NOTE

Detection and Identification of Metallic and Organic Moieties by ICP-AES and GLC-MS

MAHESH B. PHALAK*, M.I. TALELE and V.S. SHRIVASTAVA

Centre for P.G. Research in Chemistry, G.T.P. College, Nandurbar-425 412, India

The industrial waste samples were collected from MIDC Jalgaon, Aurangabad and Cooperative Industrial Area, Bhusawal (Maharashtra) and analyzed. Concentrated metals (*viz.*, Cu, Zn, Cd, Pd, Ni, Fe, As, Hg, Mn, B) were detected by inductively coupled plasma atomic emission spectroscopy (ICP-AES). The organic moieties present in samples were extracted with CH_2Cl_2 and identified by FTIR and GLC-MS techniques. Besides the above investigation, the physicochemical characteristics of industrial waste and their amended soil samples have also been evaluated.

Key Words: Industrial waste, Metals, Organic compounds, ICP-AES, GLCMS.

Rapid increasing industrialization is the major problem of the society. Because industrial influents contain a variety of metallic (*viz.*, Cu, Zn, Cd, Ni, Fe, etc.) and organic moieties (like phthalic anhydride, 1,2-benzenedicarboxylic acid, etc.). These metallic and organic moieties affect the quality of soil, plants and ground water adversely[1–3]. Generally metals like Cu, Zn, Cn, Cd, Pb, Hg, As, Ni etc. and organic acids and their derivatives, phenols, dyes, drugs, pesticides have been detected suitably[4,5]. For the impact studies, metallic and organic moieties have been detected and identified in western countries[6,7]. Some organic compounds and metals have been found to be reported carcinogenic, mutagenic and tetratogenic in nature[8].

In view of the above, it was considered worthwhile to detect and identify the metallic and organic moieties and their impact on the environment in Bhusawal, Jalgaon and Aurangabad MIDC areas.

Industrial effluents and their amended soil samples were collected from Bhusawal, Jalgaon and Aurangabad MIDC areas. The concentration of metals in $HCl-HNO_3$ extracts was determined by ICP-AES at RSIC, IIT Mumbai, India.

Organic compounds are extracted from the effluents by using dechloromethane[9,10]. Extracted organic mass was concentrated and it was recorded for identification of different functional groups on Perkin-Elmer IR instrument. GLC-MS was recorded on Hewlett Packard instrument at RSIC, IIT, Mumbai. The physicochemical characteristics were determined by using standard methods[11].

The results obtained during the course of the present study are given in Tables 1–4.

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*Department of Chemistry, Arts, Science and P.O. Nahata Commerce College, Bhusawal-425 201, India.

TABLE-1

CONCENTRATION OF METALS IN INDUSTRIAL WASTES AND
THEIR AMENDED SOIL

Site of sample collection	Metals (μg/mL)									
	Cu	Zn	Cd	Pb	Ni	Fe	As	Hg	Mn	B
Walunj MIDC Area, Aurangabad	1.14	0.22	ND	ND	1.29	38.27	ND	ND	1.11	0.45
Walunj MIDC Area, Aurangabad	8.78	0.11	ND	ND	ND	13.34	ND	ND	0.46	0.23
Walunj MIDC Area, Aurangabad	4.90	1.76	ND	ND	0.57	1.29	ND	ND	0.12	0.16
Co-operative Industrial Area, N.H. No. 6, Bhusawal	204.91	86.69	ND	ND	ND	1.11	ND	ND	0.096	0.44
Ajanta Rd. MIDC Area, Jalgaon	24.82	1.72	ND	12.05	ND	51.17	ND	ND	1.28	0.51
Walunj MIDC Area, Jalgaon	0.21	0.44	ND	ND	ND	10.51	ND	ND	1.52	1.10
Ajanta Rd. MIDC Area, Jalgaon	0.21	0.48	ND	ND	ND	17.60	ND	ND	0.97	0.96
Co-op. Ind. Estate NH No. 6, Bhusawal	0.29	0.40	ND	ND	ND	16.17	ND	ND	0.92	1.28
Industrial Waste Amended Soil Walunj MIDC, Aurangabad	3.20	10.77	ND	ND	1.15	612.25	ND	ND	9.16	2.08
Ind. Waste Amended Soil Co-op., Ind. Area, NH No. 6, Bhusawal	3.87	16.03	ND	ND	2.03	701.33	ND	ND	19.05	2.55
Industrial Waste Amended Soil Ajanta Rd., MIDC, Jalgaon	1.92	17.58	ND	2.81	6.89	5557.45	ND	ND	7.75	1.99

ND: Not detected

The concentration of metals (Table-1) in industrial waste samples were found to be of various metals except Cd, As and Hg. The metal Pb was detected only in MIDC area of Jalgaon, whereas it was not detected in most of the other samples. Nickel in amended soil sample was detected in Jalgaon MIDC area. The concentration of these metals in the industrial waste and amended soil samples appears to be detected because of improper treatment and care of industrial waste in these areas.

The adsorption bands present in the identified compounds are tabulated in Table-2.

TABLE-2

IR SPECTRUM (cm^{-1}) OF CH$_2$Cl$_2$ EXTRACTED MASS

Frequency	Functional groups	Frequency	Functional groups
3424.6	—OH (H-bounded)	1286.0	>C—O (Ether linkage)
3073.3	=C—H	1143.4	>C—O (Alcoholic)
2930.7	>C—H	1077.2	>C—O (Ether type)
1713.7	—COOH	756.4 ⎫	Disubstituted benzonoid ring
1637.7	>C=C<	715.7 ⎭	
1576.2	>C=C<	654.6	>C—Cl
1403.1	>C—H (Bending)	494.7	>C—Cl

The band at 1713.7 cm^{-1} indicates the presence of carboxylic acid (U$_c$ = 0). Other characteristic bands are present at 3425, 3074, 2931, 1637, 1576, 1403, 1286, 1143, 1077, 756, 716, 655, 497 cm^{-1}. The functional groups obtained are given in Table-2.

For GLC-MS analysis, the organic mass was extracted by CH$_2$Cl$_2$. The GLC-MS analysis identified two compounds: phthallic anhydride and 1,2-benzenedicarboxylic acid.

The physicochemical characteristics of all the industrial effluents and their amended soils are given in Table-4. Some samples are acidic in nature and some are alkaline in nature, whereas Jalgaon MIDC amended soil was found to be acidic in nature. The concentration of TDS, hardness, pH was found to be detected in all samples. The physico-chemical characteristics also support the presence of metallic and organic moieties in the industrial wastes.

TABLE-3

CONCENTRATION OF METALS IN INDUSTRIAL WASTES AND
THEIR AMENDED SOIL

S. No.	Site of sample collection	Parameters									
		Hardness	Chloride	Total dissolved solid	pH	Dissolved oxygen	COD	Nitrogen	Sulphate	Acidity	Alkalinity
[A]	**Effluent sample**										
1.	Walunj MIDC Area, Aurangabad	900	—	89	2.30	2.5	18.8	2	98.76	50	500
2.	Walunj MIDC Area, Aurangabad	250	—	80	2.30	2.4	16.4	43	0.98	—	—
3.	Walunj MIDC Area, Aurangabad	340	9.82	45	7.68	3.0	6.8	252	102.8	—	200
4.	N.H. No. 6, Co-op., Ind. Area, Bhusawal	60	—	544	8.74	2.3	0.8	—	0.411	—	—
5.	Ajanta Rd. MIDC Area, Jalgaon	610	6.93	180	8.88	1.4	18.0	—	1.52	—	760
[B]	**Amended soils**										
6.	Amended soil from Walunj MIDC Area, Aurangabad	—	—	54	6.2	—	—	—	—	300	—
7.	Amended soil from NH No. 6, Co-op., Ind. Area, Bhusawal	—	—	600	6.3	—	—	—	—	200	—
8.	Amended soil from Ajanta Rd. MIDC Area, Jalgaon	—	—	800	6.4	—	—	—	—	600	—

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