

Petkim: Organic Analytical Report 1: Analysis of marine sediments and seawater from locations adjacent to the main wastewater discharges of the Petkim chemical complex, Aliaga, Turkey.

Introduction

In September 1996, a number of samples of marine sediments and seawater were collected immediately offshore from the two principal combined wastewater discharge points of the Petkim chemical complex in order to determine whether discharges from the complex had impacted the chemistry of the surrounding environment. The results of analyses of these samples for heavy metal contaminants are reported elsewhere. This report focuses on the organic compounds isolated and identified from the samples.

A total of six samples were collected from the marine environment:-

MI6148 and 6149 - duplicate sediment samples collected 10-15m offshore from outfall #1

MI6150 and 6151 - duplicate sediment samples collected 20-25m offshore from outfall #2

MI6152 - seawater collected immediately offshore from outfall #1

MI6153 - seawater collected immediately offshore from outfall #2

Neither of the outfalls #1 or #2 had a significant discharge at the time of sampling so it was not possible to sample the wastewater directly. Nevertheless, a single sample was obtained of the sediment from the side of the channel of outfall #1, approximately 5-10m inshore of the discharge point (MI6147). All samples were collected between 23rd and 24th September 1996.

Materials and Methods

Sediment samples were collected using a standard box corer and approximately 100g was transferred to an analytically clean glass bottle for refrigerated storage prior to analysis. Surface seawater samples were collected in 1 litre analytically clean glass bottles and were also refrigerated. All samples were transported immediately to the UK for analysis at the Greenpeace Research Laboratories, University of Exeter, UK.

Samples were prepared for analysis using extraction methods based on those described in Swindlehurst *et al.* (1995). Organic contaminants were extracted using standard liquid:liquid or liquid:solid solvent extraction techniques and analysed using gas chromatography/mass spectrometry (GC/MS). Further details of the analytical techniques employed are given in Appendix 1.

Results and Discussion

Data are reported for each sample in Appendix 2, including the number of individual

compounds isolated as discreet peaks and a list of those compounds identified. Compounds identified to a match quality of 90% or greater against library spectra (see Appendix 1) and confirmed using expert interpretative judgement, are assumed to be reliable identifications. Those with match qualities between 50 and 89% are assumed to be tentatively identified only. All compounds yielding lower match qualities than 50% are assumed to be unidentified.

In all seven samples, more than 100 individual organic compounds were isolated. Replication of qualitative results between duplicate sediment samples was good. Organic contaminants were dominated by long-chain and aromatic hydrocarbons, particularly polycyclic aromatic hydrocarbons (PAHs) in the case of the sediments. This is fairly typical of marine sediments heavily impacted by industrial or shipping activity and probably reflects a variety of sources including spilt and unburnt fuel and/or crude oil and discharges from the Petkim chemical complex. Given the close proximity of the discharge outfalls, it seems likely that the Petkim complex may be the primary source of such contaminants in this case. Indeed, analysis of the single sample from the side of the channel of outfall #1 (MI6147) revealed a very similar range of compounds, including derivatives of naphthalene and other PAHs, as was obtained for the sediments immediately offshore (MI6148 and 6149).

PAHs are toxic substances, their toxicity varying greatly with chemical structure. A number of PAHs are carcinogenic in laboratory animals, including fluorene (USPHS 1990). Studies in the North Sea suggest that high concentrations of PAHs are associated with liver disease in some fish species (Stebbing *et al.* 1992).

Some toxic and persistent organochlorine compounds were also reliably identified from the sediment samples. These include hexachlorobutadiene (HCB), a potent developmental toxin and potential carcinogen, which was identified in the sediment in the channel of outfall #1. Sediment MI6149, taken offshore from outfall #1, yielded 1,2,4-trichlorobenzene, while both sediments taken offshore from outfall #2 (MI6150 and 6151) were found to contain hexachloroethane. MI6151 also yielded hexachlorobenzene (HCB), a highly toxic and persistent organochlorine which is a known carcinogen. Both HCB and HCB are common by-products of a range of chemical processes involving chlorine, including oxychlorination reactions used in the manufacture of vinyl chloride monomer (VCM) and the onward use of chlorinated residues from VCM production for the synthesis of chlorinated solvents. Note that organochlorines are included as priority contaminants for elimination from discharges to the aquatic environment under Annex 1 of the Barcelona Convention Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources (UNEP 1992). Further details of the toxicity of these chemicals are discussed in "Petkim: Organic Analytical Report 2", as are details of the chemical processes which may be responsible for their formation.

The two samples of seawater revealed significant levels of contamination with a wide range of organic, petrochemical compounds, despite the absence of any significant discharges from the two outfalls at the time of sampling. It is possible that these compounds were present in the water in dissolved or dispersed form, but more likely that they were present either on the surface of particulates resuspended from the contaminated sediments or in the surface microlayer (air-sea interface) of the seawater. Whatever the case, the number and range of compounds identified should warrant further investigation by the relevant authorities in order to locate the sources.

Although once again dominated by PAHs and other complex hydrocarbons which could well have arisen from activities on the Petkim complex, sample MI6152, taken near outfall #1, yielded two compounds with mass spectra very similar to that of the organochlorine DDT (listed in Appendix 2 as o,p'-DDT and 2,2-chlorophenyl-1,1-dichloroethylene). The precise identities of these compounds could not be confirmed absolutely in this investigation. Nevertheless, the possible presence of DDT in seawater adjacent to the Petkim complex requires urgent investigation.

Summary

Analysis of sediments immediately offshore from the two main outfalls serving the Petkim chemical complex revealed contamination with a large number and range of organic compounds, many of which can be related directly to the petrochemical industry. The compounds identified, dominated by PAHs, were very similar to those in a sample of sediment taken inside the channel of outfall #1 from the plant. In addition, sediment samples showed evidence of contamination with toxic and persistent organochlorine compounds, including HCB, HCBd and HCE. The most likely source of these contaminants in the marine environment is discharge of wastes from production of VCM and other chlorinated chemicals at the Petkim complex.

References

Stebbing, A.R.D., V. Dethlefsen, R.F. Addison, M. Carr, P.M. Chapman, W.P. Cofino, C. Heip, L. Karbe, M.N. Moore and A.D. Vethaak (1992). Overall summary and some conclusions from the Bremerhaven Workshop. *Marine Ecology Progress Series* 91 (1-3)

Swindlehurst, R.J., P.A. Johnston, S. Troendle, R.L. Stringer, A.D. Stephenson and I.M. Stone (1995). Regulation of toxic chemicals in the Mediterranean: the need for an adequate strategy. *The Science of the Total Environment* 171: 243-264.

UNEP (1992). *Mediterranean Action Plan and Convention for the Protection of the Mediterranean Sea Against Pollution and its Related Protocols*. United Nations Environment Programme, Athens.

USPHS (1990). *Toxicological Profile for Polycyclic Aromatic Hydrocarbons*. U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, Document TP-90-20. December 1990.

Appendix 1: Details of analytical techniques.

Organic compounds

Liquid samples

Following removal of a sub-sample of 100ml for analysis of heavy metals (see below) the remaining 900ml of sample was spiked with a small volume of a standard solution of deuterated-naphthalene (to a final concentration of 100 ppm) to act as an internal standard. 25ml of analytical grade pentane were added to the spiked sample and the bottle rolled for 2 hours in order to improve contact between solvent and sample matrix. The solvent fraction was removed using a separating funnel, the remaining sample acidified (to enable extraction of organic acids), 25 ml of fresh solvent added and the sample rolled for a further two hours before separation.

For each sample the two solvent fractions (before and after acidification) were combined and the whole volume cleared of very high molecular weight compounds by one or more passages through an activated Florasil column. Following clean-up, the extract was evaporated down to approximately 2 ml under a stream of analytical grade nitrogen. A small volume of a standard solution of brominated naphthalene was added to allow accurate determination of the final volume of extract.

Solid samples

A sub-sample of approximately 30g was taken for analysis from each sediment sample. This was spiked with deuterated naphthalene as for the liquid samples, and 20 ml of a 3:1 (by volume) mixture of analytical grade pentane:acetone added. Subsamples were sonicated for two hours to improve efficiency of extraction. This first extract was decanted off, the sediment acidified, and the extraction process repeated.

Following the two extraction phases, the two extracts were again combined and prepared for analysis as described for the liquid:liquid extracts above.

Sample analysis

Extracts were analysed using a Hewlett Packard GC/MS system, injecting 1ul on to a 25m BPX-5 fused silica capillary column held in an HP 5890 GC connected in line to an HP 5972 Mass Selective Detector (MSD). Analytes were identified through a combination of computer matching of mass spectra, against a library of 136 000 compounds, and expert interpretation.

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Sediment
Sample name: Petkim 1
Sampling date: 23.09.96
Lab. code: MI6147

Other information: Sediment collected from the bank of open canal, 5-10m from sea, receiving discharge from outfall 1. No significant discharge at time of sampling.

Analysis method: GC/MS screen

Number of compounds isolated: 289

Compounds identified to better than 90%:

Naphthalene, 1,5-dimethyl-
Octadecane
1,1':2',1":3",1'''-Quaterphenyl
2,5-Furandione, 3-(dodecenyl)dihydro-
Dodecane, 2,6,10-trimethyl-
Naphthalene, 2,3,6-trimethyl-
Naphthalene, 2,7-dimethyl-
1,1':2',1"-Terphenyl
Benzene, 2-ethenyl-1,3,5-trimethyl-
Anthracene, 1-methyl-
Benzene, 1-ethenyl-3,5-dimethyl-
Naphthalene, 1,3-dimethyl-
1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
1H-Indene
1H-Indene, 1-methyl-
28-Nor-17alpha(h)-hopane
Docosane
Hexadecane
Naphthalene, 1,4,6-trimethyl-
Naphthalene, 1-methyl-
1,1':3',1"-Terphenyl
2,8-Dimethyldibenzothiophene
9H-Fluorene, 2-methyl-
Hahnfett
Naphthalene, 1,4,5-trimethyl-
Pentadecane

Pyrene, 1-methyl-
1,1'-Biphenyl, 2,2'-dimethyl-
2-Cyclopropen-1-one, 2,3-diphenyl-
9H-Fluorene
Cyclotetradecane, 1,7,11-trimethyl-4-(1-methylethyl)-
Decane, 2-methyl-
Naphthalene
Nonadecane
1,1':4',1''-Terphenyl
4,6-Dimethoxy-3-(4-methoxybenzylidene)benzo(b)furan-2-one
6-Methoxy-1-phenyl-3,4-dihydronaphthalene
Benzene, 2-ethenyl-1,4-dimethyl-
Cycloprop[a]indene, 1,1a,6,6a-tetrahydro-
Benzene, butadienyl-

Compounds tentatively identified :

Bi-2,4,6-cycloheptatrien-1-yl
Naphthalene, 1,4-dimethyl-
Naphthalene, 2-ethenyl-
1-(3-Methylphenyl)buta-1,3-diene
Benzene, 1,1'-[(methylthio)ethenylidene]bis-
2,7-Dimethyldibenzothiophene
2-Amino-3,9-dimethyl-5-methyl-5-methylamino-(3H-1,3,4,6-tetrazacyclopentene)azulene
20-Methyl-5.beta.-pregnan-3.beta.-ol
29-Methyl-(17.alpha.H,21.beta.H)-hopane
4-Fluoro-2',3',4',5',6'-pentamethylbiphenyl
Azulene, 7-ethyl-1,4-dimethyl-
Phenanthrene, 4-methyl-
Phenanthrene, 9,10-dihydro-1-methyl-
Bicyclohexyl, 4-phenyl-
Naphthalene, 1,2-dihydro-4-phenyl-
Cyclohexanamine, N-cyclooctylidene-
Methanone, (4-methylphenyl)phenyl-
Acenaphthylene, 1,2-dihydro-
Chrysene
Phenanthrene, 4-methyl-
1H-2,3-Benzodiazepine, 1-methyl-4-phenyl-
1a,7b-dihydroazirine(5,6)benzo(1,2-c:3,4,-c')dithiophene
2,3,6,7-Tetramethylantracene
2-Ethyl-anthraquinone
2-Ethyldibenzothiophene
Benzene, (1,1-dimethylethyl)-
Benzene, 1-methyl-3-(1-methylethyl)-
Lup-20(29)-en-3-ol, (3.beta.)-
Naphthalene, 1-(2-propenyl)-
Benzene, 1-methyl-2-(1-methylethyl)-

Naphthalene, 1-ethyl-
Phenanthrene, 2,3,5-trimethyl-
Pyrene
1,4-Methanonaphthalene, 1,4-dihydro-9-phenyl-
2-Methyl-3-carboxy-4-spirocyclohexyl-2-buten-4-olide
Cholestan-3-one, 4,4-dimethyl-, (5.alpha.)-
cis-1-Ethynyl-2-methyl-1-cyclohexanol
Dibenzocycloheptadiene
Methyl 4,8-dihydrodibenzo(cd,gh)pentalene-4-carboxylate
1,5,5-Trimethyl-4-phenyl-cyclopentan-1,3-diene
9H-Xanthen-9-one, 4-methoxy-
Benzene, 1,1'-ethenylidenebis-
Phenanthrene, 2,7-dimethyl-
Purine-6(1H)-thione, 3,7-dimethylseleno-
(-)-(2R,9S,10S)-2,5,5,9-Tetramethyl-trans-1-decalone
1H-Indene, 2-butyl-5-hexyloctahydro-
2,5-Dimethyl-11-methylidene-tricyclo(4.3.2.0*5,9)undeca-2,7-diene
Hexadecane, 1-(ethenyloxy)-
1-(4-Methylphenyl)buta-1,3-diene
5,9-Dimethyl-2-(1-methylethyl)-1-cyclodecanone
anti-9-Methyl-1,6-methanofluorene
Capnellane-5.alpha.-ol
Dihydroionone
1H-Indene, 2,3-dihydro-1,6-dimethyl-
2,3-Dihydro-1-Methylindene
Tridecane, 2,2,4,10,12,12-hexamethyl-7-(3,5,5-trimethylhexyl)-

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Sediment
Sample name: Petkim 2
Sampling date: 23.09.96
Lab. code: MI6148

Other information: Sediment collected from the sea, 10-15m from the mouth of open canal receiving discharge from outfall 1. No significant discharge at time of sampling.

Analysis method: GC/MS screen

Number of compounds isolated: 148

Compounds identified to better than 90%:

Dodecane, 2,6,10-trimethyl-
Naphthalene, 1,5-dimethyl-
Octadecane
Naphthalene, 1,4-dimethyl-
Nonadecane
Sulfur, mol. (S8)
Naphthalene, 1-methyl-
9H-Fluorene, 2-methyl-
Anthracene, 1-methyl-
Benzene, 1,1'-methylenebis-
Hahnfett
Heptadecane
Hexadecane
Tetradecane
1,1'-Biphenyl
1,1'-Biphenyl, 2-methyl-
Azulene
Naphthalene, 2,3,6-trimethyl-
1,1':2',1''-Terphenyl
9H-Fluorene
Naphthalene, 1,4,5-trimethyl-
Pentadecane
Phenanthrene, 4-methyl-

Compounds tentatively identified :

2-Allyl-1-methylnaphthalene
9H-Fluorene, 1-methyl-
Bicyclohexyl, 4-phenyl-
Anthracene
11-Isopropylidetricyclo[6.2.1.0(2,7)]undeca-2,4,6,9-tetraene
Phenanthrene, 2,3-dimethyl-
Anthracene, 9-methyl-
Azulene, 2,4,6-trimethyl-
Cyclohexanone, 4-ethyl-
Cyclopentane, 1,2-dibutyl-
Pyrene
2-Methyl-3-carboxy-4-spirocyclohexyl-2-buten-4-olide
5,6-Dihydrobenzo(b)naphtho(1,2-d)thiophene
7-Cycloheptyltridecane
Benzene, 1,2-propadienyl-
2-Ethyl-1,3,4,5,8-pentamethylnaphthalene
Cyclohexane, 1-(cyclohexylmethyl)-2-ethyl-, cis-
Naphthalene, 1,4-dihydro-
Naphthalene, 2-phenyl-
1-Ethyl-4-methoxy-9H-pyrido[3,4-B]indole
1H-Indene, 3-methyl-
Cyclotetradecane, 1,7,11-trimethyl-4-(1-methylethyl)-
Pyrene, 1-methyl-
Bicyclohexyl, 4-phenyl-
2-Isopropyl-1-methylnaphthalene
1H-Indene, 1,1-dimethyl-
2(1H)-Naphthalenone, octahydro-4a-methyl-7-(1-methylethyl)-, (4a.alpha.,7.beta.),
Benzene, 1,1'-cyclohexylidenebis-
Benzene, 1,2,3-trimethoxy-
Naphthalene, 1,2-dihydro-
Phenanthrene, 9,10-dihydro-1-methyl-
2-Butanone, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-, (R)-
2-N-Butyl-3-N-hexyldecahydronaphthalene
Tridecane, 6-propyl-
Cyclotetradecanol, 1,7,11-trimethyl-4-(1-methylethyl)-, (-)-
Naphthalene, 1-(2-propenyl)-
.alpha.-phenyl-1-piperidine acrylonitrile
11H-Benzo[b]fluorene
9-exo-Methyltricyclo[4.3.1.0]decaatriene
Benzene, chloro-1-methyl-4-(methylethyl)-

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Sediment
Sample name: Petkim 3
Sampling date: 23.09.96
Lab. code: MI6149

Other information: Sediment collected from the sea, 10-15m from the mouth of open canal receiving discharge from outfall 1. No significant discharge at time of sampling.

Analysis method: GC/MS screen

Number of compounds isolated: 190

Compounds identified to better than 90%:

1,1':2',1''-Terphenyl, 4'-phenyl-
1,1':3',1''-Terphenyl, 5'-phenyl-
11-Isopropylidetricyclo[6.2.1.0(2,7)]undeca-2,4,6,9-tetraene
Naphthalene, 1,5-dimethyl-
Octadecane
1,1'-Biphenyl, 2,2'-dimethyl-
Benzene, 2-ethenyl-1,4-dimethyl-
Naphthalene, 1,4,6-trimethyl-
Naphthalene, 2,3,6-trimethyl-
Naphthalene, 2,6-dimethyl-
Triphenylene, 1,2,3,4,5,6,7,8,9,10,11,12-dodecahydro-
Benzene, 1,3-diethyl-
Hexadecane
Terphenyl
1,1'-Biphenyl, 2-methyl-
1,1':2',1''-Terphenyl
1H-Indene, 1-methyl-
9H-Fluorene, 2-methyl-
Benzene, 1,2,4-trichloro-
Benzene, 1-methyl-2-(1-methylethyl)-
Naphthalene, 1,2-dihydro-6-methyl-
Naphthalene, 1,4,5-trimethyl-
Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
syn-1(6),8(13)-Dimethano-[14]annulene
Tetradecane

1H-Indene
2,5-Furandione, 3-(dodecenyl)dihydro-
Naphthalene, 1,2-dihydro-
Naphthalene, 1-methyl-
Phenanthrene, 9,10-dihydro-1-methyl-
1H-Indene, 1,1-dimethyl-
Anthracene, 2-methyl-
Benzene, 1-butyryl-
Hahnfett
Naphthalene, 1-(2-propenyl)-
Naphthalene, 2,7-dimethyl-
Pyrene, 1-methyl-
1,1'-Biphenyl
1H-Benzo[b]fluorene
2,8-Dimethyldibenzothiophene
9H-Fluorene
Azulene
Benzene, 1,1'-methylenebis-
Benzene, 1,2,4,5-tetramethyl-
Octadecanoic acid, 17-oxo-, methyl ester
Pyrene, 4-methyl-
1H-Indene, 2,3-dihydro-1,2-dimethyl-
3-(p-Tolyl)-1,2-benzopyrone
Azulene, 7-ethyl-1,4-dimethyl-
Benzene, 1-ethyl-2,3-dimethyl-
Methyl-phenanthrene or Methyl-anthracene
Nonadecane, 2-methyl-

Compounds tentatively identified :

Fluoranthene
1,2,3,4,5,6,7,8-Octahydrotriphenylene
9H-Fluorene, 4-methyl-
Benzene, 1,1'-(1,2-ethenediyl)bis-, (E)-
Eicosane
Heptadecane
Pentadecane
1H-Cyclopropa[b]naphthalene, 1a,2,7,7a-tetrahydro-
1H-Indene, 2,3-dihydro-2-methyl-
Benz(a)azulene
Anthracene, 9,10-dimethyl-
Benzeneacetaldehyde, .alpha.-ethylidene-
Tricosane
1,1'-Biphenyl, 4,4'-dimethyl-
Undecane
Tridecane
1-(3-Methylphenyl)buta-1,3-diene

2-Amino-3,9-dimethyl-5-methyl-5-methylamino-3H-1,3,4,6-tetrazacyclopente)azulene
3,5,7-Trimethoxy-2,8-dimethyldibenzophosphole 5-oxide
3-(4-Methoxy-3-tert-butyl-5-methylphenyl)propanol
Maturin-acetate
8,8'-Diapo-20-hydroxycarotene-8,8'-dial (4)
9H-Fluorene, 2,3-dimethyl-
Benzene, 1,1'-[(methylthio)ethenylidene]bis-
Decamethylphenanthrene
Naphthalene, 2-phenyl-
Phenyl-tert-butyl-acetylene
Octadecane
Triphenylene
2-Allyl-1-methylnaphthalene
Heptadecane, 3-methyl-
1,5,5-Trimethyl-4-phenyl-cyclopentan-1,3-diene
Chrysene
Isopropyl-phenyl-acetylene
1H-Indene, 2,3-dihydro-1,1,3-trimethyl-
5,6-Dihydrochrysene
7-Ethylidene bicyclo[4.2.1]nona-2,4-diene
Benzene, ethyl-1,2,4-trimethyl-
(+)-3,3-Dimethyltricyclo[5.4.0.0(2,9)]undecan-8-one
9-(Hydroxymethyl)-6,11-dihydroxy-12-oxoxantho[2,3-g]tetralin
[2,1]Benzoxazino[4,3-c][2,1]benzoxazine
7,8-Diphenyl bicyclo[4.2.1]nona-2,4,7-triene
Benzene, [1-(2,4-cyclopentadien-1-ylidene)ethyl]-
1-Hydroxymethyl-pyrene
Benzene, 2-ethenyl-1,3,5-trimethyl-
Benzene, 2-ethyl-1,3-dimethyl-
Dibenzothiophene
Phenanthrene, 2,3,5-trimethyl-
1,1,3-Trimethylindene
Cyclopropane, 2-methylen-1,1-diphenyl-
1-Ethylidibenzothiophene
Benzene, 1-methyl-2-propyl-
Benzene, cyclopropyl-
Naphthalene, 2-(1-cyclopenten-1-yl)-
Phenanthrene, 4,5-dimethyl-
Phenanthrene, 9-methyl-
Undecane
1,1'-Biphenyl, (1-methylethenyl)-
1,1'-Biphenyl, 2-methyl-
4-Hydroxymellein
Dibenzothiophene, 3-methyl-
Naphthalene
Naphthalene, 2-(phenylmethyl)-
9-exo-Methyltricyclo[4.3.1.0]decaatriene
Methane, phenyl-(m-tolyl)-

2-Ethyl-anthraquinone
2-Hydroxy-tricyclo[7.4.1.1(3,8)]pentadeca-3,5,7,9,11,13-hexaene
Dibenzocycloheptadiene
Naphthalene, 1-ethyl-
Octane, 3,6-dimethyl-
1H-Indene, 2,3-dihydro-4,6-dimethyl-
(E)-4-Methyl-1-phenyl-1,3-pentadiene
Allyl 2-naphthyl ether
Heptane, 2,2,4,6,6-pentamethyl-
Bicyclohexyl, 4-phenyl-
Fluorene, 1,4-dihydro-
Capnellane-5.alpha.-ol
1,3-[13C]-1-Oxo-1,2,3,4-tetrahydronaphthalene
9H-Xanthen-9-one, 4-methoxy-
Azulene, 2,4,6-trimethyl-
Benzene, 1,3-diethenyl-
Ethanone, 1-(4-ethylphenyl)-
Tridecane, 5-methyl-

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Sediment
Sample name: Petkim 4
Sampling date: 23.09.96
Lab. code: MI6150

Other information: Sediment collected from the sea, 20-25m from the mouth section of outfall 2.

Analysis method: GC/MS screen

Number of compounds isolated: 129

Compounds identified to better than 90%:

Tetradecane
Tridecane
Fluoranthene
Hahnfett
Docosane
Pentacosane

Compounds tentatively identified :

Heptacosane
Octane, 2-methyl-
1-Dodecene
Phenanthrene
Cyclododecane
Tridecane, 3-methyl-
Cyclohexane, 1,2-dimethyl-3-pentyl-4-propyl-
Heneicosane
Hexadecane
Tetracontane, 3,5,24-trimethyl-
Ethane, hexachloro-
Nonahexacontanoic acid
Nonane, 2,2,4,4,6,8,8-heptamethyl-
Octadecane
Octane, 2,4,6-trimethyl-
Tetracosane, 2,6,10,15,19,23-hexamethyl-

Tetratriacontane
Tricosane
Phosphonic acid, dioctadecyl ester
Dodecane, 2,6,10-trimethyl-
Hentriacontane
Hexadecane, 2,6,10,14-tetramethyl-
Hexatriacontane
Tetradecane, 2,5-dimethyl-
Undecane, 3-methyl-
1,4:8,11-Bisimino(14)annulene
1-Hexacosanol
11-Methyl-1,4-dihydroanthracen-1,4-imine
Dodecane, 1,1'-oxybis-
Dodecane, 2,7,10-trimethyl-
Heptane, 2,2,3,4,6,6-hexamethyl-
Hydroxylamine, O-decyl-
Nonadecane
Pyridinium, 1-hexadecyl-, chloride, monohydrate
Tetradecane, 2,6,10-trimethyl-
Tetradecane, 6,9-dimethyl-
Tetratetracontane
9-Eicosene, (E)-
Ethanol, 2-(dodecyloxy)-
Heptadecane, 2,6,10,15-tetramethyl-
Nonacosane
Pentadecane, 6-methyl-

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Sediment
Sample name: Petkim 5
Sampling date: 23.09.96
Lab. code: MI6151

Other information: Sediment collected from the sea, 20-25m from the mouth section of outfall 2.

Analysis method: GC/MS screen

Number of compounds isolated: 137

Compounds identified to better than 90%:

Cyclododecane
Tetradecane
Tridecane
Cyclododecane, ethyl-
Hexadecane
Benzene, hexachloro-
Dodecane, 2,6,10-trimethyl-
Ethane, hexachloro-
Cyclotetradecane
Fluoranthene

Compounds tentatively identified :

Benz[a]azulene
Cyclohexane, 1-methyl-4-(1-methylethylidene)-
Undecane
Hahnfett
Pyrene
Heneicosane
Triacontane
1-Hexadecene
Tetradecane, 2-methyl-
Tetradecane, 3-methyl-
9-Undecen-2-one, 6,10-dimethyl-
2(1H)-Benzocyclooctenone, decahydro-4a-methyl-, trans(-)-

2(1H)-Naphthalenone, octahydro-4a-methyl-, trans-
Cyclohexane, 1-(cyclohexylmethyl)-4-methyl-, cis-
Dotriacontane
Tetracontane, 3,5,24-trimethyl-
Tridecane, 6-cyclohexyl-
Hexatriacontane
Perchloropropane
1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
10-Methylbenz[a]azulene
Cyclopentane, (2-methylbutyl)-
Dodecane
Endoisocamphene
Naphthalene, decahydro-2,3-dimethyl-
Phenanthrene, 3-methyl-
3,5-Octadiene, 4,5-diethyl-, (E,Z)-
Anthracene, 2-methyl-
Oxirane, tetradecyl-
1,11-Dodecadiene
11,12-Dihydroxyseychellane
Bicyclo[4.1.0]heptane, 3-methyl-7-pentyl-
Nonahexacontanoic acid
Pentadecane, 2,6,10,14-tetramethyl-
Tetradecanal

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Mixture of industrial wastewater and sea water

Sample name: Petkim 6

Sampling date: 24.09.96

Lab. code: MI6152

Other information: Collected from the mouth of the canal receiving discharge from outfall 1. No significant discharge at time of sampling.

Analysis method: GC/MS screen

Number of compounds isolated: 157

Compounds identified to better than 90%:

Heptacosane
2,2-Chlorophenyl-1,1-dichloroethylene
Hexacosane
Naphthalene, 1,5-dimethyl-
Octadecane
Pentacosane
Tricosane
1,1':2',1"-Terphenyl
Eicosane
Tetracosane
Benzene, 2-ethenyl-1,4-dimethyl-
o,p'-DDT
Nonacosane
1,1':4',1"-Terphenyl
1H-Indene, 1-methyl-
9H-Fluorene, 2-methyl-
Benzene, 1,3-diethyl-
Hexadecane
Naphthalene, 1,3-dimethyl-
Naphthalene, 1-methyl-
Naphthalene, 2,7-dimethyl-
1H-Indene
Naphthalene, 1,6,7-trimethyl-
Naphthalene, 2-ethenyl-
Naphthalene, 2-methyl-
Benzene, 1,1'-methylenebis-

Benzene, 1-propynyl-
Benzene, 2-butenyl-
Hentriacontane
Naphthalene, 1,2-dihydro-
Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
Anthracene, 1-methyl-
Azulene, 2,4,6-trimethyl-
1,1'-Biphenyl, 2-methyl-
1H-Cyclopropa[b]naphthalene, 1a,2,7,7a-tetrahydro-
1H-Indene, 2,3-dihydro-5-methyl-
9H-Fluorene
Azulene
Benzene, 1,2,3,5-tetramethyl-
Benzene, 1-methyl-4-(1-methylethyl)-
Benzeneacetaldehyde, .alpha.-ethylidene-
Hexadecane, 2-methyl-
Phenanthrene, 4-methyl-
Benzene, 1,1'-(-ethenyl-1,3-propanediyl)bis-
Benzene, 3-butenyl-
1-H-Indene, 2,3-dihydro-1,6-dimethyl-
Indeno[2,1-a]indene, 4b,5,9b,10-tetrahydro-
Pentadecane

Compounds tentatively identified :

Viny lindene
Bicyclohexyl, 4-phenyl-
1-(3-Methylphenyl)buta-1,3-diene
1H-Indene, 2,3-dihydro-
Anthracene
1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
2-Allyl-1-methylnaphthalene

2-Amino-3,9-dimethyl-5-methyl-5-methylamino-3H-1,3,4,6-
tetrazacyclopentene)azulene

9-(Hydroxymethyl)-6,11-dihydroxy-5-oxoxantho[3,2-g]tetralin
9H-Fluorene, 1-methyl-
Triacontane
1,1'-Biphenyl, 2,2'-dimethyl-
Benzene, diethenyl-
Hexatriacontane
3-Methylheneicosane
Undecane
Benzene, 2-ethyl-1,4-dimethyl-
Naphthalene, 2,3,6-trimethyl-
Naphthalene, 2-(1-cyclopenten-1-yl)-
Phenanthrene, 9,10-dihydro-1-methyl-

4H-Cyclopenta[def]phenanthrene
1,1'-Biphenyl, 2,3'-dimethyl-
1H-Indole, 2-methyl-3-phenyl-
2,3,5,6-Tetramethylenenorborane
Naphthalene
Naphthalene, 1,4,6-trimethyl-
Pentadecane, 3-methyl-
Docosane, 11-decyl-
Naphthalene, 1-(2-propenyl)-
Naphthalene, 2-ethyl-
Benzene, 1,1'-cyclohexylidene,bis-
5-Ethylindan
Docosane
Tetratetracontane
Dibenzothiophene
Nonahexacontanoic acid
Fluoranthene
Tetratriacontane
Dibenzothiophene, 3-methyl-
Fluorene, 2,4a-dihydro-
bis-(3,3-dichloropropyl ether
1H-Indene, 1,1-dimethyl-
1-Propene, 1,3-dichloro-
2-Propen-1-one, 3-[4-(1-methylethyl)phenyl]-1-phenyl-
Heptadecane, 2,6,10,15-tetramethyl-
Phenanthridinium, 5,6-dimethyl-, iodide

ORGANIC ANALYTICAL RESULTS

Petkim, Aliaga, Turkey, 1996

Sample type: Mixture of industrial wastewater and sea water

Sample name: Petkim 7

Sampling date: 24.09.96

Lab. code: MI6153

Other information: Collected 2-3m from the mouth of the canal receiving discharge from outfall 2.

Analysis method: GC/MS screen

Number of compounds isolated: 132

Compounds identified to better than 90%:

Octadecane

Eicosane

Nonadecane

Heptadecane

1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester

Heneicosane

Tetradecane

Undecane

Compounds tentatively identified :

Dodecane

Hexatriacontane

Dotriacontane

Tetratriacontane

Benzene, (1-methyldecyl)-

Heptacosane

Pentane, 2,4-dibromo-

Phenol, 2-methyl-

Propanoic acid, 2-methyl-, 2-ethyl-3-hydroxyhexyl ester

7-Tetradecene, (Z)-

Undecane, 2,8-dimethyl-

Undecane, 4,8-dimethyl-

Cyclopentane, 1-pentyl-2-propyl-

Pentadecane

1-Heptanol, 2-propyl-

4,5,6-Trimethoxyindole
Benzene, (1-butylheptyl)-
Benzene, (1-propyloctyl)-
Hexadecane, 2,6,10,14-tetramethyl-
Tetracosane, 2,6,10,15,19,23-hexamethyl-
Tricosane
1,1-Dimethyl-2-propylcyclohexane
1-Tridecanol
Benzene, (1-methylundecyl)-
1-Octanol, 2-butyl-
2H-Thiopyran-3(6H)-one
Ketone, 2,2-dimethylcyclohexyl methyl