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RESEARCH ARTICLE

Oil input of surface water of the Turkish rivers flow to the Black Sea in 2005-2007

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Abstract

In this work, the oil input of the Turkish rivers' surface water flow to the Black Sea was investigated during the years of 2005-2007. The maximum oil amount in surface water (µg/l) was found in 2005 for Filyos 253.16, Sakarya 484.96, Yeşilırmak 628.20 and Kızılırmak 721.63. In total input of oil (t) to the Black Sea from the surface water of Turkish rivers was calculated in 2005: 2031.65, in 2006: 801.35, in 2007: 633.77. There is no report on annual input of oil from the rivers flowing to the Black Sea in the other countries. Therefore it is difficult to compare of the oil input to the Black Sea from Turkish rivers and those from other rivers. These results showed that the oil pollution of the rivers must be continuously surveyed.

Keywords: Oil input, surface water, Turkish rivers, the Black Sea

Introduction

The Black Sea is 420,000 km^2, volume 537 km^3, 1200 km long, 615 km wide and the maximum depth is being 1270 m, salinity 18 to 19‰. Total water volume is 4547,015 km^3. Its water column is 90% anoxic. It is a semi-closed sea and connected only through the narrow Istanbul Strait to the Mediterranean Sea, 32,100 metric tons per second out from the Black Sea (Anon. 1941). The Black Sea is bordered by Bulgaria, Romania, Ukraine, Russian Federation, Georgia and Turkey. One of the pollutants of the Black Sea is oil. The sources of oil pollution are crude oil terminals in the Russian Federation and Georgian coasts, oil transportation and accident by tankers, busy ship traffic and river inputs. Many papers were published about oil pollution of the Black Sea, such as Polikarpov *et al*. (1994), Mironov (1991), Fashchuk and Shaporenko (1995), Fashchuk *et al*. (1996), Fashchuk (1998), Oradovskii *et al*. (1997), Shaporenko (1997), Piescu (1998), Güven (2006), Güven *et al.* (2008). Oil input into the

Black Sea were calculated in total (t/y) (domestic, industrial, land based, rivers) in Bulgaria 6,652, Romania 7,196, Ukraine 38,299, Russian Federation 4,419, Georgia 78,0, Turkey 760,0 (BSEP 1997). According to some other researches, from tens to hundreds, thousand tons of oil is annually delivered to the Black Sea. In 1980-1987 from 19 to 90 thousand tons of oil products per year were flowed into the Black Sea (Mandych and Shaporenko 1992). Fashchuk *et al.* (1991) consider that about 410 thousand tons/year of oil products.

The most of rivers flowing to the Black Sea (Figure 1) are polluted with oil. The average long-term total riverine flow equals to 338.2 km^3/year (Altman and Kumysh 1986) and 10.9% of this outflow (38.0 km^3) comes from rivers of Turkey: including Kızılırmak, Yeşilırmak, Sakarya and Filyos (EEA 2002). Some information on these rivers is shown in Table 1.

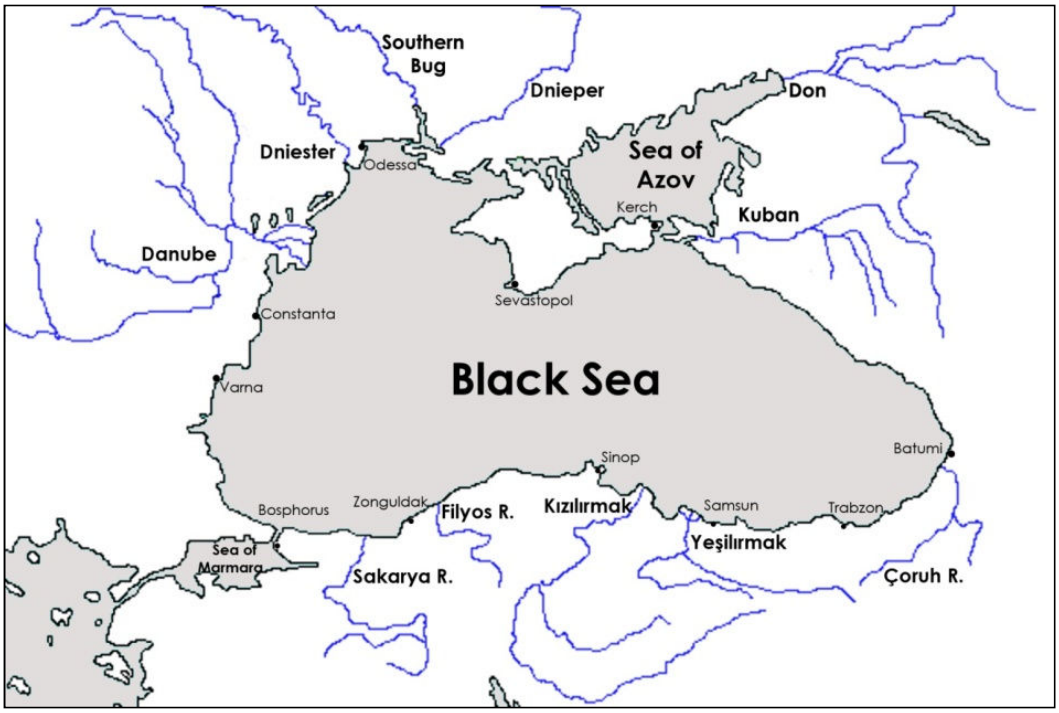

Figure 1. Map of rivers flow into the Black Sea.

Table 1. Length and mean annual runoff of the rivers around the Black Sea.

Rivers	Length (km)	Mean Annual runoff (km^3) (min-max)	Annual discharge[3] km^3	% Annual discharge[3]
Danube[1]	2850	208 (136-313)	200	57.5
Dniester[1]	1328	10.2 (5.36-19.3)	9.1	2.6
Southern Bug[1]	857	3 (1.22-6.25)		
Dnieper[1]	2201	47.9 (23-83.2)	43.5	12.5
Don[1]	1870	29.5		
Kuban[1]	870	12.4		
Sakarya[2]	824	77-219 (m^3/sec)	5.6	1.6
Filyos (Yeniçağ)[2]	225			
Kızılırmak[2]	1355	18.4-1675 (m^3/sec)	5.9	1.7
Yeşilırmak[2]	519	1.5-656 (m^3/sec)	5.3	1.5
Çoruh[2]	466*	39-2431 (m^3/sec)	8.71	2.5

[1]Faschuk (1998), [2]Meydan Larousse (1986), [3]EEA (2002).
* 442 m^3/sec in Turkey, 24 m^3/sec in Georgia.

The oil pollution of the Black Sea rivers as flows:
Danube: 10370 t in 1988, 21120 t in 1989. Dnieper: 8702 t in 1988, 5450 t in 1989.From the Sakarya surface water is 254.13 t/y (Balcıoğlu and Öztürk 2009).

In this work, discharged of oil amount from the Turkish river surface water flow to the Black Sea was determined.

Materials and Methods

The sea water samples were taken in the rivers in April and September, 2005-2007. The samples of river water (3.5 L) were taken from 0.5 cm surface layer in a special bottle. The samples were divided into 3x800 ml and each portion was extracted 3 times with 3x30 ml of dichloromethane. The extracts were combined and dried over anhydrous sodium sulfate, filtered and distilled at 40^{o}C. The residue was dissolved in hexane and the volume adjusted to 10 ml with hexane. The oil concentration was measured by UV Fluoro-spectrophotometer (Shimadzu RF 1501).

Russian crude oils (2004-2007) obtained from TUPRAŞ refinery (Izmit/Turkey) were used as reference materials. The standard curves were plotted in each year with a concentration of 0.25-1.25 µg/ml in hexane and the fluorescence intensity was measured at 310/360 nm (ex/em) by UVF (Shimadzu RF 1501).

Chemicals

Hexane, dichloromethane and anhydrous sodium sulphate were purchased from Merck (Darmstadt, Germany).

Results

The oil amounts found in the surface water of the Turkish rivers flowing into the Black Sea are shown in Table 2. The oil amounts decreased during the years of 2005-2007. The highest amount of oil pollution was found in 2005 in the Kızılırmak, in 2006 in the Yeşilırmak and in 2007 in the Sakarya River.

Table 2. Pollution (1) and input (2) of oil from the surface of the Turkish rivers to the Black Sea.

Rivers	Flow (km^3/y)	2005		2006		2007	
		µg/l (1)	t/y (2)	µg/l (1)	t/y (2)	µg/l (1)	t/y (2)
Filyos	0.8	253.16	196.86	41.94	32.62	54.92	42.70
Sakarya	5.6	86.60	484.96	47.78	267.57	51.21	286.78
Yeşilırmak	5.3	118.53	628.20	51.18	271.30	34.08	180.62
Kızılırmak	5.9	122.31	721.63	38.96	229.86	24.35	143.67
TOTAL			2031.65		801.35		653.77

The oil pollution ranks of four Turkish rivers are:

in 2005: Kızılırmak>Yeşilırmak>Sakarya>Filyos
in 2006: Yeşilırmak>Sakarya>Kızılırmak>Filyos
in 2007: Sakarya>Yeşilırmak>Kızılırmak>Filyos

Conclusion

The total oil input from the surface water of the Turkish rivers flowing into the Black Sea were 3466.77 t during the years of 2005-2007. The mean of oil input was calculated as: 1155.59 t/y. There is no report on annual input of oil by the rivers flowing to the Black sea from the other countries. Therefore it is difficult to compare in the same years of the oil input to the Black Sea with rivers in other countries. These results showed that the oil pollution of the rivers must be continuously surveyed on the every meter of the column of water.

Türkiye nehirlerinden Karadeniz'e akan petrol kirliliğinin 2005-2007 yıllarındaki miktarı

Özet

Bu çalışmada Karadeniz'e akan Türkiye nehirlerinin yüzey suyunda petrol kirliliği miktarı 2005-2007 yılları arasında Nisan ve Eylül aylarında tayin edilmiştir. Bunun sonunda bulunan en yüksek petrol kirliliği miktarı (µg/l) 2005 yılında Filyos: 253.16, Sakarya: 484.96, Yeşilırmak: 628.20 ve Kızılırmak: 721.63. Total olarak senelere göre

yüzey suyundan denize verilen petrol kirliliği (ton) 2005: 2031.65 2006: 801.35, 2007: 633.77'dir. Petrol kirliliği sıralaması yıllara gore Türkiye nehirlerinde: 2005'de Kızılırmak > Yeşilırmak > Sakarya > Filyos; 2006'da Yeşilırmak > Sakarya > Kızılırmak > Filyos ve 2007'de Sakarya> Yeşilırmak > Kızılırmak > Filyos şeklindedir. Karadeniz'e akan nehirlerdeki petrol kirliliği miktarını belirten literatürlerin tarihi 1990 yılının evveline aittir. Ayrıca bunların nasıl tayin edildiğine dair detaylı bilgi yoktur. Bu sebeplerden herhangi bir mukayese yapılması mümkün değildir. Önerimiz Karadeniz'e akan bütün nehirlerden petrol kirliliği tayininin su kolonunun her metresinde yapılması gerekliliğidir.

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