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Research Paper

Detection of Hazardous Metals and Organics in Wastewater Around Udaipur by Ftir and Gc-Ms Technique : A Green Chemistry Approach

Chemistry

KEYWORDS : Organics, Trace Metals, ICP-AES, FTIR, GC-MS, Industrial wastewater

P.P.TAILWARE Deptt. Of Chemistry, K.A.M. Patil Arts, Commerce and Science College, Pimpalner

P.M. Yeole Centre for Research in Chemistry, R.L. College, Parola.(Jalgaon)

ABSTRACT

For this study industrial wastewater samples from near by area of Hindustan Zink Ltd. Company, Udaipur were collected. At this point the soil is getting polluted by the disposal of different industrial wastewater. This work describes a green chemistry approach by the detection and identification of metals and organic compounds in industrial wastewater by ICP-AES and GC-MS techniques. For detection of metals HCl-HNO3, (2:1) extract was prepared, while organic compounds were detected in CH2Cl2 extracted mass. Also the functional groups present in organic compounds were identified by FTIR. Detected some of the metals and organic compounds are toxic to the environment. This analysis can highlight the urgent need for continuous monitoring which will affect on environment.

Introduction:-

The continuous increase of industrial area in Udaipur has revealed to reach organics in ground water (1,2). Waste water contains variety of organic compounds and heavy metals. These organics and heavy metals affect the quality of ground water. The organics contains phenol, esters, carboxylic acids, amides, ketones, alkene, alcohol, ether, alkane and some heavy metals like Cu, Zn, Fe, Pb, Cr, Sr and As etc. are toxic to living organisms(3,4). Heavy metals are major environmental pollutants and they are regarded to be cytotoxic and carcinogenic(5).The industrial waste water perculate through the soil and affects the ground water, soil and plants growth in the near by area(6,7). Numerous studies have been reported for detection and identification of organics in western countries (8, 9). Pollutants released into the air, water and soil can find their may enter into the human body by breathing, eating and drinking (10).

In view of the above it has been considered worthwhile to investigate the strength of heavy metals in the waste water samples of industrial area of Udaipur by ICP-AES and GC-MS to study their pollution status.

Experimental:

Materials and Methods:-

For this study we have selected the industrial area of Udaipur(Rajasthan). The waste water samples were collected from the near by area of Hindustan Zinc ltd. Company, Udaipur. Organic compounds were extracted by taking equal amount of waste water sample and dichloromethane in a separating funnel and shake the mixture for about 30 minutes and the sample layer collected in beaker which was extracted on a sand bath or on a hot plate. This extracted mass was recorded for FTIR on Perkin Elmer make IR instrument and GC-MS was recorded on Hewlett-Packard make GC-MS spectrophotometer at Sophisticated Analytical Instrumentation Facility (SAIF), IIT, Mumbai.

Results and Discussion:-

The results obtained during the course of present study are being tabulated in table 1-3. The results obtained for heavy metals are tabulated in table-1. This result shows the concentration of heavy metals in industrial wastewater samples. The concentration of metals like Pb and As was found to be not detected (< 0.01 µg/ml) in both of the industrial wastewater samples. The concentration of Cu was found to be in the range 0.1 to 0.11 µg/ml. The concentration of Zn was found to be detected in the range of 0.77 to 0.84 µg/ml, whereas the concentration of Fe, Cr and Sr were found to be in the range of 1.7 to 5.18, 0.09 to 0.42 and 0.15 to 1.58 µg/ml respectively.

Table-1) Metal Concentration in Waste water Samples:-

Sr.No.	Samples	Cu (ppm)	Zn (ppm)	Fe (ppm)	Pb (ppm)	Cr (ppm)	Sr (ppm)	As (ppm)
1	Sample-1	0.11	0.847	5.186	ND	0.421	0.149	ND
2	Sample-2	0.104	0.773	1.704	ND	0.092	1.577	ND

The obtained characteristic bands, IR frequencies and organic compounds are given in table-2 and 3. The saturated and unsaturated hydrocarbons, alcohols, esters, amides, ketone, aromatic dione, heterocycles, phenols are found in both the industrial wastewater samples. Hydrocarbons are naturally occurring compounds; they are emitted to the environment by trees, petroleum industries, coal and automobile emission. The fumes of chimneys and paint thinner contain a mixture of volatile hydrocarbons. Phenolic and acidic compounds impart typical odor and test of water and are hazardous to aquatic life and vegetation even at low concentration. When animal and human beings used such polluted water they frequently affected the disease of elementary track and stomach. It provides toxic effects on brain, liver and lungs etc (11-12).

FTIR: (Fourier Transfer Infra Red Spectroscopy):

The IR spectra of the wastewater sample-1 and sample-2 have been used to determine organics present in wastewater samples. The adsorption between 4000 cm-1– 400cm-1 in KBr using FTIR spectrometer model SIMADZU 8400 S PC with 4.0 per cm resolution.

Fig-1) The IR spectra of waste water sample-1.

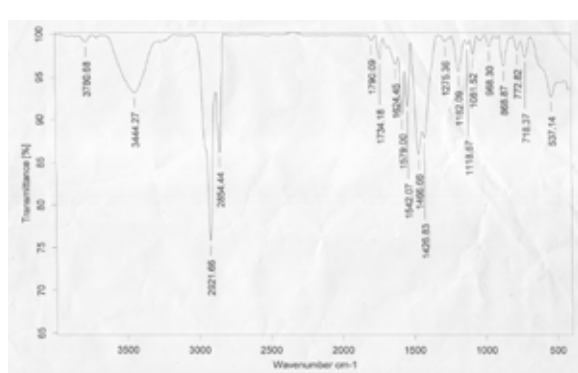

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Fig-2) The IR spectra of waste water sample-2.

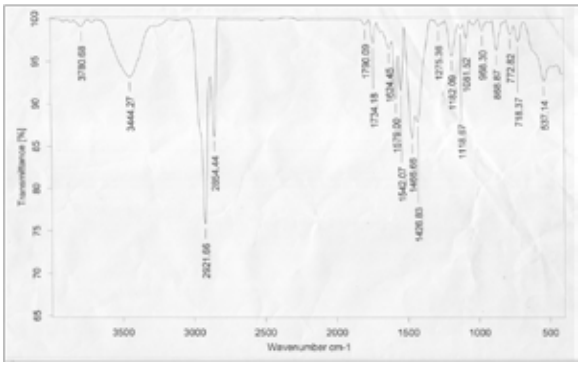
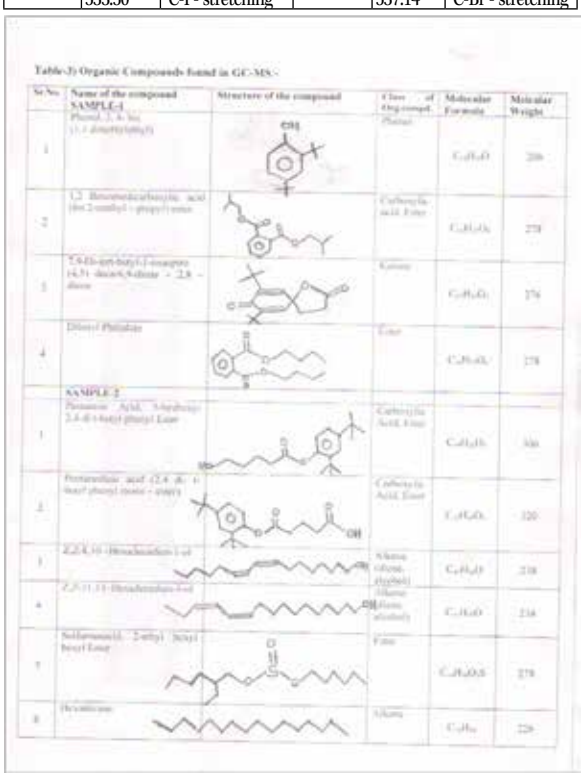


Table-2) The IR spectra of CH2Cl2 extracted mass:-

Sample	Wave Length	Characteristic Bands	Sample	Wave Length	Characteristic Bands
Sample -1	3783.41	O-H - stretching	Sample -2	3780.68	O-H - stretching
	3704.58	O-H - stretching		3444.27	O-H - stretching
	3441.07	O-H - stretching		2921.66	C-H - stretching
	2924.73	C-H - stretching		2854.44	C-H - stretching
	2857.87	C-H - stretching		1790.09	C=O - stretching
	1729.59	C=O - stretching		1734.18	C=O - stretching
	1690.60	C=O - stretching		1624.45	N-H def.
	1605.90	N=O - stretching		1579.00	N=O - stretching
	1460.94	C-H – def.		1542.07	N=O - stretching
	1374.17	C-H – def.		1466.66	O-H - bending
	1276.64	C-O - stretching		1426.83	O-H - bending
	1188.12	C-C - stretching		1275.36	O-H - bending
	1123.48	C-C - stretching		1182.67	C-C - stretching
	1081.88	C-C - stretching		1081.52	C-C - stretching
	1033.88	C-C - stretching		968.30	C-C - stretching
	968.45	C-C - stretching		868.87	C-C - stretching
	854.07	C-H – rocking		772.62	C-H – rocking
	719.24	C-H – rocking		718.37	C-H – rocking
	533.50	C-I - stretching		537.14	C-Br - stretching



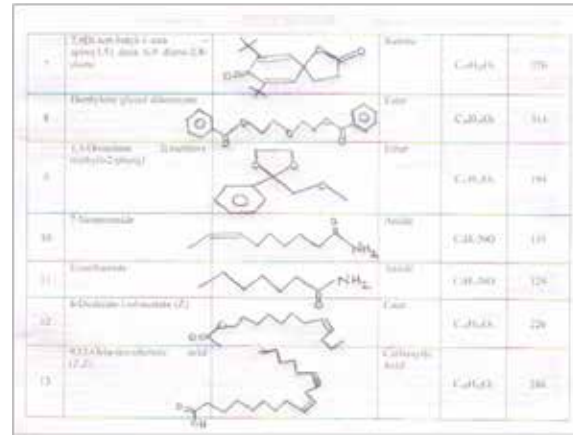


Table-4) Various Regression Coefficients (a and b) between various parameters of Waste water samples:

Parameter Pairs	a	b
Cu and Zn	-0.509	12.33
Cu and Fe	-2.772	0.581
Cu and Cr	-5.628	55.00
Cu and Sr	26.329	-238.0
Zn and Fe	-34.671	47.056
Zn and Cr	-3.345	4.446
Zn and Sr	-14.769	19.299
Fe and Cr	-0.0691	0.0945
Fe and Sr	2.276	-0.410
Cr and Sr	2.215	-4.335

Table-5) Correlation (r) between various metals of Industrial Waste:

Parameters	Cu	Zn	Fe	Cr	Sr
Cu	1				
Zn	3.538	1			
Fe	2.985	1.00695	1		
Cr	3.013	1.00745	1.0015	1	
Sr	-13.328	-0.9684	1.00035	-2.0527	1

Correlation and Regression Study:

Correlation and regression analysis of the results obtained on metal analysis in wastewater is tabulated in tables 4-5. Any correlation will be statistically significant (13) only if r value is very close to 1 or -1. In this study table-5 shows the correlation coefficient of waste water samples. High positive correlations were obtained between Cu and Zn (3.538), Cu and Fe (2.985), Cu and Cr (3.013), Zn and Fe (1.00695), Zn and Cr (1.00745), Fe and Cr (1.0015) and Fe and Sr (1.00035). The high correlation coefficient was observed in metals of waste water samples (table-5) in Cu and Zn (3.538), Cu and Fe (2.985) and Cu and Cr (3.013). Whereas correlation coefficient in some metals of waste water samples was found to be negative in the pairs Cu and Sr (-13.328), Zn and Sr (-0.9684) and Cr and Sr (-2.0527). The pairs having high positive correlation between the parameters show the dependency of one metal on the other.

The values of regression coefficient (a and b) greatly help in finding out the regression equation (table-4) between the two parameters, observed values and 95% confidence limit. Therefore we have carried out correlation and regression analysis provides inter relation between the parameters and measurable and rapid information for the quality of the effluents (14).

Application:

With this analysis we want to highlight the urgent need for the continuous monitoring of nearby area of Hindustan Zink company ltd., Udaipur which will affect on environment.

Conclusion:

On the basis of above results (table 1-5) it will be logical to say

that industrial effluent has its impact on the quality of ground water in the nearby area. The detected metals and organics affect the quality of soil and also on aquatic life. Even very low concentration of heavy metals in water bodies may affect the quality of aquatic environment. This can cause physiological, chemical and biological deterioration of water bodies. Due to non biodegradability of heavy metals their concentration in environment continuously increases. With this analysis we want to highlight the urgent need for the continuous monitoring of nearby area of Hindustan Zink company ltd., Udaipur which will affect on environment.

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