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Study of physico-chemical properties, detection and toxicity study of organic compounds from effluent of MIDC Thane and GIDC Ankleshwar industrial zone

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Abstract

The anthropological activities and huge industrialization to fulfil needs of mankind are making the remarkable and disastrous effect on aquatic life and responsible for severe pollution. The research deals with the identification and detection of organic pollutants present in industrial effluent by FTIR and GC–MS techniques. The samples were collected from paint, textile and dyes industries of MIDC Thane and GIDC Ankleshwar situated in western zone of India and recognized to be the most polluted cities in Asia. The samples were collected by standard operating procedure and then operated for extraction in ether so as to dissolve maximum organic compounds. These samples after extraction sealed in airtight glass vessel and used for FTIR and GC–MS analysis. The large number of organic compounds was detected by GC–MS analysis, whereas the presence of different functional groups of organic pollutants confirmed by FTIR analysis. The physico-chemical analysis was performed for effluent samples to know the different chemical factors associated with aqua samples. The statistical analysis of collected data was carried out; it comprises the mean, standard deviation, standard errors, Pearson correlation constants and regression analysis. The calculated results compared with WHO standards and water quality index were calculated. Large number of organic and aromatic compounds identified from GC–MS data and their toxicity is discussed.

Keywords Chemical toxicity · Effluent · Extraction · FTIR · GCMS · Physico-chemical · WQI

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Introduction

The rapid urbanization and immense industrialization is making a mark influence on global environment, especially water, air and land pollution. The major pollution augmenting unit is a water pollution. In general, the water is considered to be polluted when its quality impaired by several anthropological activities (Birjandi et al. 2016). Some of the major sources responsible for water pollution are excess discharge of untreated sewage from various industries, waste water production due to anthropological activities released in the rivers, costal area (Sharma et al. 2017; Kumar and Krishna 2017). The major contribution for water pollution reported due to untreated effluent of drugs, dyes, chemicals, pharmaceutical industries and nuclear waste, which are found to be huge pestilent. As most of the major pathogenic diseases, hazards and dermatological problems, are recognized due to consumption of polluted water, it is whole onus of industries that the effluent must be amend before subjecting to the discharge in various water sources (Wang et al. 2017; Nirgude et al. 2013).

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In undeveloped country like India, water pollution is a major issue because of polluted waste discharged in water streams may effect on economical budget if processed for sewage treatment. Hence, majority of industries released their sewage without further process and contributing to make the water contamination. However, most of the chemical industries take enough care while releasing the waste to the water streams, but this number is less and thus enhancing the pollution (Kumar et al. 2012). The pollutants present in water contain a large number of organic and inorganic contaminants which are unnecessary, producing pestilent and fatal effects on human health as well as aquatic life. These organic and inorganic pollutants as well as different pathogenic organism make the quality of water squalor. Most of the researchers are coalesce to defeat this problem of water pollution to serve the mankind better (Hladchenko et al. 2017).

The cities like Ankleshwar and Thane industrial found to be the most polluted according to the global pollution survey. Both the cities covered large industrial area and becoming a native place for most of the pharmaceutical, drugs, dyes, paint, textiles and API manufacturing industries (Mishra and Soni 2016; Mostafa 2015). These various drugs, dyes and paint industries synthesizes huge quantity of organic products every year. Most of the products manufactured by industries are valuable to the society and domestic use, but at the same time waste by-products and waste water which is left after synthesizing these products is a major environmental threat. This waste water indiscriminately flowed in the water streams lead to an inception of water pollution imperceptibly (Ouasif et al. 2013). Most of the researchers worked on this type of serious issue and published their view and facts related to waste water from these industrial zones (Patil and Shrivastava 2016).

The effluent samples were collected from paint, Textile and dye industries. The effluent discharged by them contains astonishing contaminants which ruffles quality of water. It is previously anticipated that these industries utilize large number of chemicals that are organic in nature. Even though the finished products synthesized by these industries are probably organic in nature. The inception of water pollution is started from these organic compounds; nevertheless, these industries discharged their waste after synthesis of their products, dying, processing, etc., in the river stream or costal region (Ong et al. 2011). Textile and paint industries also utilize different colours, dyes and pigments which are organic in nature (CPCB 2016; Chandran 2016).

In the present research, an attempt has made to identify and detect the different organics that are probably present in effluent sources. Also, the physico-chemical analysis of collected water samples was examined. Finally, the results obtained from physico-chemical analysis subjected for water quality index comparison. The toxicity of organic compound detected by GC–MS has been discussed.

Materials and methods

Diethyl ether [$(C_2H_5)_2O$] AR grade purchased from Merck, India. All the effluent samples (7 samples) were collected from MIDC Thane, India and GIDC, Ankleshwar, India. Solvent extraction technique was used to separate the organic contaminants present in the collected effluent samples.

Sampling of effluents

Three samples were collected from dyes and textile industries, from waste water effluent outlet Ankleshwar GIDC (Gujarat Industrial Development Co-operation, Ankleshwar), and four samples were collected from various paint and dye industries of Thane MIDC (Maharashtra Industrial Development Co-operation, Thane). Collected samples were stored in glass bottles previously washed with acetone to remove all the organics and further with nitric acid as well as by using double-distilled water, to remove all the metallic and other inorganic content previously present. All the containers then dried and kept in hot air oven for three hours at 120 °C. All the extracted samples were preserved in refrigerator for further analysis (Patil and Shrivastava 2013; Mahajan and Shrivastava 2013). The labelling of the collected samples is shown in Table 1.

Sample preparation for FTIR analysis

All the samples were extracted in diethyl ether; the aqueous and organic layer was separated by use of solvent extraction technique in separating funnel. After extraction, organic layer was stored in airtight glass vessel and used for FTIR characterization (Ladwani et al. 2016).

Sample preparation for GC–MS analysis

Similar extraction procedure was followed for GC–MS analysis, i.e. solvent extraction technique (Helaleh et al. 2001). After extraction, the samples AG2, TM5 and TM6 were used for GC–MS analysis (Thermo Scientific TSQ 8000).

Table 1 Sampling locations and source of sampling

S. no.	Sample name	Sampling point	Sampling source
01	AG1	Ankleshwar GIDC	Dyes and textiles
02	AG2	Ankleshwar GIDC	Dyes and textiles
03	AG3	Ankleshwar GIDC	Dyes and textiles
04	TM4	Thane MIDC	Paint industry
05	TM5	Thane MIDC	Paint industry
06	TM6	Thane MIDC	Dyes
07	TM7	Thane MIDC	Dyes

Detection of organics by FTIR

The main purpose of FTIR study is to investigate the possible organics present in the collected effluents. All the samples were extracted in diethyl ether. The labelled samples (Table 1) were sent for FTIR studies to detect the possible functional groups that are present in collected effluent samples (Table 2).

Detection and identification of organics by GC–MS

The samples AG-2, TM-5 and TM-6 were extracted in diethyl ether. These extracted samples were analysed by GC–MS (Thermo Scientific TSQ 8000). The GC–MS data from which speculated organics obtain their corresponding spectrum are depicted in Table 3. The imperceptibly concentration is detected by GC–MS. The toxic, fatal and environmental hazards of selected compounds are discussed in results and discussion section (Srebrenkoska et al. 2014; Kotowska et al. 2012).

Statistical analysis of data obtained from physico-chemical results

Table 4.

Table 2 Detected organic functional groups in collected wastewater sample

S. no.	Frequency in cm^{-1}	Interpretation (functional group)	S. no.	Frequency in cm^{-1}	Interpretation (functional group)
Sample AG1			*Sample TM4*		
01	2974.23	Alkane C–H	01	2924 (2850–2975)	Alkane C–H
02	2862.36	C–H stretching freq in –CH$_3$	02	2854.65	C–H stretching freq in –CH$_3$
03	1975.11	C=O stretch in acid/aldehyde	03	1712.79	C=O stretch in acid/aldehyde
04	1450.47	C–H bending in –CH$_2$	04	1458.18	C–H bending in –CH$_2$
05	1381.03	C–O stretching in benzoate	05	1265.30	
06	1288.45	C–O–C stretch in ether (broad)	06	740.67	Monosubstituted aromatics
07	1122.57	C–N stretching in sec. amines	–	–	–
08	929.69	Ethylene	–	–	–
09	840.96	Tetra-substituted benzene	–	–	–
10	752.24	Monosubstituted aromatic ring	–	–	–
Sample AG2			*Sample TM5*		
01	2970.38	Alkane C–H	01	2924.09	Alkane C–H
02	2924.09		02	2862.63	C–H stretching freq in –CH$_3$
03	2862.36	C–H stretching freq in –CH$_3$	03	1728.22	C=O stretch in acid/aldehyde
04	1728.22	C=O stretch in acid/aldehyde	04	1597.06	C=C frequency for alkene
05	1450.47	C–H bending in –CH$_2$	05	1458.18	C–H bending in CH2
06	1373.32		06	1381.03	
07	1126.43	C–N stretching in sec. amines	07	1273.02	C–O–C stretch in ether (broad)
08	840	Tetra-substituted benzene	08	1126.43	C–N stretching in sec.amines
	–	–	09	1064.71	C–O stretching freq in alcohols/ethers
	–	–	10	740.67	Monosubstituted aromatics
Sample AG3			*Sample TM6*		
01	3425.58	O–H stretch (broad)	01	2970.38	Alkane C–H
02	3001.24	Chelate H bridge (O–H)	02	2862.36	C–H stretching freq in –CH$_3$
03	2877.81	C–H bending in –CHO	03	1450.47	C–H bending in –CH$_2$
04	1458.18	O=S=O stretch	04	1373.32	
05	1350.17		05	1126.43	C–N stretching in sec.amines
06	1296.16	C–O–C stretch in ether (broad)	06	925.83	≡CH bending frequency
07	1249.87	C–H out of plane bending	07	840.96	Tetra-substituted benzene
08	1111.10	Anhydride C=O stretch	–	–	–
09	941.26	≡CH bending frequency	–	–	–
10	756.10	Monosubstituted aromatics	–	–	–

Table 3 Probable organic compounds detected from collected effluent samples AG2, TM5 and TM6 by GC–MS technique

S. no.	Name of compound	RT	Molecular formula	Molecular weight in g	CAS number
Sample AG2					
01	4-Methyl-3-hexanol	4.83	$C_7H_{16}O$	116	615-29-2
02	2,3-Dimethyl-2-butanol	4.83	$C_6H_{14}O$	102	594-60-5
03	3-Heptanol	4.83	$C_7H_{16}O$	116	589-82-2
04	Hexadecane	11.49	$C_{16}H_{34}$	226	544-76-3
05	2,6,10-Trimethyl tetradecane	11.49	$C_{17}H_{36}$	240	14905-56-7
06	Heptadecane	11.49	$C_{17}H_{36}$	240	629-78-7
07	2,6-Dihexadecanoate-1-(+)-ascorbic acid	14.13	$C_{38}H_{68}O_8$	652	28474-90-0
08	*n*-Hexadecanoic acid	14.33	$C_{16}H_{32}O_2$	256	57-10-3
09	Palmitic acid anhydride	14.33	$C_{32}H_{62}O_3$	494	623-65-4
10	3-Ethyl-5-(2-ethylbutyl)-octadecane	14.38	$C_{26}H_{54}$	366	55282-12-7
11	3,5-Dehydro-6-methoxy-pivalate-cholest-22-ene-21-ol	14.38	$C_{33}H_{54}O_3$	498	NA
12	2,6,10-Trimethyl tetradecane	14.38	$C_{17}H_{36}$	240	14905-56-7
13	1-Monolinoleoylglycerol trimethylsilyl ether	19.50	$C_{27}H_{54}O_4Si_2$	470	54284-45-6
14	2,3-Bis(trimethylsilyl) oxylporpyl ester,(*z,z,z*)-9,12,15-octadecatrienoic acid	19.50	$C_{27}H_{52}O_4Si_2$	440	55521-22-7
15	25-(Trimethylsilyl) oxy-(3a, 5Z, 7E)-9, 10-secocholesta-5, 7, 10 (19)-tiene-1-3-diol	19.50	$C_{30}H_{52}O_3Si$	488	55759-94-9
16	Ethyl iso-allocholate	19.69	$C_{26}H_{44}O_5$	536	NA
17	(3a,5Z,7E)-9, 10-Secocholesta-5, 7, 10 (19)-tiene-3, 24,25-triol	19.69	$C_{27}H_{44}O_3$	416	40013-87-4
18	3-Acetoxy-7,8-epoxylanostan-11-ol	19.69	$C_{32}H_{54}O_4$	502	NA
19	4-en-3-one-stigmast	21.11	$C_{29}H_{48}O$	412	1058-61-3
20	Cypionate testosterone	21.11	$C_{27}H_{40}O_3$	412	58-20-8
21	4-en-3-one-cholest	21.11	$C_{27}H_{44}O$	384	601-57-0
Sample TM5					
22	Nonane	4.69	C_9H_{20}	128	111-84-2
23	Decane	4.69	$C_{10}H_{22}$	142	124-18-5
24	2,4-Dimethyl hexane	4.69	C_8H_{18}	114	589-43-5
25	1-Ethyl-3-methyl benzene	5.69	C_9H_{12}	120	620-14-4
26	1-Ethyl-2-methyl benzene	5.69	C_9H_{12}	120	611-14-3
27	1,2,4-Trimethyl benzene	5.69	C_9H_{12}	120	95-63-6
28	1,2,3-Trimethyl benzene	5.82	C_9H_{12}	120	526-73-8
29	3,5-Dimethyl octane	6.29	$C_{10}H_{22}$	142	15869-93-9
30	4,6-Dimethyl undecane	6.29	$C_{13}H_{28}$	184	17312-82-2
31	4-Methyl-decane	6.64	$C_{11}H_{24}$	156	2847-72-5
32	2-Ethylhexyl ester, trichloroacetic acid	6.64	$C_{10}H_{17}Cl_3O_2$	275	16397-79-8
33	5-Ethyl-2-methyl heptane	6.64	$C_{10}H_{22}$	142	13475-78-0
34	Undecane	7.89	$C_{11}H_{24}$	156	1120-21-4
35	Dodecane	7.89	$C_{12}H_{26}$	170	112-40-3
36	4,5-Dimethyl nonane	7.89	$C_{11}H_{24}$	156	17302-23-7
37	(*Z*)-9,17-Octadecadienal	20.34	$C_{18}H_{32}O$	264	56554-35-9
38	7,11-Hexadecadienal	20.34	$C_{16}H_{28}O$	236	NA
39	12-Methyl-*E,E*-2,13-octadecadienal-1-ol	20.34	$C_{19}H_{36}O$	280	NA
Sample TM6					
40	5-Methyl-3-hexanol	4.84	$C_7H_{15}O$	115	615-29-2
41	Phenol	5.43	C_6H_6O	94	108-95-2
42	*p*-Hydroxy phenyl phosphonic acid	5.43	$C_6H_7O_4P$	174	33795-18-5
43	Carbamic acid, phenyl ester	5.43	$C_7H_7NO_2$	137	622-46-8
44	2,6-Dimethyl quinoline	10.17	$C_{11}H_{11}N$	157	877-43-0
45	2,8-Dimethyl quinoline	10.17	$C_{11}H_{11}N$	157	1463-17-8

Table 3 (continued)

S. no.	Name of compound	RT	Molecular formula	Molecular weight in g	CAS number
46	4,8-Dimethyl quinoline	10.17	$C_{11}H_{11}N$	157	13362-80-6
47	7-Methoxy-2,2,4,8-tetramethyl tricyclo[5.3.1.0(4,11)] undecane	10.37	$C_{16}H_{28}O$	236	NA
48	2-Acetyl-3,3-dimethyl-2-(3-oxo-1-butenyl)-(E)-cyclopentanone	10.37	$C_{13}H_{18}O_3$	222	70412-49-6
49	3-(1,1-Dimethylethyl)-4-methoxy, phenol	10.37	$C_{11}H_{16}O_2$	180	88-32-4
50	2,6-bis(1,1-dimethylethyl)—2,5-cyclohexadiene-1,4-dione	10.44	$C_{14}H_{20}O_2$	220	719-22-2
51	2,5-di-tert-butyl-1,4-benzoquinone	10.44	$C_{14}H_{20}O_2$	220	2460-77-7
52	Furan-5-yl-1(5,6,7,8-tetrahydro-2,8,8-trimethyl-4H-cyclohepta, ethanone	10.44	$C_{14}H_{20}O_2$	220	71596-88-8
53	Butylated hydroxytoluene	10.76	$C_{15}H_{24}O$	220	128-37-0
54	4,6-di(1,1-dimethylethyl)-2-methyl-phenol	10.76	$C_{15}H_{24}O$		616-55-7
55	2,4,6-tris(1-methylethyl)-Phenol	10.76	$C_{15}H_{24}O$	220	2934-07-8
56	Heptadecane	11.48	$C_{17}H_{36}$	240	629-78-7

NA not applicable; *CAS* chemical abstracts service

Table 4 Physico-chemical properties of collected industrial effluent samples

Parameter	PH	Electrical conductivity	Sulphate	Chloride	COD	BOD	TDS
Unit	(µmho/cm)	(µmho/cm)	(mg/L)	(mg/L)	(mg/L O_2)	(mg/L O_2)	(mg/L)
AG1	8.2	398	91.60	262	1610	536	1590
AG2	7.8	402	82	300	1460	486	1620
AG3	7.7	500	76	387	1570	523	1480
TM4	8.5	398	93.50	281.50	1760	586	1805
TM5	7.5	402	86.42	310	1350	450	1745
TM6	7.4	500	72.83	418	1465	488	1654
TM7	7.2	530	80.00	497	1580	526	1970
Mean	7.26	447.14	83.19	350.78	1542.14	513.57	1694.85
S.D	0.95	40.1246	7.7233	85.76	131.58	43.68	160.61
S.E	0.36	15.16	2.92	32.42	49.73	16.51	60.70
WHO	6.5–9.5	1400	500	250	–	–	1000
US-EPA	6.5–8.5	250	250	250	–	–	500

SD standard deviation; *SE* standard error

Table 5 Pearson correlation coefficient (*r*) of different physico-chemical parameters for waste water effluent samples

Parameters	Correlation coefficient (*r*) of different parameters						
	pH	EC	Sulphates	Chlorides	COD	BOD	TDS
PH	1						
Electrical conductivity	− 0.9514	1					
Sulphates	0.81	− 0.797	1				
Chlorides	− 0.9758	0.9603	− 0.7435	1			
COD	0.2916	− 0.239	0.4545	− 0.1145	1		
BOD	0.2917	− 0.0237	0.4546	− 0.1146	1	1	
TDS	− 0.2684	0.1763	0.2143	0.4009	0.1654	0.1649	1

Table 6 Water quality index data for collected industrial effluents

Parameter	Tested value (Vn)							(Wn)	Sn	V10
	AG1	AG2	AG3	TM4	TM5	TM6	TM7			
pH	8.2	7.8	7.7	8.5	7.5	7.4	7.2	0.219	7.5	7.0
EC	398	402	500	398	402	500	530	0.371	300	0
Sulphates	91.60	82	76	93.50	86.42	72.83	80	0.01236	500	0
Chlorides	262	300	387	281.5	310	418	497	0.0074	250	0
TDS	1590	1620	1480	1805	1745	1654	1970	0.0037	1000	0
∑Qn	695.86	740	624	743.80	549.79	593.82	628.46	–	–	–
∑Wn.Qn	103.65	88.26	93.52	116.40	73.38	81.37	76.69	–	–	–
WQI	168	143	152.45	189.75	119.62	132.65	125.26	–	–	–

Sn, std. value; V10, ideal value; Qn, quality rating; Wn, unit weight; WQI, water quality index

Pearson correlation coefficient (*r*) data of different parameters

Table 5.

Water quality index

Table 6.

Results and discussions

Physico-chemical properties

(a) *pH* The negative proton ions are universal species that decide the acidic and basic condition of aqua solution. The species strongly affect different properties, characteristics of water. The major reliable contribution made by the authentic institutes such as WHO, US-EPA to control important water parameters (Elango et al. 2017). The present investigation was compared against the standard data of these institutes. Here, the maximum value of protonic ions was shown by sample AG1, i.e. 8.2 (slightly alkaline, MIDC Thane), while the least value was shown by sample TM7, i.e. 5.76 (Acidic, GIDC Ankleshwar). All the samples comprise the given range prescribed by the standard data.

(b) *Electrical conductivity* Total dissolved salts are generally responsible for high values of electrical conductivity (Manikandan et al. 2015). Values of electrical conductivity were in the range of 398–530 μm/cm. The highest value was observed for sample TM7, probably due to the presence of dissolved inorganic salts in the collected sample. The electrical conductivity data pass the permissible limit prescribed by the WHO and US-EPA standards.

(c) *Sulphates* Probably sulphates are present in water streams due to utilization of sulphonates and sulphu-ric acid for various industrial processes such as tanning. Most of the time magnesium and calcium sulphates are responsible for permanent water hardness. The sulphates data obtained for all the effluent sample are listed in table 4. This data matches within the priscribed limit of WHO and US-EPA (Periyasamy and Rajan 2009).

(d) *Chlorides* Chloride ions originate probably from sewage, industrial effluent, several natural sources, in certain cases due to urban activities such as saline intrusion, de-icing salt process, etc. In all the collected samples, the chloride values were found in the range of 262–497 mg/L. The values of chloride ion found to be very high and beyond the decided level of WHO.

(e) *BOD* The biological oxygen demand is found to be higher in all the samples indicating the more percentage of bacterial content utilizing the oxygen, probably due to the presence of higher organics content in the sample.

(f) *COD* The higher values of COD are attributed to more carbon containing waste present in all the samples, because all the samples which are collected are from organic source (Brahmbhatt and Pandya 2015).

(g) *TDS* The total dissolved solids are the organic contaminants and inorganic insoluble, suspended particles, sulphates, phosphates, sodium chloride, etc., are present due to which the water quality is ruffled. The TDS value limited by authorized institutes is said to be 1000 mg/L, while all the samples have astonishing TDS values (Rawway et al. 2016).

Correlation coefficient

Correlation coefficient was calculated to know the relationship between two variables. The positive relationship is assumed when the value expected is 1; the strong negative relationship is expected when *R* has a value − 1. The net zero value indicates no relationship between two

Table 7 Water quality index report status

S. no.	Water quality index range	Quality of water
Water quality index legend		
01	90–100	Unsuitable for potable purpose
02	70–89	Very poor quality water
03	50–70	Ruffled water quality
04	25–50	Good quality water
05	0–25	Excellent quality water

WQI for collected effluent samples
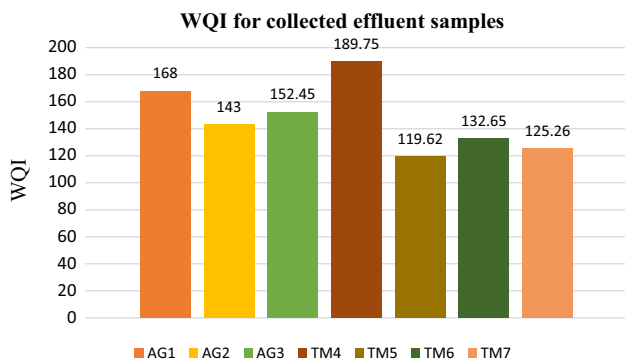
Fig. 1 Diagrammatic representation of calculated water quality index (WQI) for all the collected effluent samples

variables. The correlation coefficient was calculated by using formula

$$r = \frac{n\left(\sum xy\right) - \left(\sum x\right)\left(\sum y\right)}{\left[n\sum X^2 - \left(\sum x\right)^2\right]\left[n\sum Y^2 - \left(\sum y\right)^2\right]} \quad (1)$$

The correlation coefficient values for selected variables depicted in Table 5 show good agreement of values for present variables (Saxena and Saxena 2015; Nagaraju et al. 2017). The correlation coefficient values are depicted in Table 5.

Water quality index

Water quality index is 100-point scale of water parameters considered for physico-chemical analysis. In the present discussion, five parameters are examined for water quality index. The water quality index was found to be very high for all the collected effluent samples; all the effluent samples are unsuitable for potable and other purposes due to high WQI. The standard water quality index report is shown in Table 7. The diagrammatic representation of calculated water quality index of all the collected effluent samples is summarized in Fig. 1.

Toxicity of selected compounds detected by GC–MS in effluents

As the samples contain dissolved organics, these samples were analysed by GC–MS. The detected organics and their data obtained are as shown in Table 3. In this section, the toxicity of some selected organic compounds detected in GC–MS is discussed.

(a) *2-ethyl, hexyl ester trichloroacetic acid* The compound in association with water (drinking or effluent) produces complex by-products disinfectants which are found to raise the risk of colon, rectal and bladder cancer in human (Kumar and Pandit 2012) and adverse effects on reproduction.

(b) *3,5-dehydro-6-methoxy-pivalate-cholest-22-ene-21-ol* The compound was investigated for microbiological studies and showed toxic effects against the S. pyogenes organism that was found to be effective. This compound serves as an effecive reagent to inhibit the growth of most of pathogenic and non-pathogenic microorganisms (Singariya et al. 2016).

(c) *4,6-di(1, 1-dimethylethyl)-2-methyl-phenol* This is one of the toxic compounds detected in cigarette mainstream smoke (CMS), and if this compound is found in water streams then its free radicals are responsible for cardiovascular disease, (Smith et al. 2002) occupational and environmental lung diseases. Substituted phenols with electron releasing molecules can frame conceivably poisonous phenoxyl free radicals, and those substituted phenols with electron pulling back impact apply their lethality for the most part through lipophilicity (Vallyathan et al. 1998).

(d) *Palmitic acid* The major threat of suffering from cardiovascular diseases as well as enhancement of LDL level in the bloodstream may cause due to feeding of palmitic acid anhydride according to WHO reports. Oxidation of fats in the body and energy utilization rates may alter due to palmitic acid (Borsheim et al. 2006).

(e) *Carbamic acid, phenyl ester* The assessment of accessible poisonous quality information for fish, aquatic invertebrates and amphibian plants is moderate.

(f) *3-(1,1-dimethylethyl)-4-methoxy, phenol* Most of the substituted phenol used as an antioxidant in food and fats, viz. BHA and BHA, is for preservation of food products (Davi and Gundi 1999). The toxicity of phenolic compounds can be explained by the substitution of this surface-active agent with new products, as polyethoxylated alcohols, with the substitution of the phenolic group, because of the problems correlated with toxicity accumulation and oestrogenic effects that this

surfactant induced in some animals and organisms. Regular monitoring of phenolic compounds is essential due to their toxicity and bioaccumulation effects in animal and vegetable organisms (Kumar and Pacha 2015).

(g) *Heptadecane* However, carcinogenic reports, reproductive toxicity and genotoxicity chronic reports are not available for heptadecane, but several subchronic cases are reported for this compound.

(h) *3-acetoxy-7,8-epoxylanostan-11-ol* The compound was investigated from plant extract of *Hamelia patens* using chloroform as extractor in the research work reported that 3-acetoxy-7,8-epoxylanostan-11-ol compound shows an antidepressant activity for animals (Surana and Wagh 2017).

(i) *4-en-3-one-stigmast* This compound was extracted from bark of *Anacardium occidentale* (cashew), reported that the 4-en-3-one-stigmast shows hypoglycaemic effects (lowering of blood sugar level) in healthy dogs (Alexander-Lindo et al. 2004).

(j) *2,3-bis(trimethylsilyl)oxylporpyl ester, (z,z,z)-9,12,15-octadecatrienoic acid* The extraction of *Diospyros Montana* (Roxb.) reported the presence of this compound which shows some phytochemical effects (Bodele and Shahare 2018).

Conclusions

All the samples collected from Ankleshwar GIDC and Thane MIDC from paint and dyes industries were analysed by various physico-chemical parameters. The samples were found to be heavily contaminated, and some parameters not comply with standards reported by WHO and US-EPA. All the tested parameters such as BOD, COD, chlorides, sulphates and TDS were found to be very higher for AG1, AG2, AG3, TM4, TM5, TM6 and TM7 samples. Except pH and electrical conductivity passes the limit for all effluent samples. The water quality index report for all the samples was found to be extreme and not within the range of WQI; hence, it can be suggested that effluent must be treated by concern industries before discharging them into the river stream or nearby costal region so that contaminated water may become decontaminated. The infrared spectrum of the samples showed the corresponding functional groups of possible organic compounds in the samples as depicted in Table 2. The most important parameter analysed was GC–MS studied for the detection of organic contaminants. A wide range of organics were detected by this technique as the data as reported in Table 3. The most fatal and harmful compounds that can be harmful to the humans health as well as hazardous to the aquatic life are described such as, 2-ethyl, hexyl ester trichloroacetic acid,

3, 5-dehydro-6-methoxy-pivalate-cholest-22-ene-21-ol, 4, 6-di(1, 1-dimethylethyl)-2-methyl-phenol, palmitic acid, carbamic acid, phenyl ester, 3-(1, 1-dimethylethyl)-4-methoxy, phenol, heptadecane,3-acetoxy-7,8-epoxylanostan-11-ol,4-en-3-one-stigmast,2,3-bis(trimethylsilyl)oxylporpyl ester,(*z,z,z*)-9,12,15-octadecatrienoic acid.

The large number of industries discharge harmful waste effluents into the water sterams that should be monitored by the concern industries. There must be some strong regulations for discharging such a toxic chemical in the form of effluent. The industries such as paint, dyes, chemical, pharmaceutical and API should take initiate to minimize the pollution by taking government help for waste management such as construction of adequate sanitary landfills sites, catalytic activities to convert harmful chemicals into less harmful chemicals or compounds, photocatalysis, recycling of waste water, conduction of epidemiological study in the polluted area and asses the health survey on the water consumers, etc.

In the present research, we tried to investigate water-related properties, but main objects were to envisage the organic compound present in the effluent sources. We discussed the toxicity of some organic compounds from the GC-MS data (listed in Table 3). However, it is highly impossible to seperate the individual organic compounds due to presence of large number compounds present in the water streams. Also, all the compounds detected by GC–MS are organic, and hence, their quantitative and qualitative separation is very complex task. Analysis of this type of effluent is very beneficial to the society and ecosystem. The detailed toxicity of all the listed compounds has been discussed in the results and discussion section.

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