DETECTION AND IDENTIFICATION OF ORGANIC COMPOUNDS FROM INDUSTRIAL WASTE WATER SAMPLES BY USING FTIR AND GC-MS TECHNIQUES

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ABSTRACT:

Due to rapid industrialization and urbanization our environment has been polluted by toxic organic compounds through the discharge of industrial effluents. The present study monitored organic compounds in the ambient surroundings of selected industrial effluents discharge locations around Palghar and Tarapur MIDC area. Samples of industrial effluent were collected in and around some industrial sites. The different toxic organic compounds are found in the industrial effluent. The overall study indicates that the industrial effluents contains heavy toxic organic compounds which are polluted both the Palghar and Tarapur cities.

Keywords- toxic organic compound, industrial effluent.

INTRODUCTION:

The chemical composition of the industrial waste varies from day to day into the environment because they produce the waste of different characteristics and contain a higher concentration of organic and inorganic pollutants. As far as pollution from industries is concern effluents in most of the cases are discharged into the rivers, streams, pits, open grounds or open unlined drains near the factories. In many cases, rivers also receive wastewater from surrounding municipal and industrial discharges. Millions of people drink water taken from rivers (1). It has been estimated that river water can contain up to 2000 different organic substances over a wide concentration range and many of these survive during processing in the water works and occur in potable water with possible health implication (2).

Although 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 wide spread contamination of underground water and hence drinking water (3-5). There is now growing knowledge of the organic compounds in the drinking water of many cities (6-8) and to a more limited extent in wastewater of several types of industries (9-11).

Numbers of studies (12-13) have been reported for the detection and identification of organics in industrial wastes in western countries. But in our country no such study was undertaken for industrial waste water so far. Therefore this study was under taken to detect

and identify organic compounds present in industrial wastes by using FTIR and GC-MS techniques.

For this investigation the samples were collected from the Palghar and Tarapur MIDC areas. These areas are one of the important industrial belts situated nearby Mumbai.

MATERIAL AND METHODS:

The organic compounds present in industrial wastewater and amended soil were detected and identified by Infra Red and GC/MS spectroscopic methods (14-15).

For the IR and GC/MS studies of organic compounds present in industrial effluents, batch wise extraction of 250 ml sample was carried out. 50 ml of industrial effluents was taken in 250 ml separating funnel and 50 ml of dichloromethane (CH_2Cl_2) was added to it. The funnel was shaking for 60 minutes. Both the phases are allowed to separate. Organic phase is separated off and anhydrous sodium sulphate was added for the removal of water molecules. The CH_2Cl_2 extract was evaporated on water bath up to dryness. The FTIR and GC mass spectra of these residues were recorded at SAIF, IIT, Mumbai.

RESULTS AND DISCUSSION:

In combined GC-MS, the chromatographic retention parameters provide isomer specificity, while the mass spectral parameters provide class and homologue specificity. Besides the various technological developments in GC and MS a great deal of the progress achieved can be attributed to improvement in sample preparation procedures.

Some authors (12-13) found out the organic compounds in wastewater and other samples by GC-MS. In the present study, the GC/MS analysis of industrial waste water samples extracted with chloroform was carried out at Sophisticated Analytical Instrument Facility (SAIF), IIT, Mumbai. The GC-MS of these samples and their library search compounds are shown in figures 1-4.

I am trying to expend the discussion of identified moieties individually, particularly in regard to structural and molecular formula. The Identified moieties are being tabulated in the tables 1and 2.

The heavier hydrocarbons were identified in industrial waste water samples. Saturated hydrocarbons up to octane can produce anesthesia and norcosis in many lower animals. Low boiling point aromatic hydrocarbons are even more toxic and their greater water solubility tends to enhance their distribution and uptake by aquatic organisms. Benzene, toluene, naphthalene and phenanthrene are amongst the compounds in this group. Benzene characteristically inhibits blood cell formation in bone marrow. All cause local irritation of the respiratory system and excitation or depression of the central nervous system.

In above two samples eight organic compounds have been detected (Table-3). Detected compounds were identified by maching the mass spectra of the compound with available spectra in library. The identified compounds are 1, 2 benzene dicarboxylic acid,cyclohexyl methyl hexyl ester, ester of the phthalic acid etc. Esters can cause adverse effects on endocrine system, which is comprised of the organs and glands that secrete hormones. Hormones control normal physiological processes, maintaining the body's homeostasis. Compounds that are toxic to the endocrine system may cause diseases such as hypothyroidism, diabetes mellitus, hypoglycemia, reproductive disorders and cancer. Polycyclic aromatic hydrocarbons are especially dangerous in this respect.

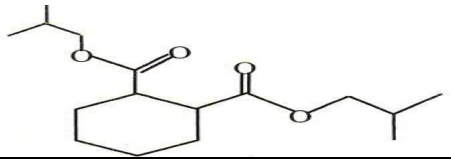
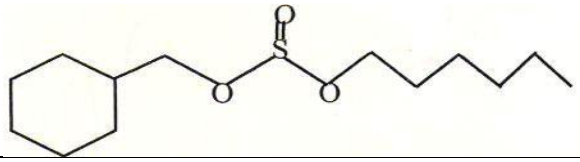
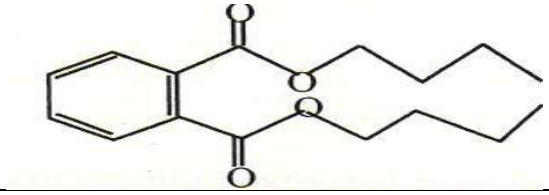
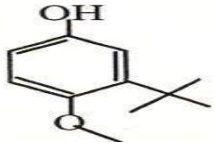
Table 1 - The characteristics frequency and their functional groups (Sample no.1)

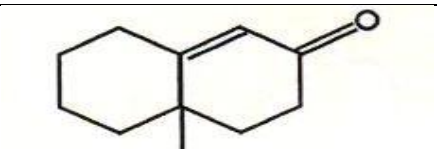
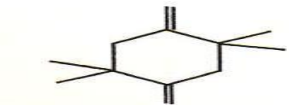
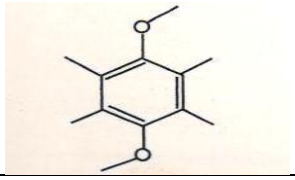
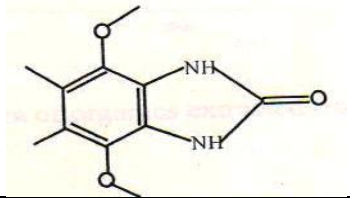
S. no.	Frequency cm^{-1}	Functional group
1.	3401.84	-OH Stretching frequency.
2.	2923.66	-OH (carboxylic acid, H-bonded.)
3.	1652.88	C=O stretching freq.(Aldehyde, Ketone, esters, Carboxylic acid)
4.	1456.15	Aromatic C=C stretching frequency.

Table 2 - The characteristics frequency and their functional groups (Sample no.2)

Sr. no.	Frequency cm^{-1}	Functional group
1.	3445.03	-OH (alcohols,phenols,H-bonded)
2.	2961.56	-OH (carboxylic acid, H-bonded.)
3.	1731.79	carboxylic acid /Aldehydes
4.	1633.87	=C=O stretching freq. (Aldehyde, Ketones, esters,Carboxylic acid)
5.	1445.71	Aromatic C=C stretching frequency.
6.	1261.76	= C-O stretching frequency (phenols/alcohols)
7.	666.86	Monosubstituted Aromatic ring.

Table 3– Organic compounds found in chloroform extracted mass of Industrial effluents (Samples 1 and 2)

Molecular Formula	Structural Formula	IUPAC Name
$C_{16}H_{22}O_4$		**1,2-Benzene dicarboxylic acid, bis ester.**
$C_{13}H_{26}O_3S$		**Cyclohexylmethyl hexyl ester.**
$C_{16}H_{22}O_4$		**1,2- Benzene dicarboxylic acid, dibutyl ester.**
$C_{11}H_{16}O_2$		**Phenol 3-tert-butyl-4-methoxy**

$C_{11}H_{16}O$		**4a-methyl-4,4a,5,6,7,8- hexa hydro-2 (3H) napthalenone**
$C_{12}H_2O$		**Cyclohexane, 1,1,4,4-tetramethyl-2,5-dimethylene**
$C_{12}H_{18}O_2$		**1,4- dimethoxy-2,3,5,6-tetramethyl**
$C_9H_{10}N_2O_3$		**4,7-dimethoxy-1,3-dihydro-2H-benzimidazol**

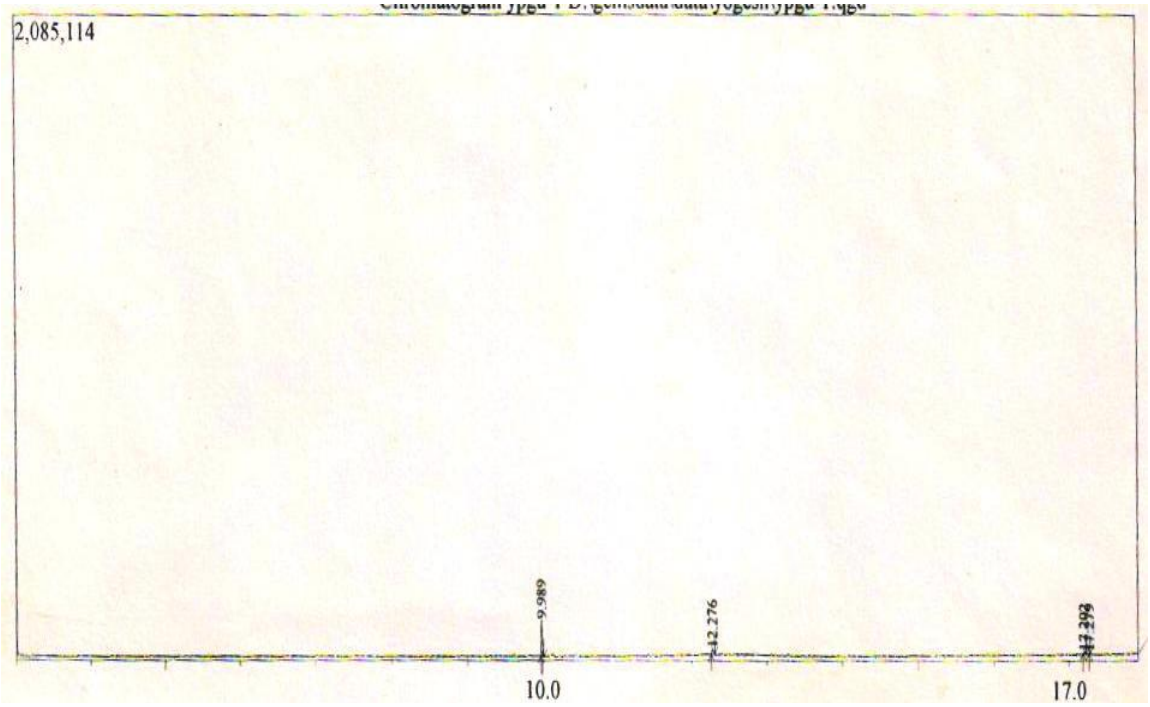


Fig.1: Gas chromatogram of organics extracted from IWW sample No.1

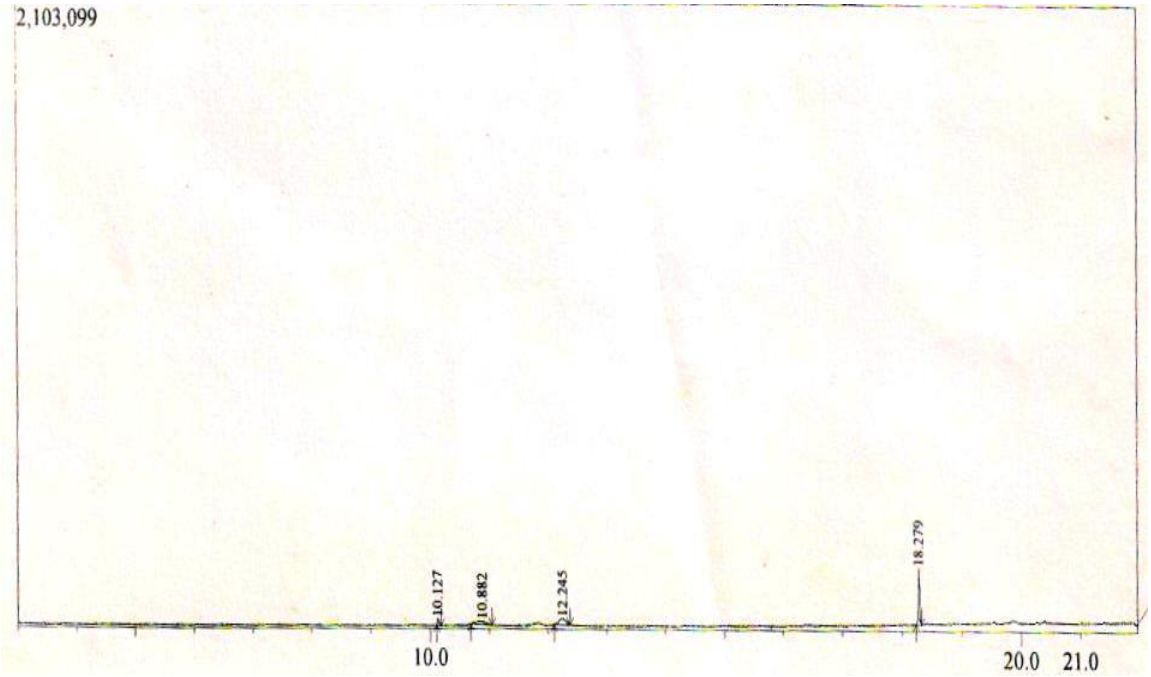


Fig.2: Gas chromatogram of organics extracted from IWW sample No.2

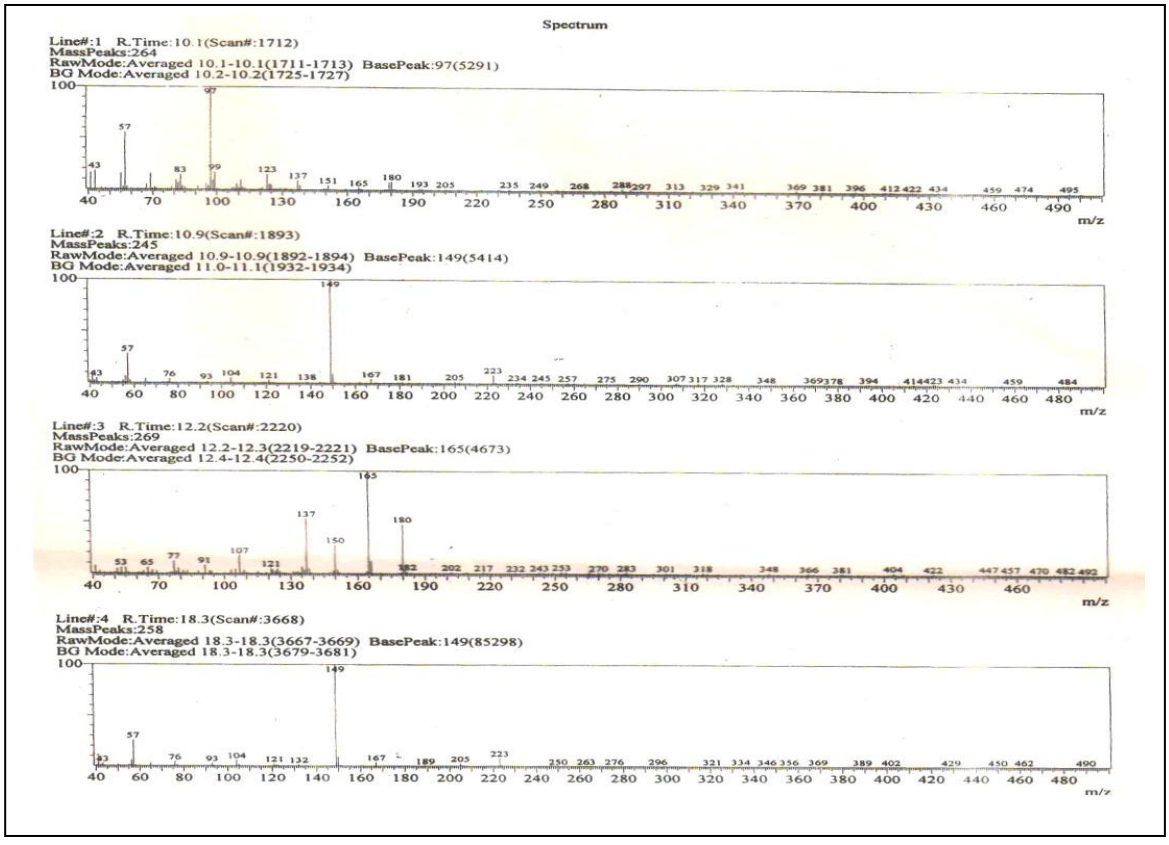


Fig. 3 Mass spectra of industrial wastewater Sample No1

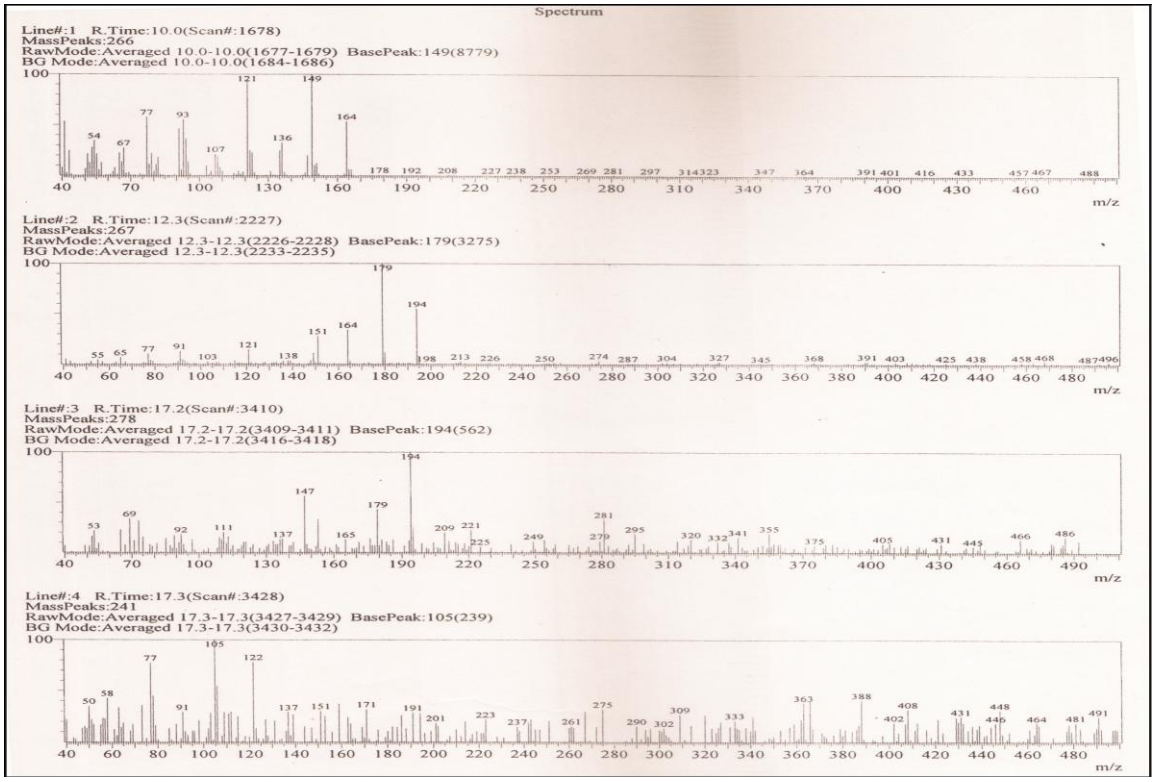


Fig. 4: Mass spectra of industrial wastewater Sample No.2

CONCLUSION:

Huge amounts of organic compounds are used in industries. The presence of these compounds in industrial wastewater may lead to the formation of the new substituted compounds. All the above compounds in industrial wastewater system will be a complex mixture of contaminants with the predominance of any type depends on effluents hydrology, discharge sources and general industrial effluent condition. The presence of such organic compounds in the industrial wastewater may be the cause of worry for the ecosystem, aquatic life, soils, flora and fauna as well as for the peoples living in the surrounding area.

REFERENCES:

1]Chavan R.P., Lokhande R.S. and Rajput S. I., Seasonal variation of organic Pollutants in the Thane Creek water Maharashtra. Poll.Res.,25(1) ;179-183 ,(2006)

2] Linda S.S. and Hites R.A., Organic compounds in the Delaware River, Env.Sci. and Tech., 12(10) : 1188-1194 (1978).

3] Shrivastava V.S. and Nemade P.N., Ground water pollution by industrial waste: A statistical approach, Jr. of Indian Water Works Association, 29: 247-250 (1997).

4] Biswal S.K., B. Mayti and Bahera J.P., Ground water quality near ash pond of thermal power plant, Poll.Res., 20(3) : 487-490 (2001).

5] Reddy P.M. and Subbha Rao, Effect of industrial effluents on the ground water regime in Vishakhapatnam, Poll. Res., 20(3) : 383-386(2001).

6] Dowty B.J., Carlisle D.R., Laseter J.L., Environ.Sci.Tech., 9 : 762 (1975).

7] Coleman W.E., Lingg R.D., Melton R.G., Kopler F.C. , Identification and analysis of organic pollutants in water, L.H. Keith , Ed. 305-327, Ann Arbon Science , Ann Arbor M.ch (1976).

8] Bhargava R.N., Chandra R. and Singh S.K., Elucidation of chemical structure of Phenolic compounds by GC-MS present in anaerobicaly digested Distillery Effluents, Ind. Jr .Env.Prot; 1015-1018 (2006).

9] Sing Vandana, Jain Archana an Verma K.K., Solid Phase micro- extraction of residues of organophosphorous pesticides from aqueous samples for their determination by Gas chromatography - Mass spectrometry, Ind. Jr. of Chem., 42(A) : 2993-2999 (2003).

10] APHA, Standard Methods for the examination of water and wastewater, 20th edn, New York (1999).

11] Jungclaus L.A., Lopez Avila V., Hites R.A., Environ.Sci.Technol., 12 : 88 (1978).

12] James McEvoy and Walter Glger, Determination of linear alkyl benzene sulphates in sewage, sludge by high resolution gas chromatography/mass spectrometry,Environ. Sci.Tech., 20(4) : 376-383 (1986).

13] Hartung J., Gas Chromatographic analysis of volatile fatty acids and phenolic/indolic compounds in pig house dust after ethanolic extraction, Environmental technology letter, 6 : 12-30 (1985).

14] Barman S.C. and Lal M.M., Accumulation of heavy metals in soil and cultivated vegetable and weeds grown in industrially polluted fields, J. Env. Bio., 15(2) : 107-115, (1994).

15] Silverstein R.M., G.C. Basslle r and T.E. Moril, Sepctroscopic identification of organic compounds, 4th edition, John Wiley and Sons, New York (1981).