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Tracing of The Leachate in The Marine Medium

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The leachate carried from the solid waste landfills constitutes a great proportion of the surface water pollution. Solid waste leachate includes much more pollution loads than the domestic and industrial waste water. In this study, the analyses of the water samples taken from the rudder room, port and starboard engine departments of the Saricabey Sea Bus and the seawater are performed and a judgment is exposed if the pollution which was determined by the law enforcement agency was originated from this sea bus or not. The analyses were carried out by using the GC/MS (HP 6890 GC system/mass selective detector) instrument. Consequently, the solid waste leachate, which was carried to the marine media, is proved to be the origin of the mentioned pollution.

Key Words: Solid waste, Leachate, Marine pollution, Organic comp-ounds, Gas chromatography.

INTRODUCTION

Environment presents integrity with its soil, water, atmosphere and the living organisms. Any parts of this integrity whose natural structure is spoiled badly-effects the other environmental agents directly. For this reason, solid waste landfills hazard soil and the aquatic environment. After rainfall, litter and the chemicals accumulated in the streets, sidewalks and gutters are carried by rainwater into the rainwater channels. Any processing is not applied to the rainwater in contrast with the waste water that is flushed out from the toilets and washbasins and directly given to the surroundings. These loads which are carried in the rainwater channels reached creeks and rivers and then mixed into the seawater. The leachate that is leaked from the solid waste landfills forms a great proportion of the surface water pollution. In fact, solid waste leachate includes much more pollutants than the domestic and industrial wastewater[1-3]. The degradation, stabilization and the concentration processes of the pollutants present at the solid waste landfills are dependent on numerous factors. These are related with the composition of the waste materials,

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degree of pressing, existence of inhibitors in the media, humidity, water touch, hydraulic properties and temperature[4]. Principally when the oxygen deficiency starts, anaerobic media conditions are formed at the solid waste landfills. The gradual decomposition process in municipal solid waste landfills (MSWLFs) has been divided into several stages. These processes start as follows[5-7]:

$$C_aH_bO_cN_d \rightarrow n(C_wH_xO_yN_z) + mCH_4 + sCO_2 + rH_2O + (d\text{-}nz)NH_3$$

$$r = (c\text{-}ny\text{-}2s) \text{ and } s = (a\text{-}nw\text{-}m)$$

The tracing organic compounds in the waste leachate can be enumerated as follows[8]: bistrimethylsilyl *n*-acetyl eicosasphinga-4,11-dienine ($C_{28}H_{57}NO_3Si_2$); tetradecamethyl-cycloheptasiloxane ($C_{14}H_{42}O_7Si_7$); methyl palmitate ($C_{17}H_{34}O_2$); methyl *n*-butanoate ($C_5H_{10}O_2$); methyl *n*-pentanoate ($C_6H_{12}O_2$); dodecamethy-cyclohexasiloxane ($C_{12}H_{36}O_6Si_6$); morphin silyliert ($C_{23}H_{35}NO_3Si_2$); methyl *cis*-9,*cis*-12-octadecadienoate ($C_{19}H_{34}O_2$); *cis*-13-octadecenoic methyl ester ($C_{19}H_{36}O_2$); methyl caproate ($C_7H_{14}O_2$); 1,3,5,7-tetraethyl-1-ethylbutoxysiloxycyclotetrasiloxane ($C_{14}H_{38}O_6Si_5$); 3,6-dioxa-2,4,5,7-tetrasilaoctane ($C_{10}H_{30}O_2Si_4$); methyl hexadec-11-enoate ($C_{17}H_{32}O_2$).

The ecological consequences of land-based pollution experienced so far prove evidence of significant environmental stress in the Marmara Sea which is a semi-enclosed internal sea with a stratified structure. Rapid urbanization on the coastal zone of the Marmara Sea has attracted population since the 1970s. This has been one of the main reasons for the pollution that has affected primarily the estuaries and bays of the Marmara Sea and has ultimately spread along the shoreline and continental shelf that constitutes 50 % of its total area[9]. The metropolitan area of Istanbul has a total area of 5712 km^2 and is bounded by the Marmara Sea, Istanbul Strait, Golden Horn and Black Sea. The proportion of agricultural land in this area is minimal; therefore land-based pollution derives mainly from residential areas, industry and storm water[10].

EXPERIMENTAL

On 06 July 2008, since marine pollution was observed around the dock where Saricabey Sea Bus was boarded, the coastguard officers took samples and the sea bus was fined. The officers took three sealed samples from the rudder room, port and starboard engine departments of the Saricabey Sea Bus and one sealed seawater sample from Kartal Sea Bus Port (Fig. 1) and delivered the samples to the Chemical Oceanography Laboratory of the Institute of Marine Sciences and Management of Istanbul University on 09 July 2008. The analyses of the water samples were taken to the agency responsible for enforcement to investigate whether the source of the marine pollution is the sea bus or not. The samples were transferred and stored in the dark coloured glass bottles which had been washed with dichloromethane (DCM) at 4 ºC. After that 1 mL of sample was extracted by DCM. Extracted content was concentrated by vapourization and then it was completed to 5 mL with hexane. The analyses were handled by using GC/MS (HP 6890 GC system/mass selective detector) instrument. The results have been given as below:

Fig. 1. Kartal Sea Bus Port location

(A) The detected compounds in the seawater sample (Fig. 2): (1) bismethylsilyl *n*-acetyl eicosasphinga-4,11-dienine; (2) tetracosamethyl-cyclododecasilocxane completed.

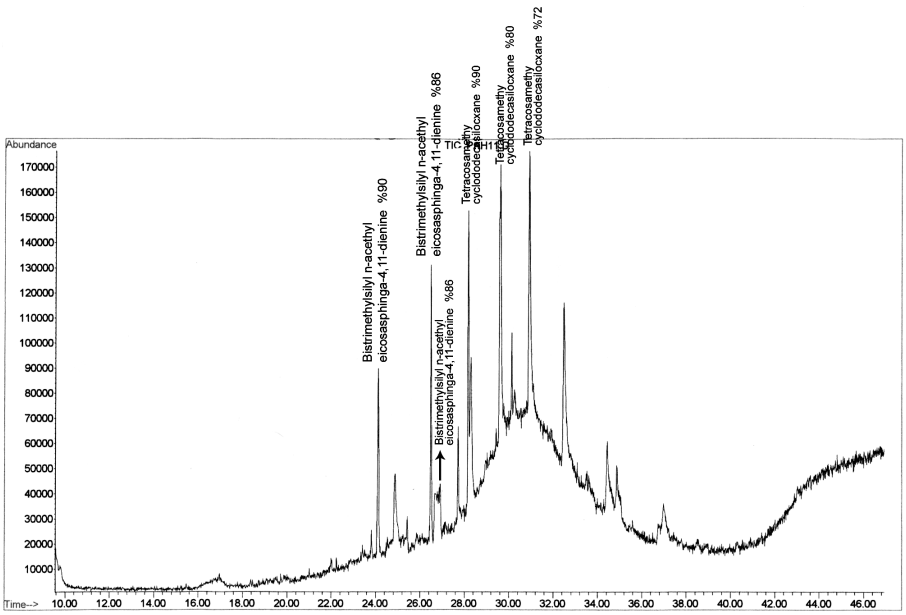

Fig. 2. GS/MS analyses of seawater sample

(B) The detected compounds in the sample water taken from the rudder room of Saricabey sea bus (Fig. 3): (1) dodecane, (2) tridecane, (3) tetradecane, (4) pentadecane, (5) hexadecane, (6) heptadecane, (7) pristane, (8) octadecane, (9) phytane, (10) nonadecane, (11) eicosane, (12) heneicosane, (13) tricosane, (14) 11-butyldocosane, (15) docosane, (16) octacosane, (17) 28-nor-17-β(H)hopane, (18) ionane.

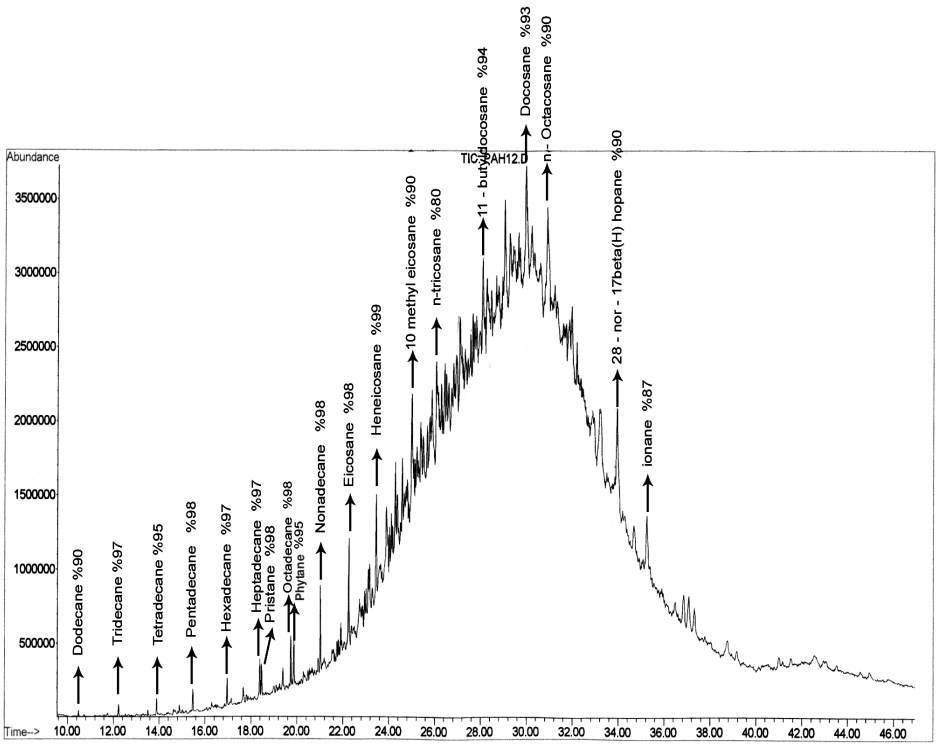

Fig. 3. GS/MS analyses of rudder room water sample

(C) The detected compounds in the sample water taken from the starboard engine department of Saricabey sea bus (Fig. 4): (1) dodecane, (2) tridecane, (3) tetradecane, (4) pentadecane, (5) hexadecane, (6) heptadecane, (7) pristane, (8) octadecane, (9) phytane, (10) nonadecane, (11) eicosane, (12) heneicosane, (13) tricosane, (14) docosane, (15) tetracosane, (16) pentacosane.

(D) The detected compounds in the sample water taken from the port engine department of Saricabey sea bus (Fig. 5): (1) dodecane, (2) tridecane, (3) tetradecane, (4) pentadecane, (5) hexadecane, (6) heptadecane, (7) pristane, (8) octadecane, (9) phytane, (10) nonadecane, (11) eicosane, (12) heneicosane, (13) tricosane, (14) docosane, (15) tetracosane, (16) pentacosane.

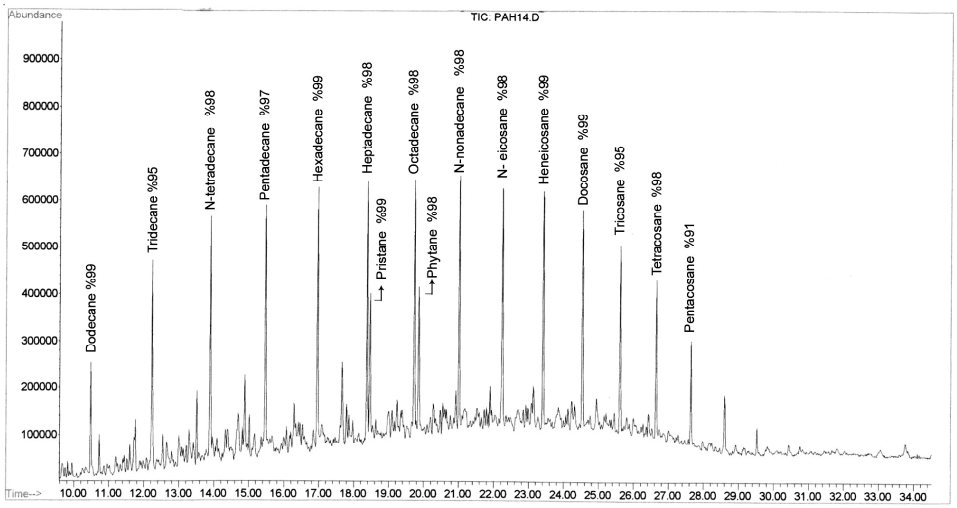

Fig. 4. GS/MS analyses of starboard engine department water sample

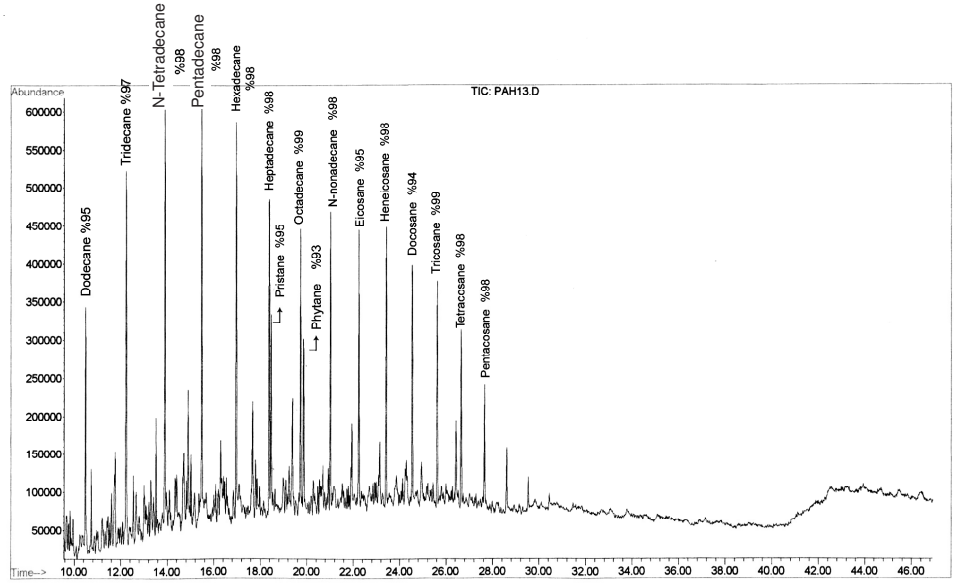

Fig. 5. GS/MS analyses of port engine department water sample

RESULTS AND DISCUSSION

The compounds present in the water samples taken from the rudder room, port and starboard engine departments of the Sea Bus and the seawater are determined and comparisons are made. According to the comparisons, the compounds detected in the sample waters taken from the port and starboard engine departments are similar and they are in the form of aliphatic hydrocarbon type of petroleum compounds. On the contrary, the following compounds are detected in the seawater sample:

bismethylsilyl *n*-acetyl eicosasphinga-4,11-dienine and tetracosamethylcyclododecasilocxane. These compounds are known to be produced in the degradation reactions at the solid waste landfills[4]. The mentioned compounds are not detected in the samples taken from the rudder room, port and starboard engine departments of the sea bus. As a result, this study proves that the leachate leaked from the solid waste landfills can reach the marine environment and constitute a pollutant agent.

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