

Detection and Identification of Some Organic Compounds in Sewage Samples by FTIR and GLC-MS

S.P. WAGH[†] and V.S. SHRIVASTAVA*

Centre for P.G. Research in Chemistry
G.T.P. College, Nandurbar-425412, India
E-mail: clayminerals@rediffmail.com

The organic compounds were identified in some sewage samples, which were taken from Someshwar and Tapovan at Nasik. These samples were extracted with the CH_2Cl_2 and characterized by FTIR and GC-MS. The identified organic compounds are saturated and unsaturated hydrocarbons, aromatic alcohols, phenols and dicarboxylic acids that affect adversely the soil and ground water quality of the area.

Key Words: Sewage, CH_2Cl_2 , Organic compounds, FTIR, GC-MS.

INTRODUCTION

The chemical composition of the municipal sewage varies from day to day into the environment because they produce the waste of different characteristics. Sewage water and industrial waste contain a higher concentration of organic and inorganic pollutants. Both drinking water and wastewater are usually treated to make them safe, many of the treatment processes are not fully effective. This has resulted in the widespread contamination of underground water and hence drinking water¹⁻³. There is now growing knowledge of the organic compounds present in the drinking water of many cities⁴⁻⁶ and to a more limited extent, in wastewater of several types of industries⁷⁻⁹.

A number of studies^{10, 11} have been reported for the detection and identification of organics in industrial wastes in western countries. But in India no such study was undertaken for sewage so far. Therefore, this study was undertaken to detect and identify organic compounds present in the municipal sewage.

EXPERIMENTAL

Two sewage samples were collected from Someshwar and Tapovan at Nasik City. These samples were extracted¹² with CH_2Cl_2 . The obtained mass was analyzed for different functional groups by FTIR and GC-MS.

[†]Department of Chemistry, Arts, Science and Commerce College, Taloda-425 413, India.

RESULTS AND DISCUSSION

The characteristic bands and IR frequencies of both the samples are given in Table-1.

TABLE-1
IR FREQUENCIES IN BOTH SEWAGE SAMPLES COLLECTED FROM SOMESHWAR
AND TAPOVAN AREA

Absorption region (cm^{-1})	Characterization (interpretation)
2930	C—H stretching (alkyl)
2864–2859	C—H stretching (—CH ₂ gr)
807	C—H bending, meta-substituted (aromatic)
1479–1464	C=C (aromatic ring)
1275–1265	C—O stretching
1026	C—O (alcoholic) stretching
1754–1744	C=O (acid or ester)
1107	C—N (aliphatic) stretching
1382, 1377	C—N (aromatic)

The GC/MS spectra of the CH_2Cl_2 extracted mass are shown in Figs. 1 and 2 and the identified organic compounds are given in Table-2. The saturated and unsaturated hydrocarbons, alcohols, phenols and aromatic dicarboxylic acids are found in both the sewage samples.

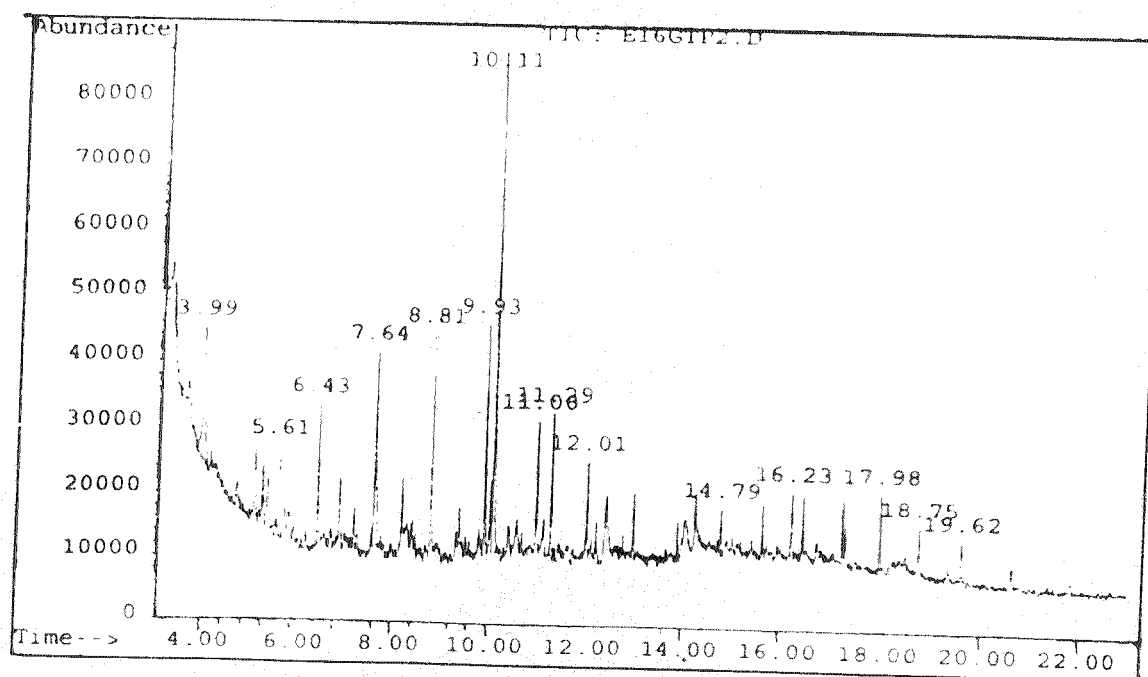


Fig. 1. GLC-MS of CH_2Cl_2 extracted mass of sample no. 1

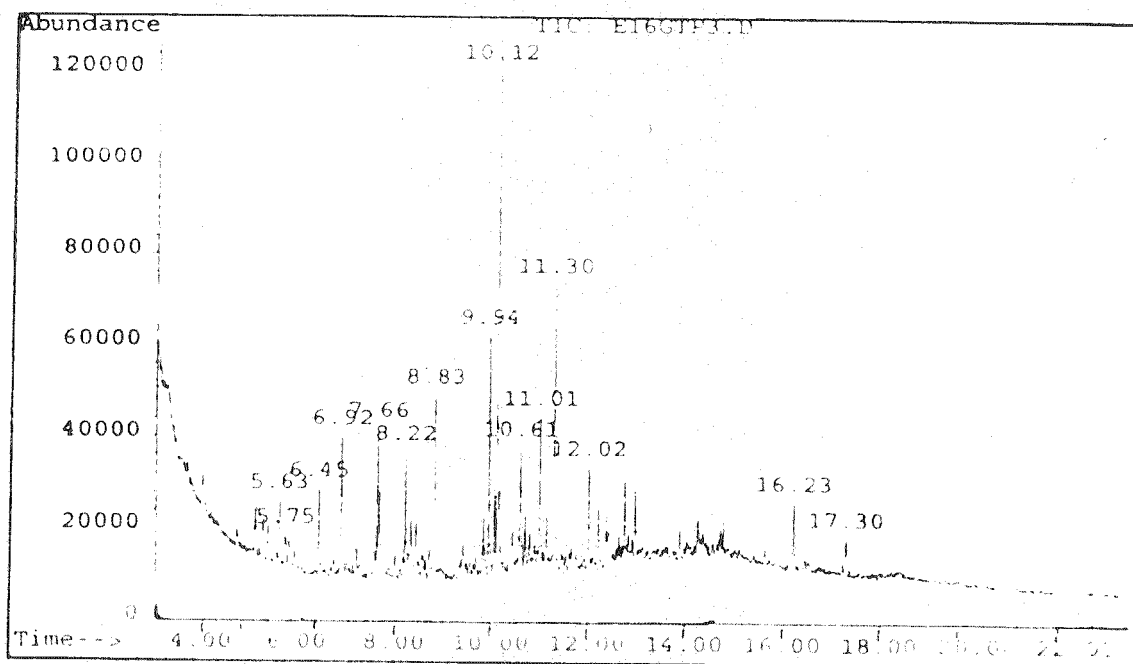


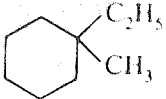
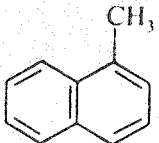
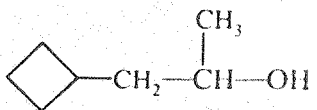
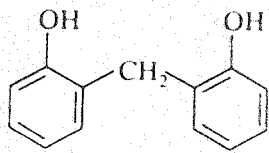
Fig. 2. GLC-MS of CH_2Cl_2 extracted mass of sample no. 2

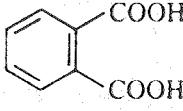
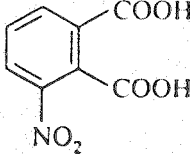
Hydrocarbons are naturally occurring compounds. They are emitted to the atmosphere by tree, domestic animals and human activities by petroleum industries, coal and automobile emission. The fumes of refineries and paint thinner contain a mixture of volatile hydrocarbons. Lead is the most important particulate matter resulting from automobile pollution. When these volatile hydrocarbons are mixed into the environment, they react or dissolve into the surface water and indirectly underground water and this water acts as toxic to animal and human beings.

Phenolic compounds impart typical odour and taste to water and is highly toxic to aquatic life and vegetation even at low concentration. When animal and human beings use phenol polluted water, they frequently affected by diseases of the alimentary track. It provides toxic effects on brain, lungs, kidney, liver, etc. A limit of 10 mg/L of polyhydric phenol has been suggested to avoid inhibition of biological processes¹³. Alcohols are used as cosmetic and perfume ingredients. These are also commonly used as preservatives in injectible products but if high amount of dose is inhaled it leads to drowsiness and headache¹⁴.

Benzene compounds, e.g., 3-nitro-1,2-benzene dicarboxylic acid can cause skin irritation, redness and pain. Excess inhalation may lead to headache and weakness. If these compounds are present in the environment, they affect the quality of soil and groundwater of the area¹⁴. Therefore, the sewage should be treated before ponding to open places or to river/sea. It may be beneficial to the water pollution control.

TABLE-2
ORGANIC COMPOUNDS FOUND IN SEWAGE SAMPLES

Name of the organic compounds	Structure	m. f.	m. w.
Saturated hydrocarbon			
3-Ethyl,3-methyl heptane	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{C}_2\text{H}_5 \end{array}$	C ₁₀ H ₂₂	142
Pentadecane	CH ₃ -(CH ₂) ₁₃ -CH ₃	C ₁₅ H ₃₂	212
Hexadecane	CH ₃ (CH ₂) ₁₄ CH ₃	C ₁₆ H ₃₄	226
Heptadecane	CH ₃ (CH ₂) ₁₅ CH ₃	C ₁₇ H ₃₆	240
Dodecane-2,6,10-trimethyl	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \\ \quad \quad \\ \text{CH}_3-\text{CH}(\text{CH}_2)_3-\text{CH}(\text{CH}_2)_3-\text{CH}-\text{CH}_2\text{CH}_3 \end{array}$	C ₁₅ H ₃₂	212
2,6,10-Trimethyl dodecane-	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \\ \quad \quad \\ \text{CH}_3-\text{CH}(\text{CH}_2)_3-\text{CH}(\text{CH}_2)_4-\text{CHCH}_3 \end{array}$	C ₁₅ H ₃₂	212
3,8-Dimethyl decane	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{CH}_3\text{CH}_2-\text{CH}(\text{CH}_2)_4-\text{CHCH}_2\text{CH}_3 \end{array}$	C ₁₂ H ₂₆	170
1-Ethyl-1-methyl cyclohexane		C ₉ H ₁₈	126
Halo Alkane			
1-Iodo dodecane	I-CH ₂ -(CH ₂) ₁₀ -CH ₃	C ₂₂ H ₄₅ I	222
Unsaturated hydrocarbon			
1-Propene-2-methyl tetramer	$\begin{array}{c} \text{CH}_3 \\ \\ (\text{CH}_3-\text{C}=\text{CH}_2)_4 \end{array}$	—	—
1-Methyl naphthalene		C ₁₁ H ₁₀	142
Alcohols			
1-Methyl-2-cyclobutane ethanol		C ₇ H ₁₄ O	114
Phenols			
2,2-Methylene bisphenol		C ₁₃ H ₁₂ O ₂	200

Name of the organic compounds	Structure	m. f.	m. w.
Acids			
1,2-Benzene dicarboxylic acid		C ₈ H ₆ O ₄	166
3-Nitro-1,2-benzene dicarboxylic acid		C ₈ H ₅ NO ₆	211

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REFERENCES

1. V.S. Shrivastava and P.N. Nemade, *J. IWWA*, **29**, 247 (1997).
2. S.K. Biswal, B. Mayhi and J.P. Bahera, *Poll. Res.*, **20**, 487 (2001).
3. P.M. Reddy and S. Rao, *Poll. Res.*, **20**, 383 (2001).
4. B.J. Dowty, D.R. Carlisle and J.L. Laseter, *Environ. Sci. Tech.*, **9**, 762 (1975).
5. W.E. Coleman, R.D. Lingg, R.G. Melton, F.C. Kopler, in: L.H. Keith (Ed.), *Identification and Analysis of Organic Pollutants in Water*, Ann Arbor Science, Ann Arbor, Ma (1976).
6. L.H. Keith, A.W. Garrison, F.R. Allen, M.H. Carter, T.L. Floyd, J.D. Pope and A.D. Thruston (Jr.), *Ibid.*, pp. 329-73 (1976).
7. G.A. Jungclaus, L.M. Games and R.A. Hites, *Anal. Chem.*, **48**, 1894 (1976).
8. L.M. Games and R.A. Hites, *Ibid.*, **49**, 1433 (1977).
9. I.A. Jungclaus, V.L. Avila and R.A. Hites, *Environ. Sci. Tech.*, **12**, 88 (1978).
10. J. McEvoy and W. Glger, *Environ. Sci. Tech.*, **20**, 376 (1986).
11. L. Marsili and S. Focardi, *Environ. Poll.*, **91**, 1 (1996).
12. APHA, *Standard Methods for the Examination of Water and Wastewater*, 20th Edn., New York (1999).
13. C.F. Foster, *Biotechnology and Wastewater Treatment*, Cambridge University Press (1995).
14. R.C. Mehrotra and A. Singh, *Organometallic Chemistry: A Unified Approach*, John Wiley & Sons, New Delhi.

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