

# **Leaching of DEHA and DEHP from PET bottles to water**

**Final Project Report**

**Submitted by**

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## **Introduction**

Global level initiative for providing safe drinking water through the household water treatment system to the world community was intensified when the United Nations' International Drinking Water Supply and Sanitation Decade (1981-1990) failed to achieve its goal of universal access to safe drinking water and sanitation by 1990 (World Health Organization [WHO], 2003). The main reasons behind the failure include population growth, funding limitations, inadequate operation and maintenance, and continuation of a "business as usual approach, drawing on traditional resources, policies, and technologies" (WHO/UNICEF, 1992). The world is on schedule to meet the Millennium Development Goal (MDG), adopted by the UN General Assembly in 2000 and revised after the World Summit on Sustainable Development in Johannesburg, to "halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation" (World Bank Group, 2004; WHO/UNICEF, 2004). However, success still leaves more than 600 million people without access to safe water in 2015 (WHO/UNICEF, 2000). In addition, although the MDG target specifically states the provision of "safe" drinking water, the metric used to assess the MDG target is the provision of water from "improved" sources, such as boreholes or household connections, as it is difficult to assess whether water is safe at the household level (WHO/UNICEF, 2004). Thus, many more people than estimated may drink unsafe water from improved sources. The weak links between the water, health, and financial sectors could be improved by communication programs emphasizing health that could be gained by achieving the safe water goals. To overcome the difficulties in providing safe water and sanitation to those that lack it, we need more research into novel interventions and effective implementation strategies that can increase the adoption of technologies and improve prospects for sustainability. Among all the household water treatment systems the zero cost method which can be practiced by all sections of people is the solar disinfection (SODIS).

## **SODIS in India**

India, being one of the vast nations in the globe with world's second largest population has been prone to many diseases on account of its unique geo-climatic conditions. Though the sub

continent has many rivers and canals' flowing the need for the drinking water is increasing day by day. Apart from the increase in the population the present technological improvement around the world which brought many industries to the county has also contributed to it. At this juncture as the community feels happy when they are able to get drinking water and they hardly think about the quality of the water they are consuming. So, there is a greater need to create awareness among the families and community about the consequences of the unsafe drinking water and the methods to get the safe drinking water so that they can be prevented by the water born diseases. Even though both the governmental and non-governmental agencies have involved themselves in making the community aware about the methods of preparing safe drinking water in the past few years Solar Disinfection Water treatment has become the zero cost method of preparing a safe drinking water.

## **Background**

SODIS (Solar water disinfection) is a simple and effective water treatment procedure to improve the microbiological quality of drinking water. SODIS uses solar radiation and elevated temperature destroys pathogenic micro-organisms causing water borne diseases. In this process contaminated water is filled into transparent plastic bottles made form PET. Recently, concerns have been raised about leaching of DEHA (di(2-ethylhexyl) adipate) and DEHP (di(2-ethylhexyl) phthalate) from PET bottle during SODIS process. The present study was done to quantify the migration of plasticizers DEHA (di(2-ethylhexyl) adipate) and DEHP (di(2-ethylhexyl) phthalate) from PET bottle during the SODIS process. The migration of DEHA and DEHP components from transparent PET bottles which were used for SODIS and also new PET bottles which can be used for SODIS process in the future were selected for the study. Samples from different locations like Chennai, Kolkata and Delhi were studied under different conditions. .

## **Method of Analysis**

A total of 65 bottles were used for this study. Among these, 38 bottles were collected from Chennai, 18 bottles were collected from Kolkata and 9 bottles were collected from Delhi. The bottles were classified as big brand, no brand and SODIS.

### ***2.1 Chemicals and glassware***

HPLC grade n-Hexane (purity 97 %) purchased from MERCK Specialties Private Limited, India, was used for extracting DEHA and DEHP from water samples. The standard DEHA (2000 $\mu$ g/ml) and DEHP (2000 $\mu$ g/ml) was purchased from SUPELCO Analytical, USA. Di-butyl phthalate (DBP) was purchased from SD-fine Chemicals, India. Preliminary study showed that HPLC grade n-Hexane contains trace amount of DEHA and DEHP, hence it was distilled and used for the extraction studies. Double distilled water procured from local vendor and redistilled in our laboratory and stored in a glass bottle was used. Care was taken to ensure that no plastic or PET component contact was there with the water throughout its distillation and storage process. Di-butyl phthalate (DBP) was used as an internal standard and extraction procedures were carried out with 500 mL and 250 mL separating funnels. 1000  $\mu$ L glass syringe (SGE, Australia) was used for transfer the extracted solution to 2 mL capacity GC glass vials and sealed with Teflon coated crimp cap (Perkin Elmer, USA).

### ***2.2 Gas Chromatography (GC) Analysis***

DEHA and DEHP were analyzed using Perkin Elmer Clarus 500 gas chromatograph (GC) with flame ionization detector (GC/FID) equipped with auto-sampler, an on-column, split/split less capillary injection system and with Perkin Elmer (PE)-5 capillary column (30m  $\times$  0.53mm  $\times$  0.5 $\mu$ m film thickness). The operating conditions were as follows: the column was maintained at a temperature of 150 $^{\circ}$ C for 2.0 min and the temperature was increased to 290 $^{\circ}$ C with incremental rate of 15 $^{\circ}$ C /min. The temperature of injector and detector were maintained at 300 $^{\circ}$ C and

350°C, respectively. Nitrogen was used as a carrier gas at a flow rate of 4.0 mL/min. and the injections (volume 5µL) were made in the split mode with 1:2 ratio.

### 2.3 Gas Chromatography/ Mass Spectrometry (GC-MS) Analysis

#### Instrument GC-MS OP2010 SHIMADZU

1. Column Oven Temp. : 150°C
2. Injector Temp. : 300°C
3. Injection mode : Split
4. Split Ratio : 1
5. Flow Control Mode : Linear Velocity
6. Column Flow : 2.27 ml/min
7. Carrier Gas : Helium 99.9995% Purity

#### Column Oven Temperature Program

Rate (°C)	Temperature (°C)	Hold Time (min)
-	150.0	2.0
15	290.0	0 (13.33 mts total)

#### Column DB 5 ms

1. Length : 30.0 m
2. Diameter : 0.25 mm
3. Film Thickness : 0.25 µm

#### MS Condition

1. Ion Source Temp. : 200°C
2. Interface Temp : 240°C

3. Start m/z : 40
4. End m/z : 650

## 2.4 Experimental Conditions

The experiments were conducted in three different conditions;

1. PET bottles were kept under the shade.
2. PET bottles were kept under the sunlight. with and without heating
3. PET bottles were heated at different temperatures under the shade.

### 2.4.1 Experiments conducted in shade

PET bottles were supplied from three different places. Sample number 1, 11, 2, 12, 21, 24, 36, 39, 42 and 45 were collected from Chennai. Sample number 27, 30, 48, 51, 54 and 57 were collected from Kolkata. Sample number 33, 60 and 63 were collected from Delhi. Before conducting the experiment the PET bottles were rinsed twice with distilled water. Known amount of distilled water was filled in the PET bottles and kept in a shade for 48 h. Sample number 1 and 11 were kept in a shade only for 6 h. Similarly, distilled water was filled in standard flask and kept along with the samples for performing the blank analysis.



**Figure 1: Experiments conducted in shade**

#### **2.4.2 Experiments conducted under sunlight with and without heating**

Exposure to sunlight was conducted on consecutive sunny and cloudless days (April 2009) at IIT Madras, Chennai (13°04'N latitude and 80°17'E) and the experiments were conducted from morning 8.00 AM to 17.00 PM. The averaged minimum and maximum solar radiation pattern of test period was varying from 39.5 to 812 W/m<sup>2</sup>. Total residence time of the water in the PET bottles was 48 hours. Bottles were exposed in horizontal position at a maximum ambient temperature of ~30-37°C and total time of exposure was 6 and 48 h. Some of the bottles were put half-way in a water bath kept at 60 ± 5°C.

Sample numbers 3, 13, 4, 14, 22, 25, 37, 40, 43 and 46 were collected from Chennai. Sample numbers 28, 31, 49, 52, 55 and 58 were collected from Kolkata. Sample numbers 34, 61 and 64 were collected from Delhi. Before conducting the experiment, the PET bottles were rinsed twice with distilled water. Known amount of distilled water was filled in the PET bottles and kept them in sunlight for 48 h. Sample numbers 3 and 13 were kept in sunlight only for 6 h. Similarly the distilled water was filled in standard Borosil flask and kept along with the samples for performing the blank analysis.



**Figure 2: Experiments conducted under sunlight**

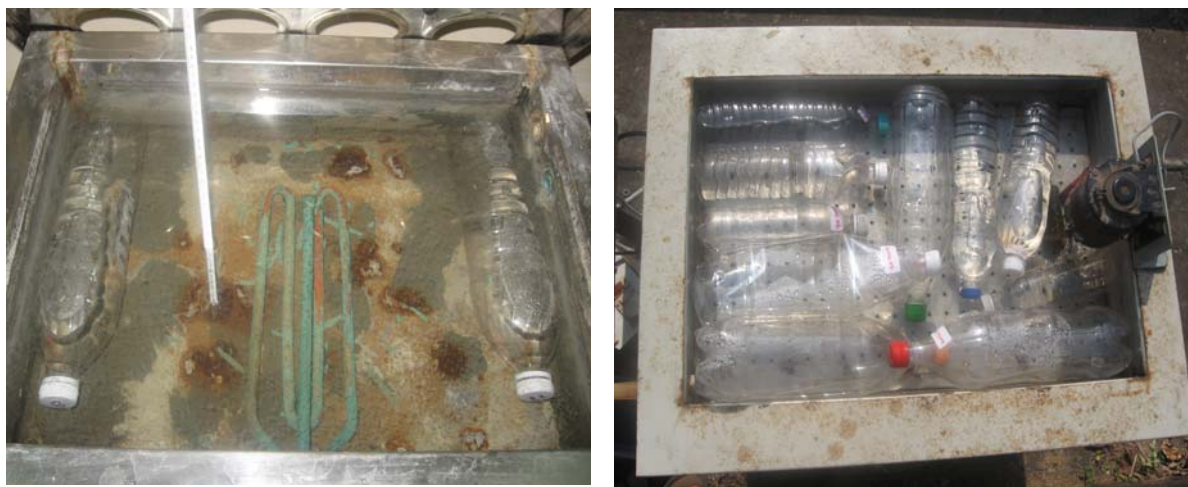
Similarly, experiment was conducted under sunlight along with heating the bottles in a water bath at 60°C. Sample numbers 6, 16, 23, 26, 38, 41, 44 and 47 were collected from Chennai. Sample number 29, 32, 50, 53, 56 and 59 were collected from Kolkata. Sample numbers 35, 62 and 65 were collected from Delhi. Before conducting the experiment, the PET bottles were rinsed twice with distilled water. Known quantity of distilled water was filled in the PET bottles and kept at 60°C in water bath under sunlight for 48 h. Similar experiment was conducted using sample numbers 5 and 15 at 60°C under the sunlight for 6 h. The blank analysis was carried out for all the experiments.



Figure 3: Experiments conducted under the sunlight at 60°C

#### **2.4.3 Experiments conducted in shade at different temperature**

This experiment was conducted for only 8 samples. Sample numbers 7 and 17 were kept in a water bath at 30°C and sample numbers 8 and 18 were kept at 40 °C. Similarly, sample numbers 9 and 19 were kept in water bath at 50°C and sample numbers 10 and 20 kept at 60°C. All the samples were kept in water bath under shade for 48h. The blank study was conducted using glass bottles filled with distilled water and kept along with the PET bottles.



**Figure 4: Experiments conducted with different temperature under the shade**

### **3.0 Discussion**

The first study was conducted in shade and 19 PET bottles were used for this experiment. Among these, two PET bottles were kept in shade for 6h and remaining 17 PET bottles were kept in shade for 48h. After 6h reaction time, there was no DEHA observed in either of the samples whereas DEHP concentration was 0.006 and 0.024 $\mu\text{g/L}$ , for samples number 1 and 11, respectively. After 48h reaction time, DEHA concentration was below detectable limit for most of the samples. Only sample number 63 showed 0.002 $\mu\text{g/L}$  of DEHA. However, DEHP was present in all the samples and the concentration was ranging from 0.0165 to 0.5271 $\mu\text{g/L}$ . The results of experiments conducted in shade are given in Table-1. The GC-MS chromatograms for sample number 2 and 12 are given in Figs. 6 and 7, respectively.

Two set of experiments (6 and 48 h) were carried out under the sunlight without heating. The results of experiments conducted under sunlight (without heating) are given in Table-2. The concentration of DEHA was below detectable limit for sample 3 and 13 and DEHP concentrations were 0.202 and 0.112 $\mu\text{g/L}$  for samples 3 and 13, respectively. After 48h of exposure, DEHA concentration was below detectable limit for most of the samples. Concentrations of DEHA were ranging between 0.0010 and 0.0053 $\mu\text{g/L}$  and concentrations of DEHP were between 0.020 to 0.2885 $\mu\text{g/L}$ .

Experiments under the sunlight with heating (60°C) were conducted for 19 samples. The results are given in Table-3. Two samples, 5 and 15, were heated for 6 h and remaining samples were heated for 48 h under sunlight. The concentrations of DEHA were 0.0090 and 0.0178µg/L and DEHP were 0.0321 and 0.2937µg/L for samples 5 and 15, respectively. Concentrations DEHA present in samples exposed to sunlight and heating for 48h varied between 0.0068 and 0.0256µg/L. Similarly for DEHP, the concentrations were ranging from 0.0576 to 0.5320µg/L. The GC-MS chromatograms for sample numbers 6, 16, 26, 32, 41, 47, 53 and 59 are given in Figs. 8, 9, 10, 11, 12, 13, 14 and 15, respectively.

The third sets of experiments were conducted in different temperature (30 to 60°C) under the shade and the results are given in Table-4. Low level of DEHA concentration was observed from 30 to 50°C (0.001-0.007µg/L). At 60°C, the concentration of DEHA was 0.019 and 0.029 µg/L for sample number 10 and 20, respectively. DEHP concentrations were between 0.088 and 0.324 µg/L. The maximum concentration of DEHP (0.324 µg/L) was observed in sample number 9 and minimum concentration (0.088 µg/L) was observed in sample 10.

## **Conclusion**

Trace amount of leaching of DEHA and DEHP was observed in most of the samples irrespective of the condition (heating, without heating and under solar light). DEHA present in water samples of present experiments varied between 0.001 and 0.0256 µg/L and DEHP concentrations varied from 0.006 to 0.5320µg/L. World Health Organization (WHO) guideline for drinking water with respect to DEHA and DEHP is presented in Table-5. As per WHO guidelines for drinking water quality, the concentration of DEHA and DEHP are well within the permissible limits.

## **References**

WHO Guidelines for drinking water quality, Di(2-ethylhexyl)adipate, World Health Organization, Geneva, 1993,  
[http://www.who.int/water\\_sanitation\\_health/GDWQ/Chemicals/di2ethylhexylsum.htm](http://www.who.int/water_sanitation_health/GDWQ/Chemicals/di2ethylhexylsum.htm).

WHO Guidelines for drinking water quality, Di(2-ethylhexyl)phthalate, World Health Organization, Geneva, 1993,  
[http://www.who.int/water\\_sanitation\\_health/GDWQ/Chemicals/di2ethylhexyphtasum.htm](http://www.who.int/water_sanitation_health/GDWQ/Chemicals/di2ethylhexyphtasum.htm).

**Table-1 : Experiments carried out in shade**

S. No	Bottles	Shade 6 hrs	Results µg/L		Shade 48 hrs	Results µg/L	
			DEHA	DEHP		DEHA	DEHP
1	Bottle 1- big brand Chennai	1	BDL	0.006	2	BDL	0.5271
2	Bottle 1a - big brand / SODIS Chennai	11	BDL	0.024	12	BDL	0.3939
3	Bottle 2 - big brand Chennai	-	-	-	21	BDL	0.0858
4	Bottle 2a - big brand / SODIS Chennai	-	-	-	24	BDL	0.0222
5	Bottle 3 - big brand Kolkata	-	-	-	27	BDL	0.1294
6	Bottle 3 a - big brand / SODIS Kolkata	-	-	-	30	BDL	0.0165
7	Bottle 4 - big brand Delhi	-	-	-	33	BDL	0.1187
8	Bottle 5 – no brand Chennai	-	-	-	36	BDL	0.0245
9	Bottle 5 a – no brand / SODIS Chennai	-	-	-	39	BDL	0.0329
10	Bottle 6 – no brand Chennai	-	-	-	42	BDL	0.0206
11	Bottle 6 a – no brand / SODIS Chennai	-	-	-	45	BDL	0.0744
12	Bottle 7 – no brand Kolkata	-	-	-	48	BDL	0.0277
13	Bottle 7 a – no brand / SODIS Kolkata	-	-	-	51	BDL	0.0702
14	Bottle 8 – no brand Kolkata	-	-	-	54	BDL	0.1144
15	Bottle 8 a – no brand / SODIS Kolkata	-	-	-	57	BDL	0.2236
16	Bottle 9 – no brand Delhi	-	-	-	60	BDL	0.3760
17	Bottle 10 – no brand Delhi	--	--	--	63	0.002	0.1281

**BDL: Below detectable limit**

**Table-2 : Experiments carried out in sunlight 6 and 48 hrs**

S. No	Bottles	Sun 6 hrs	Results µg/L		Sun 48 hrs	Results µg/L	
			DEHA	DEHA		DEHA	DEHP
1	Bottle 1- big brand Chennai	3	BDL	0.202	4	0.0016	0.0750
2	Bottle 1a - big brand / SODIS Chennai	13	BDL	0.112	14	0.0012	0.2613
3	Bottle 2 - big brand Chennai	-	-	-	22	0.0010	0.0584
4	Bottle 2a - big brand / SODIS Chennai	-	-	-	25	BDL	0.2885
5	Bottle 3 - big brand Kolkata	-	-	-	28	0.0011	0.0769
6	Bottle 3 a - big brand / SODIS Kolkata	-	-	-	31	0.0019	0.0648
7	Bottle 4 - big brand Delhi	-	-	-	34	BDL	0.020
8	Bottle 5 – no brand Chennai	-	-	-	37	BDL	0.0323
9	Bottle 5 a – no brand / SODIS Chennai	-	-	-	40	BDL	0.0828
10	Bottle 6 – no brand Chennai	-	-	-	43	BDL	0.0549
11	Bottle 6 a – no brand / SODIS Chennai	-	-	-	46	0.0011	0.0793
12	Bottle 7 – no brand Kolkata	-	-	-	49	0.0012	0.1069
13	Bottle 7 a – no brand / SODIS Kolkata	-	-	-	52	BDL	0.0583
14	Bottle 8 – no brand Kolkata	-	-	-	55	BDL	0.0085
15	Bottle 8 a – no brand / SODIS Kolkata	-	-	-	58	BDL	0.0117
16	Bottle 9 – no brand Delhi	-	-	-	61	0.0053	0.1115
17	Bottle 10 – no brand Delhi	-	-	-	64	BDL	0.1473

**BDL: Below detectable limit**

**Table-3 : Experiments carried out in sunlight and heated to 60°C**

S. No	Bottles collected	Sun 60°C 6 hrs	Results µg/L		Sun 60°C 48 hrs	Results µg/L	
			DEHA	DEHP		DEHA	DEHP
1	Bottle 1- big brand Chennai	5	0.0090	0.0321	6	BDL	0.3820
2	Bottle 1a - big brand / SODIS Chennai	15	0.0178	0.2937	16	BDL	0.5320
3	Bottle 2 - big brand Chennai	-	-	-	23	BDL	0.0369
4	Bottle 2a - big brand / SODIS Chennai	-	-	-	26	BDL	0.0576
5	Bottle 3 - big brand Kolkata	-	-	-	29	0.0256	0.0577
6	Bottle 3 a - big brand / SODIS Kolkata	-	-	-	32	BDL	0.3283
7	Bottle 4 - big brand Delhi	-	-	-	35	0.0149	0.1087
8	Bottle 5 – no brand Chennai	-	-	-	38	0.0068	0.2851
9	Bottle 5 a – no brand / SODIS Chennai	-	-	-	41	BDL	0.2120
10	Bottle 6 – no brand Chennai	-	-	-	44	0.0106	0.0458
11	Bottle 6 a – no brand / SODIS Chennai	-	-	-	47	BDL	0.2181
12	Bottle 7 – no brand Kolkata	-	-	-	50	BDL	0.1737
13	Bottle 7 a – no brand / SODIS Kolkata	-	-	-	53	BDL	0.2036
14	Bottle 8 – no brand Kolkata	-	-	-	56	0.0227	0.0155
15	Bottle 8 a – no brand / SODIS Kolkata	-	-	-	59	BDL	0.1783
16	Bottle 9 – no brand Delhi	-	-	-	62	BDL	0.0697
17	Bottle 10 – no brand Delhi	-	-	-	65	0.0166	0.0692

**BDL: Below detectable limit**

**Table-4 : Experiments carried out in shade with different Temperature**

S. No	Bottles	Temperature	Time in hrs.	Sample No	Results µg/L	
					DEHA	DEHP
1	Bottle 1- big brand Chennai	30°C	48 hrs	7	0.007	0.229
5	Bottle 1a - big brand / SODIS Chennai	30°C	48 hrs	17	BDL	0.155
2	Bottle 1- big brand Chennai	40°C	48 hrs	8	BDL	0.255
6	Bottle 1a - big brand / SODIS Chennai	40°C	48 hrs	18	BDL	0.148
3	Bottle 1- big brand Chennai	50°C	48 hrs	9	0.002	0.324
7	Bottle 1a - big brand / SODIS Chennai	50°C	48 hrs	19	0.001	0.244
4	Bottle 1- big brand Chennai	60°C	48 hrs	10	0.029	0.088
8	Bottle 1a - big brand / SODIS Chennai	60°C	48 hrs	20	0.019	0.315

**BDL: Below detectable limit**

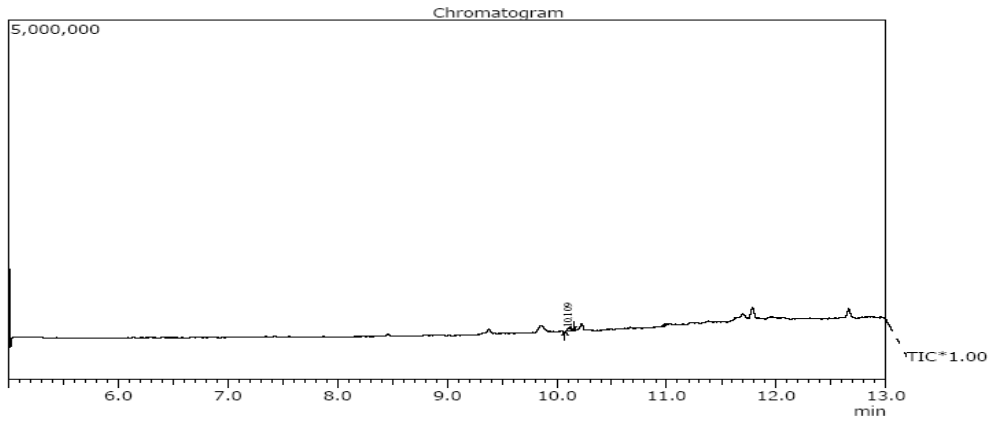
**Table-5: WHO Guidelines for drinking water quality**

S.No	Compounds	Range µg/L	WHO Standard µg/L
1	DEHA	0.001-0.0256	80
2	DEHP	0.006-0.5320	8

**BDL: Below detectable limit**

## GC-MS Analysis of Standard DEHA and DEHP

Sample Name : Std DEHA 0.1 PPM  
Sample ID : Std DEHA 0.1 PPM  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\Std DEHA 0.1 PPM.qgd

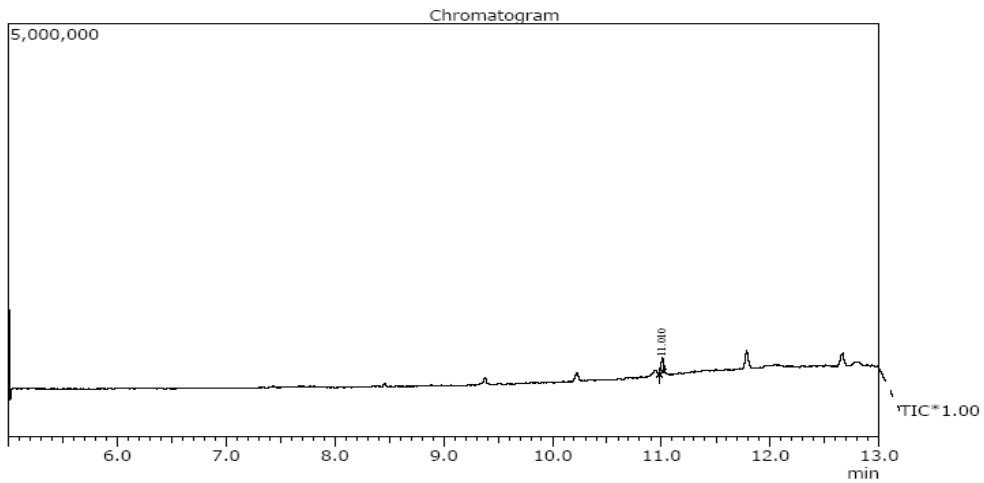


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	10.109	95532	43.69	Bis(2-ethylhexyl) adipate
		95532	100.00	

**Figure-4: Standard Graph 0.1 mg/L DEHA (GC-MC Analysis)**

Sample Name : Std DEHP 0.1 PPM  
Sample ID : Std DEHP 0.1 PPM  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\Std DEHP 0.1 PPM.qgd

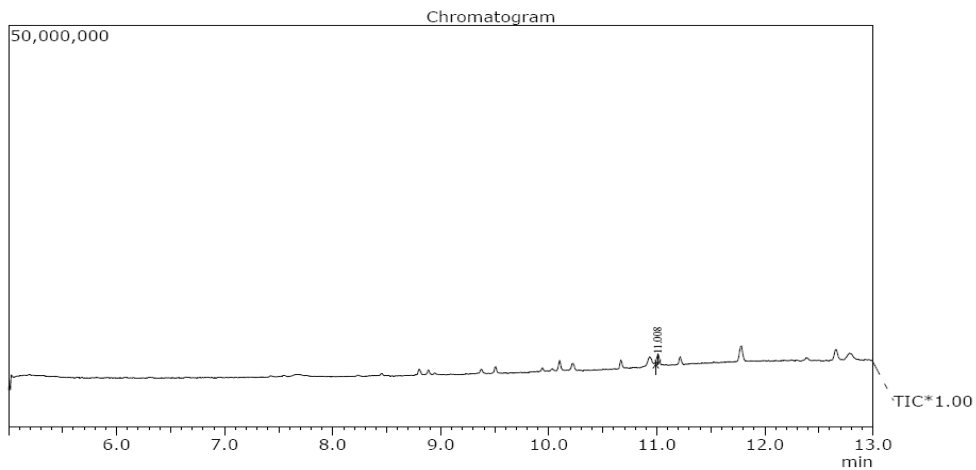


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.010	311986	100.00	Bis(2-ethylhexyl) phthalate
		311986	100.00	

**Figure-5: Standard Graph 0.1 mg/L DEHP (GC-MS Analysis)**

Sample Name : M0904-781-01  
Sample ID : Mark-2  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-01.qgd

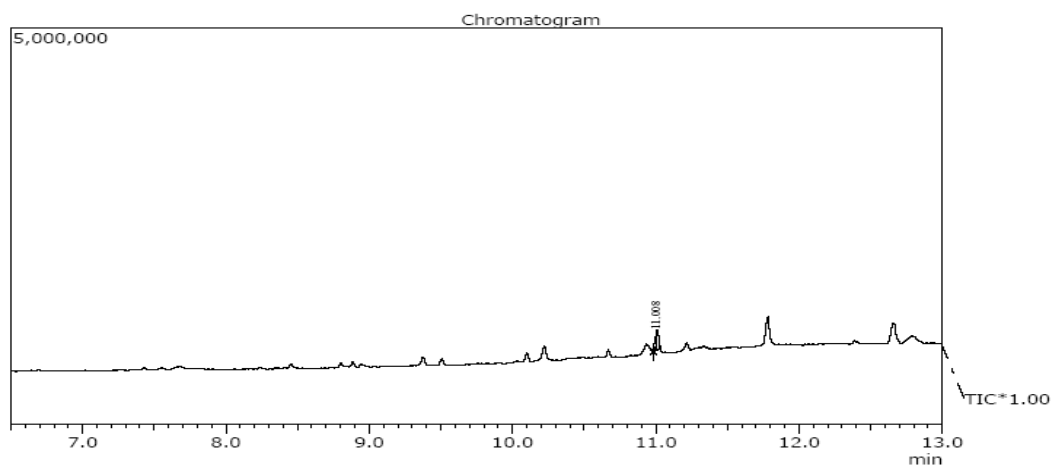


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	411129	100.00	Bis(2-ethylhexyl) phthalate
		411129	100.00	

**Figure-6: GC-MS Analysis Sample No 2**

Sample Name : M0904-781-03  
Sample ID : Mark-12  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-03.qgd

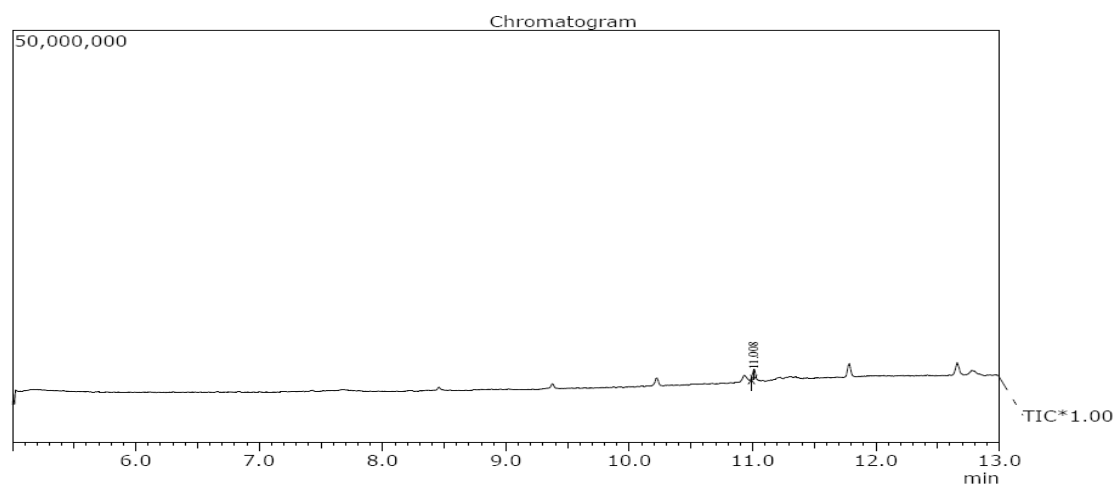


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	307289	100.00	Bis(2-ethylhexyl) phthalate
		307289	100.00	

**Figure-7: GC-MS Analysis Sample No 12**

Sample Name : M0904-781-02  
 Sample ID : Mark-6  
 Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-02.qgd

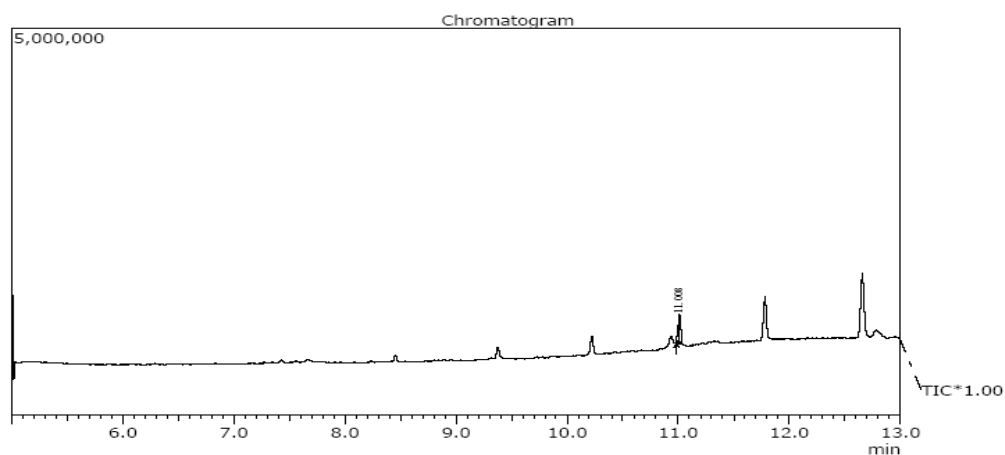


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	298069	100.00	Bis(2-ethylhexyl) phthalate
		298069	100.00	

**Figure-8: GC-MS Analysis Sample No 6**

Sample Name : M0904-781-04  
 Sample ID : Mark-16  
 Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-04.qgd

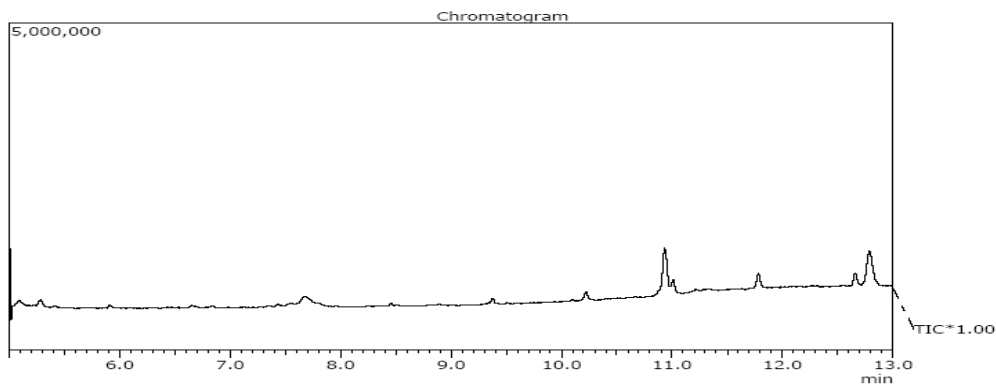


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	414990	100.00	Bis(2-ethylhexyl) phthalate
		414990	100.00	

**Figure-9: GC-MS Analysis Sample No 16**

Sample Name : M0904-781-05  
Sample ID : Mark-26  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-05.qgd

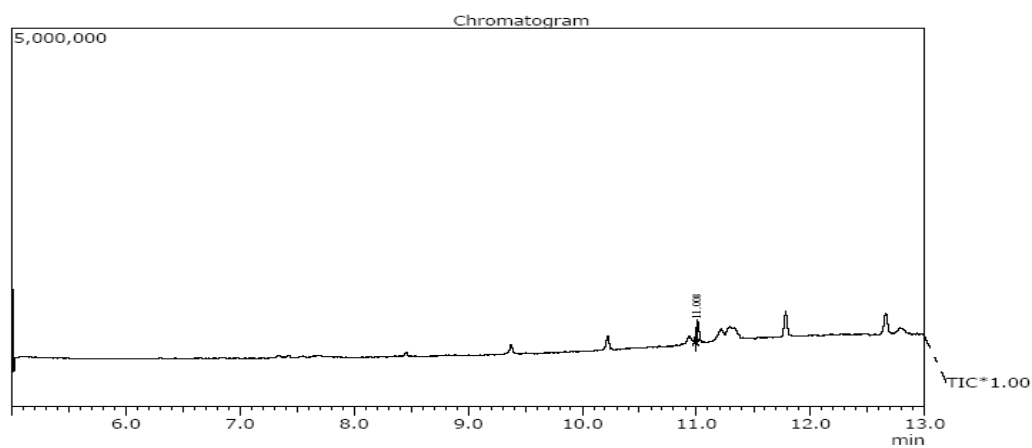


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	44990	100.00	Bis(2-ethylhexyl) phthalate
		44990	100.00	

**Figure-10: GC-MS Analysis Sample No 26**

Sample Name : M0904-781-06  
Sample ID : Mark-32  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-06.qgd

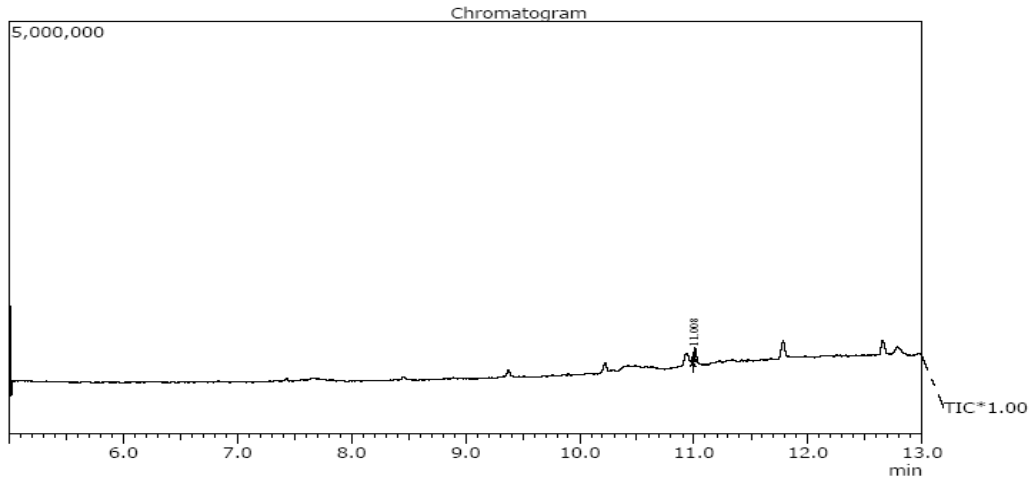


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	256070	100.00	Bis(2-ethylhexyl) phthalate
		256070	100.00	

**Figure-11: GC-MS Analysis Sample No 32**

Sample Name : M0904-781-07  
Sample ID : Mark-41  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-07.qgd

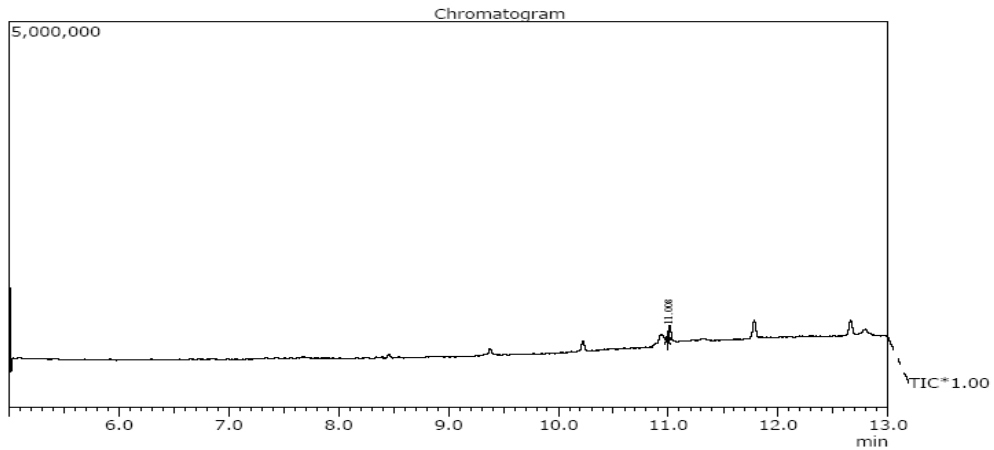


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	165417	100.00	Bis(2-ethylhexyl) phthalate
		165417	100.00	

**Figure-12: GC-MS Analysis Sample No 41**

Sample Name : M0904-781-08  
Sample ID : Mark-47  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-08.qgd

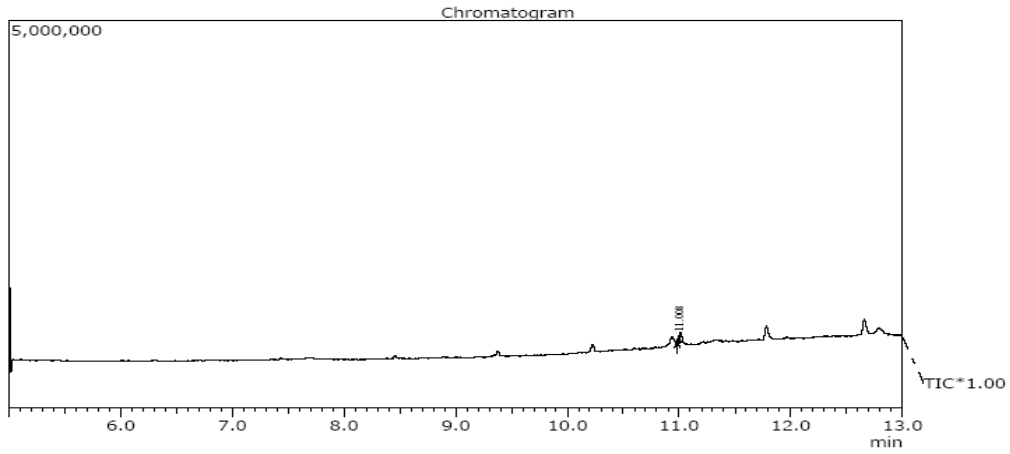


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	170129	100.00	Bis(2-ethylhexyl) phthalate
		170129	100.00	

**Figure-13: GC-MS Analysis Sample No 47**

Sample Name : M0904-781-09  
Sample ID : Mark-53  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-09.qgd

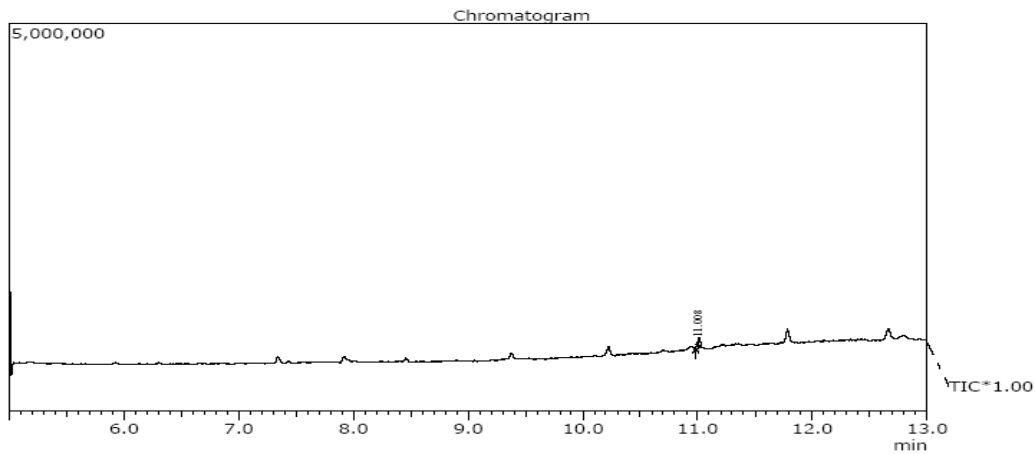


Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	158861	100.00	Bis(2-ethylhexyl) phthalate
		158861	100.00	

**Figure-14: GC-MS Analysis Sample No 53**

Sample Name : M0904-781-10  
Sample ID : Mark-59  
Data File : D:\MSDATA\Year 2009\May-09\02-05-09\M0904-781-10.qgd



Peak Report TIC

PEAK#	R.TIME	AREA	AREA%	NAME
1	11.008	139034	100.00	Bis(2-ethylhexyl) phthalate
		139034	100.00	

**Figure-15: GC-MS Analysis Sample No 59**