Workplace air monitoring

Workplace noise

Environmental noise

LEV surveys

HAV

IAQ

Biological agents

HAZMAT

COSHH

Training

H&S Support

info@ssuk.eu

01782 341827

industrialsafetysolutions

REPORT OF AIR MONITORING AND ASSESSMENT OF OCCUPATIONAL EXPOSURES TO AIRBORNE CONTAMINANTS DURING ROAD REPAIR TASKS

AT

BILLIAN UK LIMITED
T/A ROADMENDER ASPHALT
BUTTERTHWAITE BUSINESS PARK
BUTTERTHWAITE LANE
ECCLESFIELD
SHEFFIELD
S35 9WA

Report Reference: ISS 23-3644 Air

Date: 8 November 2023

Author: Amanda Bailey LFOH
Occupational Hygienist

CONTENTS

EXECUTIVE SUMMARY

Objectives

Occupational exposures to asphalt fumes, polyaromatic hydrocarbon compounds (PAH's) within the fume and hydrogen sulphide were assessed on 19 October 2023 for Roadmender Ashpalt workers during the repair of roadway potholes at the M1 Woodhall Services access Road.

The COSHH Regulations place a duty on the employer to apply principles of good occupational hygiene practice for the control of substances hazardous to health (regardless of whether a substance has an exposure limit or whether exposures are below any published limit).

Summary findings

The results and information obtained during the visit indicated that 8-hour time-weighted average exposures to asphalt fumes and hydrogen sulphide, during the use of 1 tonne of Elastomac material, were very low and do not give any cause for concern.

Summary Recommendations

Regulation 7 requires that where there is exposure to a substance hazardous to health, then control of that exposure shall only be treated as adequate if the principles of good practice for the control of exposure to substances hazardous to health set out in Schedule 2A are applied.

The monitoring results obtained during this survey may be used as part of the COSHH assessment for the processes monitored and may be used to determine whether adequate control of exposure is being achieved.

Given the potential carcinogenic nature of some of the compounds within asphalt fume, the principles of ALARP (as low as reasonably practicable) are recommended. Consideration should be given to the following: -

- Control fume emission by minimising the amount of material used, as required.
- Use the correct temperature for the process and in line with manufacturer's recommendations.
- Ensure a good viewing window on the boiler or depth check scale, to ascertain the amount of material remaining, rather than observing via the boiler top lid.
- Ensure good hygiene practices on site to prevent ingestion of material and minimise skin exposure.
- Review an alternative material transport application method, where practical, as the filling of buckets and tipping of buckets are likely to increase the risk of fume exposure, over an enclosed feed-system.
- A biological monitoring programme for PAH exposure, via post shift urinary analysis for 1-hydroxypyrene, to establish an overall body burden.

SURVEYED BY:

Amanda Bailey LFOH
Occupational Hygiene Team Leader

VERIFIED BY:

Max Whitehurst LFOH
Occupational Hygienist

1. INTRODUCTION

The survey described in this report was carried out on 19 October 2023 by Amanda Bailey at the request of Barry Foster & Harry Pearl at Billion UK Ltd T/A Roadmender Asphalt and in accordance with our work specifications outlined in quotation reference ISS 23-3644, in order to determine personal exposure to asphalt fumes, polyaromatic hydrocarbon compounds within the fume and hydrogen sulphide during the repair of roadway potholes at the M1 Woodhall Services access Road.

In accordance with the COSHH Approved Code of Practice, information relating to monitoring procedures and access to their individual results should be made available to employees and, with their authority, to employee representatives.

2. PROCESS DESCRIPTION

Billion UK Ltd, trading as Roadmender Asphalt, repair and maintain roadways, car parks etc for a variety of sectors using an innovative polymer modified material, which uses recycled tarmac and recycled tyres to replace the bitumen content in tarmac, known as Elastomac.

Elastomac is heated to around 190 to 200°C in a boiler situated on the back of a trailer to form a fluid material. The material is poured via buckets into potholes or missing patches of roadway, followed by spreading of the material, enough to fill the area. Once filled, the material is covered in an aggregate to protect the surface and tyres from vehicles passing over the patched areas (skid resistance) and seal in the heat. The material does not require compaction and will cure in approximately 1-2 hours. The material welds itself to the existing road surface, protecting from ingress of water and extending the life of the road surface.

The material is handled so as to cover square meter areas. The average material amount used in a working shift covers approximately 38m^2, with 60 to 70m^2 being the maximum amounts of material handled – though this is likely to be with more workers on the job.

The amount of material handled during the monitoring period was 1 tonne in a period of approximately 3 hours, covering 33 deep potholes (approximately 50-60m^2). Normally workers would need to set up and travel from site to site, therefore actual exposure during the use of the material is around 1.5 hours in a working shift (approximately 7 hours). There were a team of 4 workers carrying out the repairs on the day of the survey.

The material is made in a separate facility throughout the winter months, ready for use on specific jobs throughout March to November.

The weather conditions on the day of the survey were overcast with intermittent showers, approximately 15°C, with a SSE direction 17km/hr wind.

3. OBSERVATIONS & CONTROLS

3.1 General Ventilation

Work is mainly outdoors; therefore, natural ventilation occurs through climatic conditions.

3.2 Other Controls

Two workers shared the task of pouring the hot material into buckets from the boiler then placing into the holes / road surface, as required.

3.3 Personal Protective Equipment (PPE)

The workers wore general workwear, high visibility clothing, grip gloves, heatproof gauntlets (where applicable), safety boots and safety glasses. No respiratory protective equipment was worn.

3.4 Health Surveillance

The workers have annual medicals which include lung function tests (Spirometry).

4. MONITORING METHODS

Monitoring of personal exposure to asphalt fumes was carried out using Casella Apex sampling pumps to draw air at 2.0 litres per minute through pre-weighed 25mm cyclohexane washed GFA filters in an IOM sampling head located in the breathing zone i.e. attached to the lapel or collar.

Gravimetric analysis of the filters was carried out, followed by a cyclohexane extraction to obtain the cyclohexane soluble material fraction on the filter. Following this the extract was analysed for polycyclic aromatic hydrocarbons by Gas Chromatography. The methods were based on NIOSH 5042 for Asphalt Fumes and NIOSH5506/5800 for PAH's.

Exposure to hydrogen sulphide was monitored using Casella Apex pumps to draw air at 0.2 litres per minute through charcoal 226-01 tubes. These were analysed by solvent desorption and ion chromatography (IC) based on NIOSH 6013 methodology.

All analysis was carried out by an Accredited outside laboratory. A copy of the Analytical Report is given in Appendix IV.

Sample trains were calibrated before and after sampling using a Casella Airflow Detective, serial number 2023624 The calibration certificate is provided in Appendix III.

5. LEGISLATION AND GUIDANCE

5.1 The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended) and Approved Code of Practice and Guidance

The COSHH Regulations 2002 (as amended) require employers to carry out a suitable and sufficient assessment of the risk to health of employees which are exposed to hazardous substances in the workplace. The COSHH Regulations require an employer to prevent exposure of employees to hazardous substances by inhalation, ingestion or skin contact. Where this is not reasonably practicable then measures should be implemented to ensure adequate control.

Schedule 2A of the COSHH Regulations details eight principles of good practice for the control of substances hazardous to health. The guidance then provides a detailed explanation of how the principles should be applied in practice. Details of each of the principles and the relevant references in the ACOP (sixth edition 2013), are summarised in Appendix I.

5.2 Workplace Exposure Limits (WELs) EH40 (Fourth Edition 2020)

Under the COSHH Regulations a single type of occupational exposure limit is specified for substances hazardous by inhalation, this is the Workplace Exposure Limit. An employer must ensure that a WEL is not exceeded and in addition when a substance can cause occupational asthma, cancer or genetic effects then exposure must be reduced as low as reasonably practicable. The limits are time weighted average concentrations of substances in the air using either 8 hours or 15 minutes (short term exposure limit) as the reference period.

The WELs which apply in this instance are given in the following table.

Substance	8-hour TWA mg/m³	15-min STEL mg/m³	Notes
Hydrogen Sulphide	7	14	-
Asphalt, Petroleum Fumes	5	10	Suspect human carcinogen
Anthracene	0.2	-	OSHA PEL Suspect human carcinogen
Benzo[a]Pyrene	0.2	-	OSHA PEL Suspect human carcinogen
Chrysene	0.2	-	OSHA PEL Suspect human carcinogen
Naphthalene	10ppm	15ppm	ACGIH, OSHA PEL & NIOSH REL Suspect human carcinogen
Phenanthrene	0.2	-	OSHA PEL Suspect human carcinogen
Pyrene	0.2	-	OSHA PEL Suspect human carcinogen

Key:
Carc capable of causing cancer and/or genetic damage
OSHA PEL Occupational Safety and Health Administration Permissible Exposure Limit
NIOSH REL National Institute for Occupational Safety and health Recommended Exposure Limit
ACGIH TLV American Conference of Governmental Industrial Hygienists Threshold Limit Value

The COSHH Regulations also place a duty on the employer to apply principles of good occupational hygiene practice for the control of substances hazardous to health (regardless of whether a substance has an exposure limit or whether exposures are below any published limit).

Regulation 7 also requires that where there is exposure to a substance hazardous to health, then control of that exposure shall only be treated as adequate if the principles of good practice for the control of exposure to substances hazardous to health set out in Schedule 2A are applied.

6. RESULTS

Concentrations of asphalt fume and hydrogen sulphide monitored during the use of 1 tonne of material to fill potholes are reported in Table 1.

Personal exposure concentrations, as an 8-hour Time-Weighed Average, have also been calculated using the following calculation:

$(C_nT_n)/8$ = mg/m^3, where C_n is the concentration measured during the sampling period in mg/m^3 and T_n time in hours (approximately 3 hours).

7. DISCUSSION

The monitoring results obtained during this survey may be used as part of the COSHH assessment for the processes monitored and may be used to determine whether adequate control of exposure is being achieved.

Four workers were monitored for exposure to hydrogen sulphide, asphalt fume as a cyclohexane soluble material / particulate and for any PAH compounds likely to be present within the fume during the pouring of road material to repair / fill potholes and patches of a worn roadway between the two service stations at Woodhall Services on the M1.

Two workers, Martin Williamson and Mark Williamson, were responsible for pouring the molten Elastomac material via buckets. One worker, Oliver Cole was mainly spreading the material into the hole or area after it had been poured using a long-handled scraper. The remaining worker, Dean Birchall, was responsible for clearing the patches / holes of water using a motorised brush and placing aggregate on top of the patches once filled.

During the monitoring, 1 tonne of material was used to patch / repair the roadway, with approximately 33 potholes filled.

The results from the analysis indicated asphalt fumes, as a cyclohexane soluble material, below 5% of the UK Workplace Exposure limit of 5mg/m^3, when calculated as an 8-hour TWA.

Analysis for any PAH's within the fume indicated the presence of five compounds for Mark Williamson's sample and two compounds within Martin Williamson's sample. The concentrations were well below any relevant OSHA PEL's and do not give cause for concern.

Concentrations of hydrogen sulphide were determined below 4% of the UK WEL of 7mg/m^3 for all four samples and do not give rise to concern.

Exposure concentrations may vary with climatic conditions and the amount of material used in a working shift.

8. CONCLUSIONS AND RECOMMENDATIONS

The results from the survey indicate that exposures to asphalt fumes and hydrogen sulphide during the use of 1 tonne of Elastomac material were very low and do not give any cause for concern.

In accordance with COSHH Schedule 2A principles of good practice for the control of substances hazardous to health, reference (a), processes should be designed and operated to minimise the emission, release and spread of substances hazardous to health.

Given the potential carcinogenic nature of some of the compounds within asphalt fume, the principles of ALARP (as low as reasonably practicable) should be applied.

Therefore, consider controlling fume emission during the application of the material by only using the correct amount of material, at the correct temperature and rotate the workers handling the material to minimise time spent in the vicinity of the molten asphalt.

Ensure a good viewing window on the boiler or depth check scale to ascertain the amount of material remaining, rather than observing via the boiler top lid.

Ensure good hygiene practices on site to prevent ingestion of material and minimise skin exposure.

Consider an alternative material transport application method to buckets, where practical, as the filling of buckets and tipping of buckets are likely to increase the risk of fume exposure over an enclosed feed-system.

Consider biological monitoring for PAH compounds, via post shift urinary analysis for 1-hydroxypyrene, to establish an overall body burden.

Table No. 1: Levels of asphalt fume, PAH's and hydrogen sulphide during pothole filling

Sample Number	Name / Location	Monitored Times	Asphalt Fumes as Cyclohexane Extractable Material		Polycyclic Aromatic Hydrocarbons (PAH)		Hydrogen Sulphide	
			mg/m³	8-hour TWA	mg/m³	8-hour TWA	mg/m³	8-hour TWA
Tube 5523 / M087	Mark Williamson – Mastik Repair Worker	08:35 – 11:55	0.24	0.10	Benz[a]Anthracene 0.000022 Benz[b]Fluoranthene 0.000020 Benzo[a]Pyrene 0.000021 Chrysene 0.000026 Pyrene 0.000014	Benz[a]Anthracene 0.0000092 Benz[b]Fluoranthene 0.0000083 Benzo[a]Pyrene 0.0000088 Chrysene 0.000011 Pyrene 0.0000058	0.63	0.26
Tube 5524 / M088	Martin Williamson – Mastik Repair Worker	08:39 – 11:45	0.59	0.23	Benz[a]Anthracene 0.000017 Chrysene 0.000020	Benz[a]Anthracene 0.0000065 Chrysene 0.0000078	<0.27	<0.27
Tube 5527 / M089	Dean Birchall – Mastik Repair Worker	08:41 – 11:45	0.36	0.14	<0.000013	<0.000013	0.56	0.21
Tube 5528 / M090	Oliver Cole – Mastik Repair Worker	08:44 – 11:55	<0.14	<0.14	<0.000013	<0.000013	0.63	0.25
Exposure Standard (where available)			**WEL 5 mg/m³**		**OSHA PEL (Chrysene, Pyrene, Benzo[a]Pyrene) 0.2mg/m³**		**WEL 7 mg/m³**	

Notes:

- mg/m³ = milligrams of contaminant per cubic metre of air
- No known published exposure standard for Benzo[a]Anthracene and Benzo[b]Fluoranthene
- < = Indicates the result was less than the analytical limit of detection for the method employed

Key:

Red = ≥ Exposure Standard
Yellow = ≥ 50% Exposure Standard
Green = <50% Exposure Standard

Results quoted are averages over the sampling period and as an 8-hour Time Weighted Average. The 8-hour TWA results can be compared directly with the 8-hour TWA WEL/PEL as they are representative of the tasks performed during the shift.

APPENDIX I
SCHEDULE 2A. REGULATION 7 (7) (A) PRINCIPLES OF GOOD PRACTICE FOR THE CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH

Principle Reference	Principle	ACOP / Guidance Reference
Paragraph 102 – *"Good practice in the control of substances hazardous to health can be encapsulated in eight generic principles. They must be applied to obtain effective and reliable control. The principles overlap in their application. They are not rank ordered: the first is not more important than the last, although there is logic to their overall presentation".*		
(a)	Design and operate processes and activities to minimise emission, release and spread of substances hazardous to health.	Paragraph 103
(b)	Take into account all relevant routes of exposure (inhalation, skin absorption and ingestion), when developing control measures.	Paragraph 104
(c)	Control exposure by measures that are proportionate to the health risk.	Paragraph 105
(d)	Choose the most effective and reliable control options, which minimise the escape and spread of substances hazardous to health.	Paragraphs 106 - 109
(e)	When adequate control of exposure cannot be achieved by other means, provide, in combination with other control measures, suitable personal protective equipment.	Paragraphs 110 - 111
(f)	Check and review regularly, all elements of control measures for their continuing effectiveness.	Paragraphs 112 - 113
(g)	Inform and train all employees on the hazards and risks associated with the substances with which they work and the use of control measures developed to minimise the risks.	Paragraphs 114 - 116
(h)	Ensure that the introduction of control measures does not increase the overall risk to health and safety.	Paragraphs 117 - 119

APPENDIX II
CARCINOGENS

Carcinogenic and mutagenic substances

Regulation 7(5) of COSHH sets out clear requirements for the control of carcinogenic and mutagenic substances, including a requirement that exposure be reduced as low as is reasonably practicable. Appendix 1 of the COSHH (ACOP) gives additional practical guidance. The ACOP applies to any carcinogen or mutagen defined as such in COSHH.

APPENDIX III
AIRFLOW DETECTIVE CALIBRATION CERTIFICATE

www.casellasolutions.com

CASELLA

Certificate of Conformity and Calibration

Instrument Type Flow Detective Plus Air Flowmeter
Serial Number 2023624
Firmware Version 213.007.01.00

Applicable standards:-

EN1232 - Workplace Atmospheres: Pumps for Personal Sampling of Chemical Agents
MDHS14/3 - General Methods for Sampling and Gravimetric Analysis of Respirable and Inhalable Dust
NIOSH 0600 - Particulates Not Otherwise Regulated, Respirable

Test Conditions:-

Temperature	24.51	°C
Humidity	22	%RH
Pressure	1032	mBar

Test Engineer:- David Forde

Date of Issue:- February 10, 2023

Equipment Used

Air Flow Calibrator: NIST traceable
Type: Gilibrator-2 **Serial Number:** EQ11175

Declaration of conformity

This test certificate confirms that the instrument specified above has been successfully tested to comply with the manufacturer's published specifications.

Tests are performed using equipment traceable to national standards in accordance with Casella's ISO 9001:2015 quality procedures.
This product is certified as being compliant to the requirements of the CE Directive.

Test and Calibration Results :-

General tests

Item	*Measured value*	*Lower Limit*	*Upper Limit*	*Status*
Unit temperature (°C)	27.0	0	45	Pass
Battery voltage - CELL1 (V)	3.9	3.6	4.2	Pass
Battery voltage - CELL2 (V)	3.9	3.6	4.2	Pass
General hardware	OK	N/A	N/A	Pass
Bluetooth communication	Passed	N/A	N/A	Pass

General tests **All Tests Pass**

Flow rate accuracy (Low range)

Measured flow rate (litres/min)	*Reference flow rate (litres/min)*	*Result*	*Error Limits (%)*	*Status*
0.207	0.200	Pass	±(0.8% Reading + 0.2% FS)	Pass

Flow rate accuracy (Normal range)

Measured flow rate (litres/min)	*Reference flow rate (litres/min)*	*Error (% of Reading)*	*Error Limits (% of Reading)*		*Status*
			Min	*Max*	
0.959	0.954	-0.52%	-2%	2%	Pass
1.901	1.894	-0.37%	-2%	2%	Pass
4.664	4.713	1.05%	-2%	2%	Pass

All Tests Pass

Casella UK
Regent House, Wolseley Road,
Kempston, Bedford
MK42 7JY
United Kingdom
Tel: +44 (0) 1234 844100
Fax: +44(0) 1234 841490
E-mail: info@casellasolutions.com

Casella CEL Inc.
13 Pratts Junction Road,
Sterling,
MA 01564-2305
USA
Toll Free (800) 366-2966
E-mail: info@casellausa.com

Casella India
IDEAL Industries India Pvt.Ltd.
229-230, Spazedge, Tower -B Sohna Road,
Sector-47, Gurgaon-122001, Haryana , India.
Tel: +91 124 4495100
E-mail: casella.sales@ideal-industries.in

Tested to Flow Detective test sheet TP539 revision 10-00

Page 1 of 1

APPENDIX IV
LABORATORY REPORT

CERTIFICATE OF ANALYSIS

MSSL reference: 23-61714

Report date: 01-11-2023

Customer: Industrial Safety Solutions
Unit 26a,
Parkhall Business Village,
Parkhall Road,
Stoke-On-Trent,
ST3 5XA

Customer contact(s): amanda@ssuk.eu
analysis@ssuk.eu

Customer reference: 23-3644
Customer PO: -
Customer sampling date: -
Date received: 23-10-2023

Analysis started: 26-10-2023
Analysis complete: 01-11-2023
Conforming: Yes

Results only relate to the items tested. Results apply to the samples as received.

Conformance is contingent upon accurate information being provided by the customer and customer compliance with relevant sample handling and storage conditions prior to receipt at the laboratory.

All opinions and interpretations expressed within this report are outside Marchwood's scope of accreditation.

Accreditation Key:

Y : ISO 17025 UKAS M : MCERTS
N : Non Accredited (S) : Subcontracted

Notes:

Reported by: Emma Spear
Position: Senior Customer Service Advisor

Approved by: Sebastian Dahl
Position: Laboratory Manager
For/on behalf of Marchwood Scientific Services Ltd

UKAS TESTING
1668

Analysis of cyclohexane soluble material by gravimetry, and USEPA16 PAH by GC/QqQ from GFA IOM

MSSL sample ref:	23-61714-001	23-61714-002	23-61714-003	23-61714-004
Customer sample ref:	M087	M088	M089	M090
Customer sampling volume (L):	368	373	332	368

Determinand	Units	LOD	Acc.				
Cyclohexane soluble material	mg	0.05	N	**0.09**	**0.22**	**0.12**	<0.05
	mg/m^3	Calc.	N	**0.24**	**0.59**	**0.36**	<0.14

Determinand	Units	LOD	Acc.				
Naphthalene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Acenaphthylene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Acenaphthene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Fluorene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Phenanthrene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Anthracene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Fluoranthene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Pyrene	ng	5	N	**5**	<5	<5	<5
	mg/m^3	Calc.	N	**0.000014**	<0.000013	<0.000015	<0.000014
Benz[a]anthracene	ng	5	N	**8**	**6**	<5	<5
	mg/m^3	Calc.	N	**0.000022**	**0.000017**	<0.000015	<0.000014
Chrysene	ng	5	N	**9**	**8**	<5	<5
	mg/m^3	Calc.	N	**0.000026**	**0.000020**	<0.000015	<0.000014
Benzo[b]fluoranthene	ng	5	N	**8**	<5	<5	<5
	mg/m^3	Calc.	N	**0.000020**	<0.000013	<0.000015	<0.000014
Benzo[k]fluoranthene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Benzo[a]pyrene	ng	5	N	**8**	<5	<5	<5
	mg/m^3	Calc.	N	**0.000021**	<0.000013	<0.000015	<0.000014
Indeno[1,2,3-cd]pyrene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Dibenz[a,h]anthracene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014
Benzo[ghi]perylene	ng	5	N	<5	<5	<5	<5
	mg/m^3	Calc.	N	<0.000014	<0.000013	<0.000015	<0.000014

Analysis of hydrogen sulphide from charcoal tube(s) (226-09) by IC

MSSL sample ref:	23-61714-005	23-61714-006	23-61714-007	23-61714-008
Customer sample ref:	Tube 5523	Tube 5524	Tube 5527	Tube 5528
Customer sampling volume (L):	36	37	32	32

Determinand	Units	LOD	Acc.				
Hydrogen sulphide [1]	µg	10	N	**23**	<10	**18**	**20**
	mg/m^3	Calc.	N	**0.63**	<0.27	**0.56**	**0.63**

[1] Results have been blank-corrected.