



Stephenson

Environmental Management Australia

Peter W Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

52A Hampstead Road
Auburn NSW 2144
Tel: (02) 9737 9991

E-Mail: info@stephensonenv.com.au

EMISSION TEST REPORT (ETR) No. 5905B

STYRENE SCRUBBER EFFICIENCY MONITORING

ROCBOLT RESINS PTY LIMITED

SMEATON GRANGE, NSW 2567

PROJECT No.: 5905B/S24918/17

DATE OF SURVEY: 1 DECEMBER 2017

DATE OF ISSUE: 4 DECEMBER 2017

DATE OF ISSUE: REVISION A⁺ 19 JUNE 2018

DATE OF ISSUE: REVISION B⁺⁺ 19 FEBRUARY 2019



NATA accredited laboratory number 15043.

Accredited for Compliance with ISO/IEC 17025 - Testing

EMISSION TEST REPORT NO. 5905B⁺⁺

The sampling and analysis was commissioned by:		
Client	Organisation:	Rocbolt Resins Pty Limited
	Contact:	Andrew Sykes
	Address:	40-44 Anzac Avenue, Smeaton Grange NSW 2567
	Telephone:	02 4647 8388
	Email:	asykes@rocboltresins.com.au
	Project Number:	5905/S24918/17
	Test Date:	1 December 2017
	Production Conditions:	Normal operating conditions during testing
	Analysis Requested:	Dry gas density, volumetric flowrate, velocity, temperature, moisture, molecular weight of stack gases and styrene
	Sample Locations:	Styrene dry scrubber exhaust stack and inlet duct
	Sample ID Nos.:	Inlet samples 726727 and 726728
		Stack samples 726729 and 726730
	Identification	The samples are labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification) sampling date and time and whether further analysis is required.

This report cannot be reproduced except in full.

* At the request of Rocbolt Resins Pty Limited 5909A report was issued with diagrammatic information on photographs. All test, sampling and analytical results remain unchanged.

** At the request of Rocbolt Resins Pty Limited 5909B report was issued as with amended process information as supplied by Rocbolt Resins. Refer Section 1.2.1. All test, sampling and analytical results remain unchanged.



<i>Test</i>	<i>Test Method Number for Sampling & Analysis</i>	<i>NATA Laboratory Analysis By: NATA Accreditation No. & Report No.</i>
Dry Gas Density	NSW TM-23, USEPA M3	SEMA, Accreditation No. 15043, ETR No. 5905
Moisture	NSW TM-22, USEPA M4	SEMA, Accreditation No. 15043, ETR No. 5905
Molecular Weight of Stack Gases	NSW TM-23, USEPA M3	SEMA, Accreditation No. 15043, ETR No. 5905
Stack Pressure	NSW TM-2, USEPA M2	SEMA, Accreditation No. 15043, ETR No. 5905
Stack Temperature	NSW TM-2, USEPA M2	SEMA, Accreditation No. 15043, ETR No. 5905
Velocity	NSW TM-2, USEPA M2	SEMA, Accreditation No. 15043, ETR No. 5905
Volatile Organic Compounds (styrene)	NSW TM-34, USEPA M18	TestSafe Australia, Accreditation No. 3726, Report No. 2017-5424
Volumetric Flowrate	NSW TM-2, USEPA M2	SEMA, Accreditation No. 15043, ETR No. 5905

Deviations from Test Methods

Nil

Sampling Times

NSW - As per Test Method requirements or if not specified in the Test Method then as per Protection of the Environment Operations (Clean Air) Regulations Part 2, except for OM-6.

Reference Conditions

NSW – As per

- (1) Environment Protection Licence conditions, or
- (2) Part 3 of the Protection of the Environment Operations (Clean Air) Regulations

All associated NATA endorsed Test Reports/Certificates of Analysis are provided in Attachment A.

Report 5905 Issue date: 4 December 2017

Report 5905A Issue date: 19 June 2018

Report 5905B Issue date: 19 February 2019



P W Stephenson
Managing Director



1.1 SCOPE OF WORK

The scope of work undertaken at Rocbolt Resins, Smeaton Grange, on December 1, 2017 is tabled below and was requested by Rocbolt Resins to address their Environment Protection Licence (EPL) 20944 Special Condition 8 E1 *Plant and Equipment Operation Review Sub Condition 3. Confirm proper and efficient styrene scrubber operation – Scrubber Operation Investigation Action a:*

- *Monitoring of scrubber efficiency, by collecting samples upstream and downstream of the scrubber by a method agreed to in writing by EPA.**

Parameter	Styrene Scrubber Inlet Duct	Styrene Scrubber Exhaust Stack	Units of Measure	NSW Approved Test Method
Dry Gas Density	✓	✓	kg/m ³	TM-23
Styrene	2 samples	2 samples	mg/m ³	OM-2 TM-34*
Moisture	✓	✓	%	TM-22
Molecular weight of stack gases	✓	✓	g.g-mole	TM-23
Temperature	✓	✓	C	TM-2
Velocity	✓	✓	m/s	TM-2
Volumetric flowrate	✓	✓	m ³ /s	TM-2

Key:

kg/m ³	=	kilograms per cubic metre
mg/m ³	=	milligrams per cubic metre at 0°C and 101.3 kilopascals (kPa)
%	=	percentage
g.g-mole	=	grams per gram mole
°C	=	degrees Celsius
TM	=	test method
m/s	=	metres per second
m ³ /s	=	dry cubic metre per second 0°C and 101.3 kilopascals (kPa)
AS	=	Australian Standard
hr	=	hour
*	=	method agreed to by Chris Kelly, NSW EPA. Refer Benbow Environmental.



1.2 PRODUCTION AND SAMPLING CONDITIONS

Rocbolt Resins personnel considered the facility was operating under typical conditions on the day of testing. Details of production conditions are available on request.

1.2.1 PROCESS INFORMATION

The following description of the process information was sent to SEMA from Rocbolt Resins:

Rocbolt Resins manufactures resin capsules used as reinforcement for rocks/strata in the mining industry in conjunction with steel bolts and cables.

The capsules are a 2 part capsule, an outer plastic skin, sealed at both ends with clips and a separate inner compartment. The larger compartment consists of a highly viscous polyester resin mastic paste comprising approximately 20% polyester resin (contains Styrene monomer) & 80% inert limestone fillers. The smaller compartment consists of catalyst containing inert limestone fillers, benzoyl peroxide paste and oil or water as the carrier. The ratio of the two compartment ranges from 80:20 to 93:7 by weight.



1.3 SUMMARY OF EMISSION TEST RESULTS – 1 DECEMBER 2017

Parameter	Unit of measure	Average Measured Concentrations 1 December 2017			
		Inlet Duct		Exhaust Stack	
Stack temperature	°C	28		30	
Velocity	m/s	11.4		12.0	
Volumetric flow	m ³ /s	0.72		0.75	
Moisture	%	1.6		1.6	
Molecular weight dry stack gas	g/g mole	28.8		28.8	
Gas Density	kg/m ³	1.29		1.29	
Stack pressure	kPa	101.0		101.5	
		Run 1	Run 2	Run 1	Run 2
Styrene (as Styrene)	mg/m ³	382	542	0.68	<0.36
Styrene (as n-propane)	mg/m ³	161	229	0.29	<0.15
Styrene MER (as Styrene)	g/s	274	389	0.5	<0.27
Styrene Removal Efficiency	%	n/a	n/a	99.8	>99.9

Key:

°C	=	degrees Celsius
%	=	percentage
<	=	less than
kg/m ³	=	Kilograms per cubic metre
kPa	=	Kilo Pascals
g/g mole	=	grams per gram mole
m/s	=	metres per second
m ³ /s	=	dry cubic metre per second 0°C and 101.3 kilopascals (kPa)
MER	=	Mass Emission Rate
mg/m ³	=	milligrams per cubic metre at 0°C and 101.3 kilopascals (kPa)

1.4 ESTIMATED UNCERTAINTY OF MEASUREMENT

Pollutant	Methods	Uncertainty
Moisture	AS4323.2, NSW TM-22, USEPA 4	25%
Velocity	AS4323.1, NSW TM-2, USEPA 2	5%
Styrene as Volatile Organic Compound (adsorption tube)	NSW TM-34, USEPA 18	25%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source – Measurement Uncertainty)

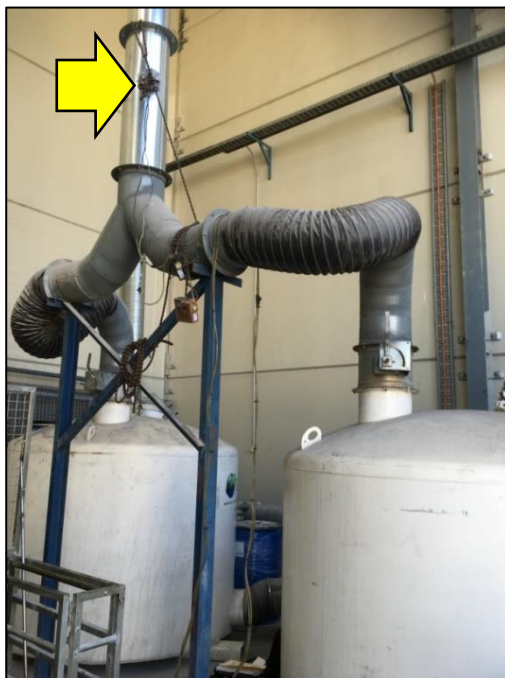
Sources: *Measurement Uncertainty – implications for the enforcement of emission limits* by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

Note: ISO 9096 is for 20-1000 mg/m³ which AS4323.2 is based on. Note DSEN 13284-1 testing for < 5 mg/m³ correlates to 5 mg/m³ with most quoted uncertainties of ± 5.3 mg/m³ @ 6.4 mg/m³. From Clean Air Engineering in the United States the lowest practical limit of USEPA M5 is 5 mg/m³ under lab conditions.

1.5 DRY SCRUBBER SAMPLING LOCATIONS

PHOTOGRAPH 1 DRY CARBON SCRUBBERS (2 OFF) AND OUTLET SAMPLE PORTS



PHOTOGRAPH 2 STACK OUTLET PENETRATING ROOF



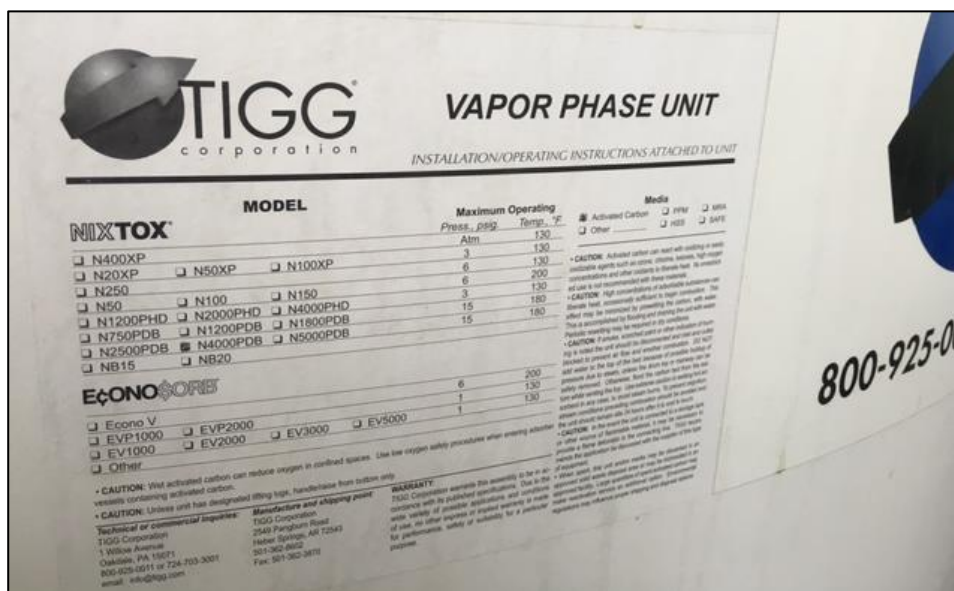
PHOTOGRAPH 3 INLET DUCT SAMPLING LOCATION



PHOTOGRAPH 4 VARIABLE SPEED FAN EXTRACTING AIR FROM WITHIN PLANT TO SCRUBBER



PHOTOGRAPH 5 DRY SCRUBBER MANUFACTURER'S DETAILS



1.6 INSTRUMENT CALIBRATION DETAILS

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
885	Digital Manometer	23-Feb-17	23-Feb-18
833	Personal Sampler	22-Mar-17	22-Mar-18
677	Personal Sampler	22-Mar-17	22-Mar-18
24	Personal Sampler	19-May-17	19-May-18
832	Personal Sampler	22-Mar-17	22-Mar-18
764	TSI THERMAL MASS FLOWMETER	17-Nov-17	17-May-18
613	Barometer	23-Feb-17	23-Feb-18
859	Digital Temperature Reader	17-Jul-17	17-Jan-18
863	Thermocouple	17-Jul-17	17-Jan-18
723	Pitot	03-Jun-17	03-Jun-2018 Visually inspected On-Site before use
946	Combustion analyzer	16-Aug-17	16-Feb-18
647	Stopwatch	18-Jul-17	18-Jan-18
Gas Mixtures used for Analyser Span Response			
Conc.	Mixture	Cylinder No.	Expiry Date
902 ppm 9.8% 10.4%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	ALSB 4980	07-Feb-18



1.7 CONCLUSIONS

Styrene was monitored on the inlet and discharge sides of the pair of dry carbon scrubbing units at the Rocbolt Resins manufacturing facility with the following results:

- The measured styrene emission concentration reported as n-propane was in compliance with the NSW Clean Air Regulation limit under the Protection of Environment (Operations) Act of 40 mg/m³;
- The styrene collection efficiency of the dry scrubbing system was greater than 99.8%;
- Rocbolt Resins advised that the variable speed extraction fan serving the scrubber system was running at its normal set point (25 Hertz) during the system efficiency testing. This is of the order of 63% of total flow.
- However, the fan speed is variable depending on demand for extraction within the plant. Rocbolt Resins advise that this is both an energy conservation and scrubber efficiency optimisation policy.



ATTACHMENT A – NATA CERTIFICATES OF ANALYSIS



SafeWork NSW



Jay Weber
Stephenson Environmental Management Australia
PO Box 6398
SILVERWATER NSW 1811

Lab. Reference: 2017-5424

SAMPLE ORIGIN: Job No. 5905

DATE OF INVESTIGATION: 01/12/2017

DATE RECEIVED: 1/12/17

ANALYSIS REQUIRED: Volatile Organic Compounds

REPORT OF ANALYSIS

See attached sheet(s) for sample description and test results.

The results of this report have been approved by the signatory whose signature appears below.

For all administrative or account details please contact the Laboratory.

Increment and total pagination can be seen on the following pages.

Nick Serbin
Senior Analytical Chemist

Date: 4/12/17

TestSafe Australia – Chemical Analysis Branch
Level 2, Building 1, 9-15 Chilvers Road, Thornleigh, NSW 2120, Australia
T: +61 2 9473 4000 E: lab@safework.nsw.gov.au W: testsafe.com.au
ABN 81 913 830 179



Accreditation No. 3726

Accredited for compliance with ISO/IEC 17025



SafeWork NSW



Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Jay Weber

Date Sampled : 1-Dec-2017

Sample ID : 726727

Sample : 2017-5424-1

No	Compounds	CAS No	Front	Back	No	Compounds	CAS No	Front	Back
			µg/section					µg/section	
Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					Aromatic hydrocarbons (LOQ = 1µg/compound/section)				
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	2122	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND	Ketones (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)				
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	260	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND	Alcohols (LOQ = 25µg/compound/section)				
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
Chlorinated hydrocarbons (LOQ = 5µg/compound/section)					60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND	Acetates (LOQ = 25µg/compound/section)				
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND	Ethers (LOQ = 25µg/compound/section)				
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	tert-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND	Glycols (LOQ = 25µg/compound/section)				
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)					71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
Total VOCs (LOQ =50µg/compound/section)				2463	ND	Worksheet check		YES	YES

2017-5424.xlsx

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TestSafe Australia – Chemical Analysis Branch

ABN 81 913 830 179 Level 2, Building 1, 9–15 Chilvers Road, Thornleigh, NSW 2120, Australia
 Telephone +61 2 9473 4000 Email lab@safework.nsw.gov.au Website testsafe.com.au



Accreditation No. 3726

Accredited for compliance with ISO/IEC 17025 - Testing



SafeWork NSW



Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Jay Weber

Date Sampled : 1-Dec-2017

Sample ID : 726728

Sample : 2017-5424-2

No	Compounds	CAS No	Front	Back	No	Compounds	CAS No	Front	Back
			µg/section					µg/section	
Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					Aromatic hydrocarbons (LOQ = 1µg/compound/section)				
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	1535	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	108-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND	Ketones (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)				
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	169	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND	Alcohols (LOQ = 25µg/compound/section)				
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
Chlorinated hydrocarbons (LOQ = 5µg/compound/section)					60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
1,1-Dichloroethane 75-34-3 ND ND					Acetates (LOQ = 25µg/compound/section)				
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND	Ethers (LOQ = 25µg/compound/section)				
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	tert-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND	Glycols (LOQ = 25µg/compound/section)				
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)					71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
Total VOCs (LOQ =50µg/compound/section)				1785	ND	Worksheet check		YES	YES



SafeWork NSW



Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Jay Weber

Date Sampled : 1-Dec-2017

Sample ID : 726729

Sample : 2017-5424-3

No	Compounds	CAS No	Front	Back	No	Compounds	CAS No	Front	Back
			µg/section					µg/section	
Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					Aromatic hydrocarbons (LOQ = 1µg/compound/section)				
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	4	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-18-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND	Ketones (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)				
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND	Alcohols (LOQ = 25µg/compound/section)				
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
Chlorinated hydrocarbons (LOQ = 5µg/compound/section)					60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND	Acetates (LOQ = 25µg/compound/section)				
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND	Ethers (LOQ = 25µg/compound/section)				
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	tert-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND	Glycols (LOQ = 25µg/compound/section)				
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)					71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
Total VOCs (LOQ =50µg/compound/section)			85	ND	Worksheet check			YES	YES



SafeWork NSW



Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Jay Weber

Date Sampled : 1-Dec-2017

Sample ID : 726730

Sample : 2017-5424-4

No	Compounds	CAS No	Front	Back	No	Compounds	CAS No	Front	Back
			µg/section					µg/section	
Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					Aromatic hydrocarbons (LOQ = 1µg/compound/section)				
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 106-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND	Ketones (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)				
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND	Alcohols (LOQ = 25µg/compound/section)				
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
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Chlorinated hydrocarbons (LOQ = 5µg/compound/section)					60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND	Acetates (LOQ = 25µg/compound/section)				
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
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28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
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35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)					71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
Total VOCs (LOQ =50µg/compound/section)			81	ND	Worksheet check			YES	YES

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TestSafe Australia – Chemical Analysis Branch

 ABN 81 913 830 179 Level 2, Building 1, 9–15 Chilvers Road, Thornleigh, NSW 2120, Australia
 Telephone +61 2 9473 4000 Email lab@safework.nsw.gov.au Website testsafe.com.au


Accreditation No. 3726

Accredited for compliance with ISO/IEC 17025 - Testing

SW08051 0817



SafeWork NSW



Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Jay Weber

ND = Not Detected

VOCs = Volatile Organic Compounds

All compounds numbered 1-73 are included of this analysis in the scope of NATA accreditation. Any additional compounds attested with * are not covered by NATA accreditation.

Method : Analysis of Volatile Organic Compounds in Workplace Air by Gas Chromatography/Mass Spectrometry

Method Number : WCA.207

Limit of Quantitation : 5µg/section; 25µg/section for oxygenated hydrocarbons except acetone, MEK and MIBK at 5µg/section and aromatic hydrocarbon at 1µg/section.

Brief Description : Volatile organic compounds are trapped from the workplace air onto charcoal tubes by the use of a personal air monitoring pump. The volatile organic compounds are then desorbed from the charcoal in the laboratory with CS₂. An aliquot of the desorbant is analysed by capillary gas chromatography with mass spectrometry detection.

Total Volatile Organic Compounds (TVOC) test result in µg/section is calculated by comparison to the average mass detector response of the 73 quantified compounds. The response of a mass detector is dependent on the fragmentation of the molecule. Therefore, the TVOC test result should be interpreted as a semi-quantitative guide to the amount of VOCs present. If the TVOC test result is less than the addition of the total amount of the 73 quantified compounds then the TVOC result is of little value other than for comparative purposes. If the TVOC test result is greater than the addition of all the compounds quantified then this can indicate that there are additional compounds present other than the 73 quantified compounds reported.

PGME : Propylene Glycol Monomethyl Ether

PGMEA : Propylene Glycol Monomethyl Ether Acetate

DGMEA : Diethylene Glycol Monoethyl Ether Acetate

Measurement Uncertainty

The measurement uncertainty is an estimate that characterises the range of values within which the true value is asserted to lie. The uncertainty estimate is an expanded uncertainty using a coverage factor of 2, which gives a level of confidence of approximately 95%. The estimate is compliant with the "ISO Guide to the Expression of Uncertainty in Measurement" and is a full estimate based on in-house method validation and quality control data.

Quality Assurance

In order to ensure the highest degree of accuracy and precision in our analytical results, we undertake extensive intra- and inter-laboratory quality assurance (QA) activities. Within our own laboratory, we analyse laboratory and field blanks and perform duplicate and repeat analysis of samples. Spiked QA samples are also included routinely in each run to ensure the accuracy of the analyses. WorkCover Laboratory Services has participated for many years in several national and international inter-laboratory comparison programs listed below:-

- ☐ Workplace Analysis Scheme for Proficiency (WASP) conducted by the Health & Safety Executive UK;
- ☐ Quality Management in Occupational and Environmental Medicine QA Program, conducted by the Institute for Occupational, Social and Environmental Medicine, University of Erlangen – Nuremberg, Germany;
- ☐ Quality Control Technologies QA Program, Australia;
- ☐ Royal College of Pathologists QA Program, Australia.

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