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RESEARCH ARTICLE

Determination of phenol in the sediments of the Turkish Black Sea coasts

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Abstract

Phenol pollution in the sediments of the eastern and western part of the Turkish Black Sea coasts was identified by GC/MS and determined by colorimetric methods. The phenol levels were found as 3.773 and 3.754 (µg/g) in the western part, 0.0334 (µg/g) in the eastern part. It is the first finding for phenol contamination in the sediments of the Turkish Black Sea coasts.

Key words: phenol, pollution, Turkish Black Sea

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Introduction

Phenol, hydroxybenzene, is the first compound of aromatic series hydrocarbons, with crystalline mass that is volatile, soluble in water and organic solvents. It is used as a reagent for synthesis of many organic compounds. As it is a constituent of automobile fuel and its exhaust gas, it can be found in areas with high levels of motor traffic (Cumalı and Guven 2007, 2008). It has been found in the Danube and the Russian coast of the Black Sea (DRPC 1999). Up to 1000 tons of phenol annually enter the Black Sea by rivers (80 % from the Danube and 20 % from the Dnieper).

Phenol is strongly toxic to fish (Tisler and Jagorc-Koncan 1995). Recently in Vietnam, 30 tons of frozen fish was destroyed after tests showed a lethal dose of phenol in them (Asian Correspondent 2016). In our earlier work, we did not found phenol in fish or mussels (Guven *et al.* 2016). Phenol was also found in the eastern Mediterranean Sea (Nord Cyprus and Syria Coasts; 0.5 m below surface as 0.88

µg/L) (Noureddin *et al*. 1998). It was found in the sediment of Zeytinburnu Port (Sea of Marmara, Turkey) (Guven *et al.* 2003).

Phenol and its derivatives have been used in various industries, therefore they are one of the main pollutants in seas. Nonylphenol which is a degradation product of nonyl phenol ethoxylate was determined in fish and sea water (Hasselberg *et al.* 2004) and marine algae (Erakın and Guven 2008). Nitrated phenols were found in sediment (Toloso *et al.* 1991) and nitrophenol was detected in sea water where high levels of sea traffic exists (Cumalı and Guven 2007, 2008).

Phenol in the marine environment can generally be determined by a colorimetric 4-aminoantipyrine method (Dennis 1951), HPLC analysis (Knauer) and GC/MS method (Erakın and Guven 2008).

In this work, phenol in sediments of eastern and western part of the Turkish coast of the Black Sea was investigated for the first time.

Materials and Methods

Sediment samples were taken by grab of Arar S/V in September 2007. Sample stations were shown in Figure 1. TBK16: Zonguldak 152 m; TBK13: Bartın 68 m; TBK51: Trabzon 47 m.

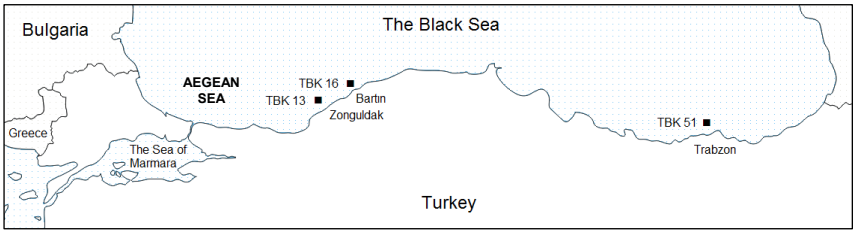

Figure 1. Locations of the sample stations.

Extraction: 40 g of sediment samples were dried and extracted with dichloromethane (DCM) in soxhlet apparatus, distilled at 40°C. Phenol was detected by GC-MS method and its amount was determined in spectrophotometer by using 4-aminoantipyrine method (Dennis 1951; APHA 1969). Calibration curve was plotted with phenol (Merck) at 460 nm. The standard equation for calculation of phenol is: $y = 0.0159\ x - 0.0475$.

Gas chromatography/Mass spectrometry (GC/MS)
Gas chromatography/Mass spectrometer (HP 6890 Series GC system; Hewlett Packard, Wilmington, DE, USA) was used with a mass selective detector HP 5972 A: ionization energy: 70 eV; HP-PONA capillary column (50 m 0.25 µm, film thickness). Injection port temperature was set as 280°C, configured for split

injection; initial oven temperature was set at 40°C at 8°C/min; final hold for 20 min. Helium was used as carrier gas (1 ml/min).

Results and Discussion

The phenol was detected (Rt: 5.00) in sediment extracts collected from Zonguldak, Bartın and Trabzon, the Black Sea and matched with reference phenol (Merck). Phenol amounts by stations are listed in Table 1.

Table 1. Phenol amounts detected in the Black Sea coast of Turkey

Station	Depth(m)	Phenol amount (µg/g)
TBK13 Zonguldak	152	3.754
TBK16 Bartın	68	3.773
TBK51 Trabzon	47	0.0334

It is assumed that in the Black Sea the pollutant originates from the Danube, Dnieper and the other rivers. The greatest amount of phenol come from Tuapse refinery and the plants of Sevastopol, followed by Poti and Batumi (Fashchuck and Shaporenko 1995; Fashchuck 1998; Fashchuck *et al.* 1996).

This study reveals that phenol, a component of petroleum, exists in the sediment of the Turkish coast of the Black Sea. It implies that oil pollution has been increased by marine traffic in the Black Sea.

Karadeniz Türkiye sahilleri sedimentinde fenol belirlenmesi

Öz

Karadeniz Türkiye sahilleri sedimentinde fenol tayini GC/MS ile ve miktarı kolorimetrik metotla belirlenmiştir. Fenol miktarı batıda 3.773 ve 3.754 (µg/g), doğuda ise 0,0334 (µg/g) olarak belirlenmiştir. Bu Türkiye kıyılarındaki sedimentlerde ilk fenol bulgusudur.

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