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Mastic Asphalt Council Member

MASTIC ASPHALT COUNCIL

Mastic Asphalt Flooring

Fume Report 2020

Our Ref: 141643

24th March 2020

Malcolm Grinstead
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Report Number: 20_02_141643_MC_1

Dear Mr Grinstead,

Workplace Air Monitoring – Mastic Asphalt Fume

Please find enclosed the report relating to the recent Workplace Monitoring Survey carried out at Briggs Amasco, Birmingham, B64 5PX on the 28th February 2020 comprising the elements detailed below:

- Bitumen Fume (Cyclohexane Extractable Material)
- Polycyclic Aromatic Hydrocarbons (PAH)
- Volatile Organic Compounds (VOC)

An account for this work will be forwarded to you under separate cover. The work was undertaken according to our General Conditions of Contract.

If we can be of any further assistance to you in this matter, please do not hesitate to contact me.

Yours sincerely
On behalf of **SOCOTEC**



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If you have any comments regarding our services or reports you can leave feedback by following the link below. https://www.surveymonkey.co.uk/r/CEN_customer_feedback

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Workplace Air Monitoring
Asphalt Fume
Briggs Amasco, Birmingham
February 2020

Carried out for:
Malcolm Grinstead
Mastic Asphalt Council
27 Greenways Crescent
Shoreham By Sea
Sussex
United Kingdom
BN43 6HR

Issue date: - 24th March 2020

Report No: - 20_02_141643_MC_1

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EXECUTIVE SUMMARY

This report presents the findings of an exposure assessment made at Briggs Amasco, 101 Powke House, Cradley Health, Birmingham, B64 5PX by Marc Cotton BSc LFOH, SOCOTEC Occupational Hygienist on the 28th February 2020. The assessment was arranged by Malcolm Grinstead of the Mastic Asphalt Council. The site contact at Briggs Amasco was Tony Lawther, Operations Director.

The objective of the exercise was to ascertain exposure to bitumen fume, polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (VOC) during a mastic asphalt spreading exercise in the workshop area at Briggs Amasco, Birmingham and to compare the results of the monitoring with current exposure limits, where available, or other relevant guidelines. Suitable recommendations will be made, as appropriate.

Summary of Findings

The results from the personal and static fume monitoring exercise indicated that all the measured parameters were below 50% of relevant HSE Workplace Exposure Limits (WELs) or other guidance values. It should be noted that recorded bitumen/asphalt fume concentrations for employees carrying out spreading works were higher than the employee using the barrow, and the static sample positioned close to the rear of the mixer lorry. The highest recorded bitumen fume concentration of 2.15 $mg.m^{-3}$ was just below 50% of the HSE WEL of 5 $mg.m^{-3}$ for asphalt, petroleum fumes. It should be noted that the samples were switched off during break times so they represent exposure if work was continuous over an 8 hour period (i.e. the samples do not take into account breaks). Therefore they may represent a worst case scenario.

Summary of Recommendations

In order to maintain low levels of exposure to asphalt fumes, employees should try to avoid being downwind of the fume source wherever possible.

During indoor work, it is recommended that the mixer lorry should not be positioned inside the area.

A natural flow of air should also be created in the area by ensuring doors are kept open.

Any available mechanical ventilation, such as roof or wall fans should be utilised.

If indoor work is required in a fairly enclosed space, a form of local exhaust ventilation should be used. This could simply be a large length of flexible hose/ducting attached to a fan which exhausts externally, away from employees and the general public. The ducting should be fitted with a hood that can be easily moved close to the source of fume.

Employees handling sand and limestone dust should do so with care to avoid generating elevated levels of dust. Crystalline silica is a known carcinogen and is present in sand.

Should employees request additional respiratory protection during either of the processes then a respirator with a combined organic gas/vapour and particulate filter should be used. RPE should only be worn by employees when exposed for brief periods to relatively high levels of fume.

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1 INTRODUCTION

1.1 This report presents the findings of an exposure assessment made at Briggs Amasco, 101 Powke House, Cradley Health, Birmingham, B64 5PX by Marc Cotton BSc LFOH, SOCOTEC Occupational Hygienist on the 28th February 2020. The assessment was arranged by Malcolm Grinstead of the Mastic Asphalt Council. The site contact at Briggs Amasco was Tony Lawther, Operations Director.

2 SCOPE AND EXCLUSIONS

2.1 The objective of the exercise was to ascertain exposure to bitumen fume, polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (VOC) during a mastic asphalt spreading exercise in the workshop area at Briggs Amasco, Birmingham and to compare the results of the monitoring with current exposure limits, where available, or other relevant guidelines. Suitable recommendations will be made, as appropriate.

2.2 The client requested and SOCOTEC quoted to undertake exposure monitoring for the components mentioned in 2.1 in the following areas:

- Two personal bitumen fume samples on Mastic Asphalt Spreaders
- One PAH and VOC sample on Mastic Asphalt Spreader
- One personal Bitumen fume sample on Barrow Man
- One static PAH and VOC sample on near the Mastic Asphalt Spreaders
- One static bitumen fume, PAH and VOC sample near mixer lorry operative

2.3 Each of the components measured required an individual sample pump. Therefore sample pumps were limited to bitumen fume only on one of the asphalt spreaders and barrow man as it would restrict movement. The static sample positioned close to the rear of the mixer lorry was positioned just above the head of the mixer lorry operative (see photograph in section 6).

2.4 The personnel monitored and the static locations were decided on site with assistance from Tony Lawther of Briggs Amasco. No other components were covered during this exercise.

2.5 It should be noted that where monitoring is required at fixed / static points, the results cannot be directly compared to WELs, as sampling is not performed on personnel with the sample head being placed within the breathing zone. Results from static monitoring are indicative of the total dust that may be present in the atmosphere at the locations monitored.

3 PROCESS / HAZARD DESCRIPTION

3.1 The process involved releasing mastic asphalt from a mixer truck and spreading it on the floor of the Mechanics Workshop area at Briggs Amasco, Birmingham. The work involved five employees carrying out the works. Three of these moved barrows of the mastic asphalt from the mixer to the area where spreading was carried out. The other two employees

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carried spreading duties on the ground. The mixer operator was positioned close the mixer throughout and was not a Briggs Amasco employee.

3.2 Asphalt fume and associated components may be generated due to fugitive emissions from the external mixer truck and release of fume from application of the product on the floor. Other components used in the process included sand that was added to the top layer of the asphalt, and limestone dust that was added to the barrows to prevent the asphalt sticking. Respirable crystalline silica from sand, and limestone dust was not covered during this exercise.

3.3 Further discussion of the process can be found in section 8.

4 EXPOSURE CONTROLS

4.1 There were no specific exposure controls at the site visit although the open roller shutter did provide a degree of natural ventilation into the area.

4.2 It is believed that employees do have access to particulate respirators although these were not used during this site visit.

5 BACKGROUND INFORMATION

5.1 Asphalt (Bitumen) Fume

5.1.1 The exact chemical composition of asphalt depends on the chemical complexity of the original crude petroleum and the manufacturing processes. The proportions of the chemicals that constitute asphalt (mainly aliphatic compounds, cyclic alkanes, aromatic hydrocarbons, and heterocyclic compounds containing nitrogen, oxygen, and sulphur atoms) can vary because of significant differences in crude petroleum from various oil fields and even from various locations within the same oil field.

5.1.2 Asphalt fumes generated at high temperatures are probably more likely to generate carcinogenic polycyclic aromatic hydrocarbons (PAHs) than fumes generated at lower temperatures.

5.1.3 Studies of the acute toxic effects of asphalt fume exposures in workers have repeatedly reported irritant symptoms of the serous membranes of the conjunctivae (eye irritation) and the mucous membranes of the upper respiratory tract (nasal and throat irritation). These health effects are best described in asphalt road pavers and typically appear to be mild in severity and transient in nature. Similar symptoms were also reported in workers exposed to asphalt fumes during the manufacture of asphalt roofing shingles and fluorescent lights (CDC, 2000, Health Effects of Occupational Exposure to Asphalt).

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5.2 Polycyclic Aromatic Hydrocarbons (PAHs)

5.2.1 In general, PAHs have a low order of acute (short term) toxicity in humans. There are a number of chronic (long term) non-cancer effects associated with PAHs, including respiratory irritation and bronchitis. Exposure to PAHs has also been linked with cardiovascular disease, and they are among the complex suite of contaminants in cigarette smoke.

5.2.2 Cancer is the primary human health risk of exposure to PAHs. It is the most significant PAH toxicity endpoint. In addition, PAHs are linked to poor foetal development. Several PAHs are classed as Carcinogens and Mutagens. There is therefore a duty under the COSHH (Control of Substances Hazardous to Health) Regulations for exposures to these categories of substance to be reduced to as low a level as reasonably practicable.

5.2.3 Cancers that have been linked to exposures to PAHs include lung, skin, bladder, kidney and skin. It should be noted that exposure by inhalation is not the only route of entry into the body. Certain PAH parent compounds are weak carcinogens, but can become potent carcinogens after undergoing metabolism in the body. Chronic or repeated exposure increases the likelihood of cancer initiation, as well as the potential for metabolism of a PAH procarcinogen to a carcinogen.

5.3 Volatile Organic Compounds (VOCs)

5.3.1 VOCs are typically solvents, used principally for cleaning or degreasing, or for dissolving another component (e.g. a paint or adhesive), or they may be chemical intermediates in their own right. Workers may be exposed wherever VOCs are manufactured, stored, used or disposed of, but they are most likely to be exposed when: vapour arises from the handling of solvent in the liquid phase; vapour is formed from a fugitive escape; and vapour is produced by a drying film. No specific meaning is intended for VOCs. The definition includes all organic compounds of medium volatility, in a boiling point range of approximately 0-400°C or vapour pressures in the range 0.10-100 kPa.

5.3.2 Dependent on the specific compound, exposure can cause irritation of the eyes and respiratory tract. When inhaled in excessive quantities, they may cause symptoms of narcosis including headache, nausea and dizziness. Prolonged or repeated skin contact can lead to the development of irritation and dermatitis.

5.4 Exposure Limits

5.4.1 Exposure of employees to substances hazardous to health should be prevented, or, where this is not reasonably practicable, adequately controlled. This is a fundamental requirement of the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended).

Without prejudice to the requirement to prevent exposure, control of a substance hazardous to health shall only be treated as adequate if:

- The eight principles of good practice for the control of substances hazardous to health have been applied (regardless of whether a substance has an exposure limit);

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- The Workplace Exposure Limit (WEL) is not exceeded; and
- Exposure to substances that can cause occupational asthma; cancer; or damage to genes that can be passed from one generation to another; is reduced as low as is reasonably practicable.

5.4.2 The eight principles of good practice are set out in Schedule 2A of the Regulations, and are as follows:

- Design and operate processes and activities to minimise emission, release and spread of substances hazardous to health.
- Take into account all relevant routes of exposure - inhalation, skin absorption and ingestion - when developing control measures.
- Control exposure by measures that are proportionate to the health risk.
- Choose the most effective and reliable control options that minimise the escape and spread of substances hazardous to health.
- Where adequate control of exposure cannot be achieved by other means, provide, in combination with other control measures, suitable personal protective equipment.
- Check and review regularly all elements of control measures for their continuing effectiveness.
- Inform and train all employees on the hazards and risks from the substances with which they work and the use of control measures developed to minimise the risks.
- Ensure that the introduction of control measures does not increase the overall risk to health and safety.

5.4.3 The HSE publishes a list of Workplace Exposure Limits (WELs) in their Guidance Note EH40 2005 which form part of the requirements of the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended).

Substance	Workplace Exposure Limit				Comments from HSE EH40
	LTEL (8-hour TWA)		STEL (15 min TWA)		
	ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Total Inhalable Dust (non-specific)	-	10	-	-	
Asphalt, petroleum fume	-	5	-	10	
Total PAHs (all species)	-	0.2	-	-	ACGIH TLV* (see below)
Naphthalene	-	53	-	-	ACGIH TLV (see below)

TWA – Time weighted average *LTEL – Long term exposure limit*
ppm – parts per million *STEL – Short term exposure limit*
BMGV Biological monitoring guidance values
ACGIH TLV American Conference of Governmental Industrial Hygienists, Threshold Limit Values
*Total PAH's (all species) **0.2 mg/m^3** ACGIH 1999, USA standard (Now Revoked)

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6 MONITORING METHODS

See Appendix A – Methods for the test methods used and their accreditation status. The location of the static samples: positioned near some of the employees, are shown in the photographs below.

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Photograph: static sample positioned near asphalt spreaders



Photograph: static sample positioned near mixer truck

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7 RESULTS

7.1 The results are included in full, at the rear of this report in Appendix B. They are discussed in full in sections 8.2 to 8.4.

7.2 Time Weighted Average (8 Hr TWA)

Concentrations of the measured parameters are presented in the results section as $mg.m^{-3}$. This concentration is calculated by dividing the concentration analysed on the sampling media by the volume of air sampled during the exercise. This calculated concentration can then be used to compare to workplace exposure limits set out in HSE document EH40/2005.

If workers are exposed to the monitored components for a shorter (or longer) period than 8 hours then this can be calculated by multiplying the concentration ($mg.m^{-3}$) by the exposure time and then dividing this by the 8 hour reference period.

The occupational exposure in any 24 hour period can be treated as equivalent to a single uniform exposure for 8 hours – the 8 hour reference period. This allows comparison with WELs expressed as 8 hour TWA as quoted in EH40.

Assuming that no further exposure is received outside of this monitoring period then an 8 hr TWA may be calculated:-

$$\frac{C_1T_1 + C_2T_2 + \ldots C_nT_n}{8}$$

Where C_1 is the occupational exposure and T_1 is the associated exposure time in hours in any 24 hour period.

8 DISCUSSION / OBSERVATIONS

8.1 General

8.1.1 The code for the product spread on the floor during the site visit was 52170000flrg F1076/111/B. This was delivered at 230°C.

8.1.2 The process was carried out over three phases lasting approximately 50 to 55 minutes each. A period of approximately 45 to 50 minutes was left between each of the spreading phases to allow the mastic asphalt to harden. During these break periods the sampling pumps were stopped then restarted just before the commencement of the next phase. The process began around 08:35 and was completed by 13:00.

8.1.3 The first stage of the process began at around 08:35 with two employees involved with the spreading, three on the barrow and an additional employee releasing materials from the rear of the mixer. Hot asphalt was released into the barrows from the mixer, moved to the required area, tipped and spread. Sand from a barrow was released by hand onto the fresh asphalt and spread with a standard brush then with a heavier spreader. It is believed that the sand helps to

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dry the asphalt but also add a little grip to the surface. Fume was visible close to the process and at the rear of the mixer.



Photograph: sand added to surface of asphalt from barrow in first section

8.1.4 Once the first section was complete at 09:25, the area was left to cool then the middle steel section was removed before starting the next section at approximately 10:20.

8.1.5 Fume levels appeared to be higher during the second section, possibly due to the temperature of the asphalt increasing in the mixer lorry. The second section was completed at approximately 11:15 and the third section began around 12:05.



Photograph: Spreaders close to the process during second section works

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Photograph: fume visible close to the Spreaders during the third section works

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8.2 Personal and Static Samples – Bitumen/Asphalt Fume (Cyclohexane Extractable Material), (see Appendix B, Tables 1 and 2)

8.2.1 The results from the personal sample indicated that exposure to bitumen/asphalt fume (as cyclohexane extractable material) was below 50% of the HSE workplace exposure limit of 5 $mg.m^{-3}$ (8Hr TWA) for Asphalt, petroleum fumes (bitumen) for all personal samples.

8.2.2 The recorded concentrations from the personal sampling ranged from 1.23 $mg.m^{-3}$ for G Rogers, Barrowman to 2.15 $mg.m^{-3}$ for K Higgins, Spreader. Keith Higgins appeared to carry out spreading near the centre of the section, whereas Peter Higgins spent more time on the edge. This arrangement may have changed slightly during the spreading on the different sections so it is uncertain if positioning had influenced the result. It should be noted that the samples were switched off during break times so they represent exposure if work was continuous over an 8 hour period. Therefore this may represent a worst case scenario.

8.2.3 The results from the static sample positioned close to the mixer lorry operative were lower than the personal samples, possibly due to the sample being positioned outdoors. It should be noted that the results from static sampling should be used for guidance only as they may not truly represent personal exposures.

8.3 Personal and Static Samples – Polycyclic Aromatic Hydrocarbons (PAH), (see Appendix B, Tables 3 and 4)

8.3.1 The results from the personal and static PAH monitoring revealed that very few components were detected above the limit of detection, all of which were well below available workplace

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exposure limits. The now revoked American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 0.2 $mg.m^{-3}$ should be used for guidance only as there is no longer a recognisable exposure limit for total PAHs, and therefore exposures should be reduced to as is reasonably practicable. The ACGIH have set a separate TLV of 53 $mg.m^{-3}$ for naphthalene, which is not a true PAH

8.4 Static Samples – Volatile Organic Compounds (VOC) (see Appendix B, Tables 5 and 6)

8.4.1 Recorded airborne concentrations of all volatile organic compounds were below the analytical detection limit and therefore insignificant during the personal and static monitoring.

9 RECOMMENDATIONS

9.1 The results from the personal and static fume monitoring exercise indicated that all the measured parameters were below 50% of relevant HSE WELs or other guidance values. It should be noted that recorded bitumen/asphalt fume concentrations for employees carrying out spreading works were higher than the employee using the barrow, and the static sample positioned close to the rear of the mixer lorry. The highest recorded bitumen fume concentration of 2.15 $mg.m^{-3}$ was just below 50% of the HSE WEL of 5 $mg.m^{-3}$ for asphalt, petroleum fumes.

9.2 The eight principles of good practice for the control of exposure to substances hazardous to health are set out in Schedule 2A of The Control of Substances Hazardous to Health Regulations 2002 (as amended) and have been reproduced in 5.4.2. If employers apply the principles correctly, exposure should be below any relevant WEL. Control by personal protective equipment should only be used when other measures are not reasonably practicable.

9.3 In order to maintain low levels of exposure to asphalt fumes, employees should try to avoid being downwind of the fume source wherever possible. During indoor work, it is recommended that the mixer lorry should not be positioned inside the area. A natural flow of air should also be created in the area by ensuring doors are kept open. Any available mechanical ventilation, such as roof or wall fans should be utilised. If indoor work is required in a fairly enclosed space, a form of local exhaust ventilation should be used. This could simply be a large length of flexible hose/ducting attached to a fan which exhausts externally, away from employees and the general public (see photograph below for an example). The ducting should be fitted with a hood that can be easily moved close to the source of fume.

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Photograph: example of extraction system

9.4 Employees handling sand and limestone dust should do so with care to avoid generating elevated levels of dust. Crystalline silica is a known carcinogen and is present in sand.

9.5 Should employees request additional respiratory protection during either of the processes then a respirator with a combined organic gas/vapour and particulate filter should be used. RPE should only be worn by employees when exposed for brief periods to relatively high levels of fume.

9.6 To make sure that the selected RPE has the potential to provide adequate protection for individual wearers, the ACoPs supporting COSHH recommend face-fit testing of RPE, which incorporate a tight fitting face-piece. This will help to ensure that inadequately fitting face-pieces are not selected for use. An inadequate fit will significantly reduce the protection provided to the wearer.

9.7 Employees should continue to be made aware of the hazards associated with exposure to airborne dust and fume, and be trained in the correct use of any engineering control measures and RPE provided.

9.8 Employees should observe good personal hygiene to ensure that particulate and other hazardous components are not ingested. Eating and drinking should be confined to designated areas and operators encouraged to wash hands before taking breaks.

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10 REFERENCES

1. The Control of Substances Hazardous to Health (COSHH) Regulations, 2002 (as amended) Approved Code of Practice and Guidance; L5 (Sixth edition) Published 2013

2. HSE Guidance Notes: HSG173: Monitoring Strategies for Toxic Substances

3. MDHS 14/4: General methods for sampling and gravimetric analysis of respirable, thoracic and inhalable aerosols

4. EH 40: 2005 Workplace Exposure Limits

5. HPA Compendium of Chemical Hazards Polycyclic Aromatic Hydrocarbons. 2008 Version 1

6. MDHS 104 Volatile organic compounds in air

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APPENDIX A – METHODS

Process	**Air monitoring for Bitumen fume**
Analytical Method	Bitumen fume Determination
Reference Documentation	Bitumen fume concentration analysis, based on NIOSH method 5023, with cyclohexane extraction
Monitoring equipment / Serial Number / Calibration status	Personal sampling pumps, Casella Flow Detective S/No. 1791166, UKAS accredited calibration 20/12/2019
Flow Rate	2.0 ± 0.1 $l.min^{-1}$
Sampling Head	IOM total dust sample head (bitumen fume)
Sample Media	25 mm filters
Accreditation	Not accredited
Analysis Laboratory	SOCOTEC Bretby

Process	**Air monitoring for Volatile Organic Compounds (VOCs)**
Analytical Method	Solvent desorption and gas chromatography
Reference Documentation	SOCOTEC In house method (ENV/009) Determination of dust and organic vapours in the workplace or general atmosphere based on HSE method MDHS 104 – Volatile Organic Compounds in air.
Monitoring equipment / Serial Number / Calibration status	Personal sampling pumps, Casella Flow Detective S/No. 1791166, UKAS accredited calibration 20/12/2019
Flow Rate	0.15 – 0.40 $l.min^{-1}$
Sampling Head	Low flow sample tube holder
Sample Media	SKC Charcoal tube 226-09
Accreditation	Not accredited
Analysis Laboratory	SOCOTEC Bretby

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Process	**Air monitoring for Polycyclic Aromatic Hydrocarbons (PAHs)**
Analytical Method	Samples extracted in solvent and analysed by Gas Chromatography / Mass Spectrometry (GC/MS)
Reference Documentation	SOCOTEC In house method (ENV/009) Determination of dust and organic vapours in the workplace or general atmosphere. NIOSH method 5515 – PAHs
Monitoring equipment / Serial Number / Calibration status	Personal sampling pumps, Casella Flow Detective S/No. 1791166, UKAS accredited calibration 20/12/2019
Flow Rate	0.90 – 1.1 $l.min^{-1}$
Sampling Head	37 mm filter holder and PAH tube in series
Sample Media	37 mm filter and XAD 2 tube in series
Accreditation	Not accredited
Analysis Laboratory	SOCOTEC Bretby

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APPENDIX B – RESULTS

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Table 1: Personal Air Monitoring Results (8 Hour TWA) – Dust and Bitumen (Asphalt) Fume – 28/02/2020

Employee Name/Static	Activity/Area	Sample Head	Start Time	Stop Time	Duration (min)	Average Flow Rate ($l.min^{-1}$)	Air Volume (m^3)	Amount collected on filter µg	Airborne Concentration of Asphalt Fume [8hr TWA] ($mg.m^{-3}$)
Keith Higgins	Mastic Asphalt Spreader	IOM865	08:35 10:16 12:04	09:30 11:11 12:55	161	2.025	0.326	**700**	**2.15**
Peter Higgins	Mastic Asphalt Spreader	IOM199	08:38 10:17 12:04	09:30 11:11 12:58	160	2.024	0.324	**500**	**1.54**
Gary Rodgers	Barrow Man	IOM266	08:39 10:18 12:05	09:30 11:13 12:59	160	2.029	0.325	**400**	**1.23**

Note:: Airborne concentrations in $mg.m^{-3}$ have been calculated to take into account a shift length of 8 hours. Asphalt (bitumen fume) as cyclohexane extractable material results were below the analytical detection limits for all samples.

Substance	Long–term (8 hour) Exposure Limit ($mg.m^{-3}$)	Type of Limit
Asphalt, petroleum fume	5	HSE WEL

Result below 50% of WEL/Limit	Result above 50% of WEL/Limit	Result above WEL/Limit

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Table 2: Static Air Monitoring Results (8 Hour TWA) – Dust and Bitumen (Asphalt) Fume – 28/02/2020

Employee Name/Static	Activity/Area	Sample Head	Start Time	Stop Time	Duration (min)	Average Flow Rate ($l.min^{-1}$)	Air Volume (m^3)	Amount collected on filter µg	Airborne Concentration of Asphalt Fume [8hr TWA] ($mg.m^{-3}$)
Static	Near Mixer Lorry Operator	IOM865	08:42	09:30	151	2.04	0.308	100	**0.32**
			10:19	11:13					
			12:05	12:54					

Note: Colour coding for static samples should be for guidance only as they may not truly represent personal exposure in the area. Asphalt (bitumen fume) as cyclohexane extractable material results were below the analytical detection limits for all samples.

Substance	Long–term (8 hour) Exposure Limit ($mg.m^{-3}$)	Type of Limit
Asphalt, petroleum fume	5	HSE WEL

Result below 50% of WEL/Limit	Result above 50% of WEL/Limit	Result above WEL/Limit

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Table 3: Personal Air Monitoring Results (8 Hour TWA) – PAH – 28/02/2020

Sample No.	Employee Name/Static	Activity/Area	Start Time	Stop Time	Duration (min)	Average Flow Rate l/min	Volume Sampled m^3	Substance	Amount collected µg	Airborne Concentration of PAHs $mg.m^{-3}$
PAH1	Keith Higgins	Mastic Asphalt Spreader	08:35 10:16 12:04	09:30 11:11 12:55	161	0.982	0.158	Naphthalene	0.03	**0.0002**
								Total PAH (Excluding Napthalene)	0.29	**0.0018**

Table 4: Static Air Monitoring Results (8 Hour TWA) – PAH – 28/02/2020

Sample No.	Location		Start Time	Stop Time	Duration (min)	Average Flow Rate l/min	Volume Sampled m^3	Substance	Amount collected µg	Airborne Concentration of PAHs $mg.m^{-3}$
PAH2	Static	Near Spreading Area	08:37 10:17 12:04	09:30 11:12 13:00	164	1.005	0.165	Naphthalene	0.04	**0.0002**
								Total PAH (Excluding Napthalene)	0.11	**0.0007**
PAH3	Static	Near Mixer Lorry Operator	08:42 10:17 12:04	09:30 11:13 12:54	151	1.020	0.154	Naphthalene	0.05	**0.0003**
								Total PAH (Excluding Napthalene)	0.18	**0.0012**

Note: Colour coding for static samples should be for guidance only as they may not truly represent personal exposure in the area.
Exposure limits: Naphthalene **53 mg/m^3** (ACGIH USA limit);
Total PAH's (all species) **0.2 mg/m^3** ACGIH 1999, USA standard (Now Revoked)

Result Below 50% of Exposure Limit/Recommended Level	Result Above 50% of Exposure Limit/Recommended Level	Result above Exposure Limit/Recommended Level

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Table 5: Personal Air Monitoring Results (8 Hour TWA) – Volatile Organic Compounds – 28/02/2020

Sample No.	Employee Name/Static	Activity/Area	Start Time	Stop Time	Duration (min)	Average Flow Rate ($l.min^{-1}$)	Air Volume (m^3)	Total VOC collected on tube µg	Total VOC 8hr TWA ($mg.m^{-3}$)
VOC1	Keith Higgins	Mastic Asphalt Spreader	08:35 10:16 12:04	09:30 11:11 12:55	161	0.147	0.024	<20	**<1**

No specific VOCs were detected above the limit of detection

Table 6: Static Air Monitoring Results (8 Hour TWA) – Volatile Organic Compounds – 28/02/2020

Sample No.	Employee Name/Static	Activity/Area	Start Time	Stop Time	Duration (min)	Average Flow Rate ($l.min^{-1}$)	Air Volume (m^3)	Total VOC collected on tube µg	Total VOC 8hr TWA ($mg.m^{-3}$)
VOC2	Static	Near Spreading Area	08:37 10:17 12:04	09:30 11:12 13:00	164	0.147	0.024	<20	**<1**
VOC3	Static	Near Mixer Lorry Operator	08:42 10:17 12:04	09:30 11:13 12:54	151	0.149	0.022	<20	**<1**

Colour coding for static samples should be for guidance only as they may not truly represent personal exposure in the area. No specific VOCs were detected above the limit of detection

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APPENDIX C – ANALYSIS REPORT

(9 pages)

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TEST REPORT ASC/43669

Customer:	Marc Cotton SOCOTEC Environmental Group Derwent Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Testing Facility:	Specialist Chemistry SOCOTEC Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Purchase Order Number:	141643
Date Samples Received:	02 March 2020
Condition of Samples:	Ambient and Satisfactory
Approved by:	
Approver's name:	Borislav Lazarov
Job Title:	Analyst
Test Report Date:	13 March 2020

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Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
3	XAD-2 Tubes and PTFE Filters	IHM	**IN HOUSE METHOD** – Samples were extracted in solvent and analysed by Gas Chromatography Mass Spectrometry (GC/MS) against a calibration of the EPA16 suite of Polycyclic Aromatic Hydrocarbons (PAHs).

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Results

Table 1: PAHs

Units		Total ng			Total ng			Total ng		
Method ID		IHM			IHM			IHM		
UKAS		NO			NO			NO		
Customer Sample Reference		141643/PAH1			141643/PAH2			141643/PAH3		
Laboratory Sample Reference		ASC/43669.001			ASC/43669.002			ASC/43669.003		
Analyte	**LOD (ng)**	**Front**	**Back**	**Filter**	**Front**	**Back**	**Filter**	**Front**	**Back**	**Filter**
Naphthalene	10	30	<10	<10	40	<10	<10	50	<10	<10
Acenaphthylene	10	<10	<10	10	<10	<10	<10	<10	<10	<10
Acenaphthene	10	10	<10	<10	10	<10	<10	20	<10	<10
Fluorene	10	40	<10	<10	30	<10	<10	50	<10	<10
Phenanthrene	10	70	<10	20	70	<10	<10	90	<10	10
Anthracene	10	10	<10	<10	<10	<10	<10	10	<10	<10
Fluoranthene	10	<10	<10	10	<10	<10	<10	<10	<10	<10
Pyrene	10	<10	<10	60	<10	<10	<10	<10	<10	<10
Benzo (A) Anthracene	10	<10	<10	40	<10	<10	<10	<10	<10	<10
Chrysene	10	<10	<10	20	<10	<10	<10	<10	<10	<10
Benzo (B) Fluoranthene	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo (K) Fluoranthene	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo (A) Pyrene	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno (1,2,3-CD) Pyrene	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenzo (A,H) Anthracene	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo (GHI) Perylene	10	<10	<10	<10	<10	<10	<10	<10	<10	<10

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END OF TEST REPORT

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TEST REPORT ASC/43670

Customer:	Mark Cotton SOCOTEC Environmental Group Derwent Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Testing Facility:	Specialist Chemistry SOCOTEC Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Purchase Order Number:	141643
Date Samples Received:	02 March 2020
Condition of Samples:	Ambient and Satisfactory
Approved by:	
Approver's name:	Darren Clarke
Job Title:	Senior Analyst
Test Report Date:	13 March 2020

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Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
3	Charcoal Sorbent Tubes	IHM	**IN HOUSE METHOD -** Samples were extracted in a desorption solution and analysed for VOCs by GC/MS. The top ten most abundant analytes were tentatively identified by mass spectral data and semi-quantified against the response of the internal standard (Tetradecane).

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Results

Table 1:

Laboratory Reference	ASC/43670.001 (front)	ASC/43670.001 (back)
Customer Reference	141643/VOC1	
Method ID	IHM	
Instrument Limit of Detection	20	10
UKAS	NO	
Units	µg	
Tentatively Identified Compounds		
VOCs	<20	<10
No VOCs above the detection limit were present		

Table 2:

Laboratory Reference	ASC/43670.002 (front)	ASC/43670.002 (back)
Customer Reference	141643/VOC2	
Method ID	IHM	
Instrument Limit of Detection	20	10
UKAS	NO	
Units	µg	
Tentatively Identified Compounds		
VOCs	<20	<10
No VOCs above the detection limit were present		

Table 3:

Laboratory Reference	ASC/43670.003 (front)	ASC/43670.003 (back)
Customer Reference	141643/VOC3	
Method ID	IHM	
Instrument Limit of Detection	20	10
UKAS	NO	
Units	µg	
Tentatively Identified Compounds		
VOCs	<20	<10
No VOCs above the detection limit were present		

END OF TEST REPORT

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ASC Report Template, V4, Jan 2019

TEST REPORT ASC/43763

Customer:	Helen Lathm SOCOTEC SHOE Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Testing Facility:	Specialist Chemistry SOCOTEC Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Purchase Order Number:	34383
Date Samples Received:	09 March 2020
Condition of Samples:	Ambient and Satisfactory
Authored by:	Nicola Baker
Approved by:	
Approver's name:	Darren Clarke
Job Title:	Senior Analyst
Test Report Date:	20 March 2020

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Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
4	Quartz Filters	IHM	**IHM** – The filters were extracted in a known amount of Cyclohexane. The amount of extracted material was calculated gravimetrically.

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Results

Table 1:

	Units	Total µg
	Method ID (ASC/SOP/xxx)	IHM
	Method Limit of Detection	100
	UKAS	NO
Customer Sample Reference	**Laboratory Sample Reference**	Cyclohexane Extractable Material
177050	ASC/43763.001	700
177051	ASC/43763.002	500
177052	ASC/4373.003	<100
177053	ASC/43763.004	400

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