/g)

Detergent pollution was high at Ölüdeniz and Fethiye but low at Göçek.

According to these findings Ölüdeniz is the highest polluted in all the examined stations. Some stations of Fethiye and Göçek the pollution level was also found high.

In sediment sample of Göçek, chrome pollution was found high.

The pollution of oil and detergent values found at some stations of Ölüdeniz, Fethiye and Göçek were found high over the limit value.

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Özet

Bu çalışmada Ölüdeniz, Fethiye ve Göçek' de deniz suyunda petrol, deterjan ile ayrıca Göçek' de sedimentte ağır metal kirliliği üzerinde araştırma yapılmıştır.
En yüksek petrol kirliliği Ölüdeniz' de 1.99 mg/L, Fethiye'de 326.76 µg/L ve Göçek' de 14.0 µg/L bulunmuştur. Petrol kirliliği için sınır değer olan 13 µg/L' nin çok üstündeki değerler Ölüdeniz'de ve Fethiye ait bazı istasyonlarda saptanmıştır. Göçek'de deniz suyunda yalnız bir istasyonda limit değerin üstünde petrol kirliliğine rastlanmıştır. Göçek sedimentinde petrol kirliliği 2 no'lu istasyonda 145.0 µg/g 3 no'lu istasyonda 72 µg/g bulunmuştur. Bu değerler sediment için verilen sınır değerin (10 µg/g) üstündedir.
Deterjan kirliliğine ait en yüksek değer Ölüdeniz' de 4.24 µg/L, Fethiye'de 37.04 µg/L ve Göçek' de 25.29 µg/L tespit edilmiştir.
Göçek' de incelenen ağır metal kirliliği arasında krom için sınır değerin üstünde. diğer metaller için ise sınır değerin altında bulgular elde edilmiştir.

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