Asian Journal of Chemistry Vol. 20, No. 8 (2008), 6365-6368

Gas Chromatography-Mass Spectral Analysis of Paint Thinner

SUKESH NARAYAN SINHA* and S.S. ZADI
National Institute of Occupational Health, Meghaninagar, Ahmedabad-380 016, India
Fax: (91)(79)22686110; Tel: (91)(79)22686351/52
E-mail: sukeshnr_sinha@yahoo.com

Gas chromatography-mass spectroscopy was used for the confirmation of volatile organic compounds presence in paint thinner. The toxic compounds are toluene, xylene, ethyl benzene, 2,4-dimethyl heptane, cyclohexane propanol, 1-(methyl ethyl)cyclohexane, propyl benzene, 1-ethyl-3-methyl benzene, *p*-ethyl toluene, 2,3-trimethyl benzene, ethyl-2-methyl benzene, heptyl cyclohexane, 1-methyl-3-propyl benzene, diethyl benzene, 4-ethyl octane, napthalene and 3-methyl decane were present in thinner. These all compounds were confirmed using retention time parameter, molecular ion peak, base peak and other characteristic peak using National Institute of Science Technology (NIST) library search. The percentage composition of thinner has been also explained.

Key Words: Gas chromatography-mass spectroscopy, Paint thinner.

INTRODUCTION

Paint thinners are mixtures of volatile organic compounds[1,2] that are commonly used to dilute paints, inks, adhesives and as cleaning agents for different purposes[3]. Zaidi *et al.*[4] has been reported death from solvent inhalation. The different methods have been used to know the composition of thinner. Recently, the benzene and toluene were analyzed by GC-MS[5,6]. A GC-MS method for measurement of the main urinary metabolites of benzene, namely-phenol, catechol, hydroquinone, 1,2,4-trihydroxybenzene, t,t-muconic acid and S-phenylmercapturic acid is reported[7]. Measurement of urinary benzene was performed *via* headspace solid phase microextraction of 0.5 mL of urine specimens followed by GC-MS[8].

In India, paint thinners are supplied as standard quality as well as the sub-standard grade; the sub-standard is quite economical and commonly used in many industries and other segments of our society. Thinners are generally supplied in large containers and then sold in retail in smaller quantities. The storage and handling of thinners provides ample opportunities

for workers to abuse solvents through sniffing, bagging and huffing[9]. In this paper, a GC-MS anaysis for identification of different toxic compounds present in the paint thinner is reported.

EXPERIMENTAL

The thinner was analyzed by GC-MS in scan mode for qualitative analysis to know the composition of thinner. The GC-MS was used with slight modification as earlier reported method[5,6] for confirmation of presence of volatile organic compounds in thinner. The Varian 2000, GC-MS equipped with CP-3800 GC and data system were used for measurement of VOC's. The 30 m DB-5 column (0.25 mm id; 0.25 um thickness) was used in a split ratio 1:10. The initial GC oven temperature was 50 ºC maintained for 2.50 min after injection. Finally, the oven temperature raised up to 120 ºC at a rate of 5 ºC per min, maintained for 6 min. The run time was 22.50 min. The injector temperature was 120 ºC with hold time 2.50 min and total time 2.50 min. The transfer line, manifold and trap temperature was maintained 270, 40 and 150 ºC, respectively. Mass spectrometric analysis was performed in the EI auto mode at the flow rate of 1 mL/min using ultra pure helium gas.

RESULTS AND DISCUSSION

The presence of volatile compounds in pain thinner has shown in Table-1. Mass spectroscopy analysis using NIST library and retention time program confirmed the presence of these 16 compounds in thinner. The result showed that the toluene, xylene, ethyl benzene, 2,4-dimethyl heptane, cyclohexane propanol, 1-(methyl ethyl)cyclohexane, propyl benzene, 1-ethyl-3-methyl benzene, *p*-ethyl toluene, 2,3-trimethyl benzene, 1-ethyl-2-methyl benzene, heptyl cyclohexane, 1-methyl-3-propyl benzene, diethyl benzene, 4-ethyl octane, napthalene and 3-methyl decane were present in thinner. The base peak obtained for toluene at m/z 91. Similarly the base peak were obtained for xylene, ethyl benzene, 2,4-dimethyl heptane, cyclohexane propanol, 1-(methyl ethyl)cyclohexane, propyl benzene, 1-ethyl-3-methyl benzene, *p*-ethyl toluene, 2,3-trimethyl benzene, 1-ethyl-2-methyl benzene, heptyl cyclohexane, 1-methyl-3-propyl benzene, diethyl benzene, 4-ethyl octane, napthalene and 3-methyl decane were 91, 91, 57, 67, 55, 91, 105, 105, 105, 57, 55, 105, 105, 57, 128 and 57, respectively.

The percentage of compounds showed (Table-1) that the toluene, xylene, ethyl benzene, 2,4-dimethyl heptane, cyclohexane propanol, 1-(methyl ethyl)cyclohexane, propyl benzene, 1-ethyl-3-methyl benzene, *p*-ethyl toluene, 2,3-trimethyl benzene, 1-ethyl-2-methyl benzene, heptyl cyclohexane, 1-methyl-3-propyl benzene, diethyl benzene, 4-ethyl octane, napthalene and 3-methyl decane were having 0.148, 4.623, 2.557, 4.846, 1.141, 1.267, 0.240, 4.542, 3.4781, 10.41, 4.585, 1.881, 1.411, 2.109, 2.504, 0.466 and 0.020 percentage in thinner.

TABLE-1
SOLVENT INGREDIENTS IN LACQUER THINNER IDENTIFIED BY GC-MS

Code no.	Name of the compound	Retention time (min)	CAS. No. (from NIST library)	M/Z with % relative abundance	Percentage of compounds
1	Toluene	4.188	108- 88 -3	91(100), 65(19)	0.148
2	Xylene	6.633	106 - 42-8	91(100), 65(10), 105(29), 106(69), 57(18)	4.623
3	Ethyl benzene	7.264	100 - 41-4	91(100), 106(58), 77(11), 65(11)	2.557
4	2,4-Dimethyl heptane	7.459	213- 23-2	57(100), 41(53), 71(43), 85(50)	4.846
5	Cyclohexane propanol	8.119	1124-63-6	67(100), 82(73), 55(64), 96(15)	1.141
6	1-(Methyl ethyl) cyclohexane	8.419	696-29-7	55(100), 67(53), 83(81), 91(12), 126(9)	1.267
7	Propyl benzene	9.079	103-65-1	91(100), 120(47), 65(18), 78(6)	0.240
8	1-Ethyl-3-methyl benzene	9.304	620-14-4	105(100), 120(53), 79(13), 57(20), 91(12)	4.542
9	1,2,4-Trimethyl benzene	9.574	622-96-8	105(100), 120(62), 91(11), 79(11), 51(6)	3.437
10	1,2,3-Trimethyl benzene	10.338	526-73-8	105(100), 120(60), 91(10), 79(10)	4.781
11	Bihexyl	10.534	112-40-3	57(100), 71(67), 85(53), 98(11)	10.41
12	1-Ethyl-2-methyl benzene	11.178	611-14-3	?	4.585
13	Heptyl cyclohexane	11.584	5617-41-4	55(100), 67(61), 83(81), 117(24), 140(6)	1.881
14	1-Methyl-3-propyl benzene	12.109	1074-43-7	105(100), 134(52), 106(17), 77(15), 91(13)	1.411
15	Diethyl benzene	12.274	25340-17-4	105(100), 134(87), 119(25), 77(19), 91(97), 57(38)	2.109
16	4-Ethyl octane	13.653	15869-86-0	57(100), 71(61), 98(10), 85(46)	2.504
17	Naphthalene	16.263	91-20-3	128(100), 102(15), 127(16), 50(13), 63(10), 74(7)	0.466
18	3-Methyl decane	16.863	3113151-34-03	57(100), 71(79), 97(6), 85(46), 112(5)	0.020

These all compounds were highly carcogenic and toxic. As per the earlier report toluene, acetone, mineral sprit, methyl ethyl ketone and methyl isobutyl ketone were the composition of thinner. Most of the organic solvents are volatile at room temperature and have considerable potential for abuse by inhalation, ingestion and adsorption through skin. Manifestations caused by acute or chronic exposure include nasal and respiratory irritation, cardiovascular effects, renal dysfunction, central nervous system depression, unconsciousness or in extreme cases, death[7]. Toluene is a potent neurotoxy[10,11] and exposure to it has been associated with cardiac arrest[10,11]. Toxicological and clinical effects of solvents depend upon their mode of action, but the majority produces cardio respiratory[12], renal dysfunction[13] and neurological effects[14,15]. Morbidity cases due to acute or chronic exposure to organic solvents are often reported in literature. Thus the worker, which is working in, the paint thinner industry is at high risk of health.

REFERENCES

1. T. Inoue, M. Ikeda, M. Ogata, K. Saito, H. Sakurai, Y. Takeuchi, I. Hara, T. Matsushita, N. Hisanaga and Y. Ono, *Sangyo Igaku*, **26**, 518 (1984).
2. J. Saito and M. Ikeda, *Tohoku J. Exp. Med.*, **155**, 275 (1988)
3. WHO-IARC-Monograph: Evaluation of Carcinogenic Risk to Humans, Some Organic Solvents, Resin Monomers and Related Compounds, Pigments and Occupational Exposures in Paint Manufacture and Painting, IARC Lyon, France, Vol. 47 (1989).
4. S.A. Zaidi, A.N. Shaw, M.N. Patel, V.V. Shah, D. Rajendran, B.P. Shaw, S.N. Sinha, S.J. Gandhi and H. Saiyed, *Clin. Toxicol.*, **45**, 287 (2007).
5. S.N. Sinha, P.K. Kulkarni, S.H. Shah, N.M. Desai, G.M, Patel, M.M. Mansuri and H.N. Saiyed, *Sci. Total Environ.*, **357**, 280 (2006).
6. S.N. Sinha, P.K. Kulkarni, S.H. Shah, N.M. Desai, G.M. Patel, M.M. Mansuri and H.N. Saiyed, *J. Chromatogra. A*, **1065**, 315 (2005).
7. S. Waidyanatha, N. Rothman, G. Li, M.T. Smith, S. Yin and S.M. Rappaport, *Anal. Biochem.*, **327**, 184 (2004).
8. S. Waidyanatha, N. Rothman, S. Fustinoni, T. Smith, R.B. Hayes, W. Bechtold, M. Dosemeci, G. Li, S. Yin and S.M. Rappaport, *Carcinogenesis*, **22**, 279 (2001).
9. E.J. Reisdorff and M.B. Miller, Volatile organic substance abuse (available at http:// www.thrombosisconsult.com/articles/Textbook/115_substanceabuse.htm). Accessed 20 June (2005).
10. J.W. Knox and J.R. Nelson, *N. Engl. J. Med.*, **275**, 1494 (1966).
11. M. Sera, S. Igarashi, T. Miyazaki, K. Miyazaki, S. Nakano and I. Matsuoka, *Arch. Otorhinolaryngol.*, **221**, 163 (1978).
12. M. Vural, S.U. Dayi, Z. Tartan, H. Kasikcioglu, E. Okmen and N. Cam, *Anadolu Kariyol Derg*, **3**, 363 (2003).
13. N. Brautbar, Solvent and Kidney Disease-Scientific Methodology for Causation (available at http:// www. Environmentaldiseases.com) Accessed 28 June (2005).
14. National Institute for Occupational Safety and Health (NIOSH), Current Intelligence Bulletin 48, Organic Solvent Neurotoxicity. Centers for Disease Control, Atlanta, Georgia (1987).
15. L. Welch and H. Krishner, *J. Toxicol. Clin. Toxicol.*, **29**, 435 (1991).

(*Received*: 21 January 2008; *Accepted*: 14 July 2008) AJC-6693