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OCCUPATIONAL EXPOSURE TO AIRBORNE CONTAMINANTS IN WORKING ENVIRONMENT

2009

ABSTRACT

The occupational exposures to airborne contaminates during welding at welding bays were carried out on22nd October by Alcontrol and general workshop areas on 5 November by ADGS Ltd.

This is the first time monitoring has been carried out at these premises as PcP Gratings had been previously informed that since the new extraction units were installed along with the existing roof extraction units such monitoring was not required.

PcP Gratings are a proactive company with regards to the health and safety of their employees and take their responsibilities very seriously when it comes to carrying out risk assessments and complying with regulations. As soon as the company were informed that tests were required they put in place the means to comply.

All individual metal species monitored were within their Workplace Exposure Limit (WELs) and it was pleasing to note that in the general workshop area all tests for Carbon Monoxide, Nitrous Fumes, Ozone were below detectable levels.

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1.0 INTRODUCTION

PcP gratings Ltd have carried out an assessment of the occupational exposure to airborne contaminants in the general workshop and welding bays. This was carried out in two parts. Firstly by measuring the possible contaminates in welding bays of; Welding Fume Exposure, Iron Oxide[2] Exposure, Manganese[3] Exposure, Chromium VI Exposure and Nickel Exposure. This specialist monitoring was carried out on behalf of PcP Gratings Ltd by ALcontrol On-Site Services of Birmingham.

General workshop monitoring was carried out by using Dräger tubes activated by hand pump. This was carried out by ADGS Ltd. On advice from Dräger the following tube tests were carried out to monitor levels of; Carbon Monoxide, Nitrous Fume, Oxygen Levels, Ozone.

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

2.0 OBSERVATIONS

PcP Gratings Ltd produce floor gratings, stair treads, access ramps for a wide variety of customers at the Four Ashes site.

The general layout of the workshop gives over of the available floor space to material storage. Besides the welding bays there are associated equipment used in the manufacture of gratings including; cross cut saw, horizontal band saw, small presses.

Welfare facilities for staff are situated at the side of the workshop, office accommodation is situated in the adjoining office building.

The majority of welding performed is MIG welding on mild steel and this was predominate during both monitoring visits. On occasions welding can be performed on stainless steel, galvanised steel and aluminium.

All workshop operatives are issued with the appropriate Personal Protective Equipment to carry out their tasks in a safe manner. Each welding bay also has a Nederman, damper controlled, with adjustable captor hood extraction unit for localised work. This is connected to an external centrifugal fan with stack release The general workshop area has roof mounted extraction units that are on throughout the working day. All work is carried out on a standard day shift.

The workshop contains seven welding bays, on the day of the assessment carried out by Alcontrol not all bays were in use. The following report contains a random selection of three of the bays used for welding.

3.0 MONITORING

During the monitoring carried out by Alcontrol, the personal exposure to welding fume in welding bays was carried out using Gillian Provalve3 sampling pumps to draw air at 2lts per minute through pre-weighted 25mm GFA filters in an IOM sampling head located in the breathing zone. Gravimetric analysis of the filters was carried out in accordance with MDHS 14/3 and subsequent analysis for metal species by ICP in accordance with MDHS 99. Colormetric indicator tubes were also used to determine gaseous components of Ozone and Nitrogen Dioxide in welding bays.

The general air sampling of the workshop was carried out by using Dräger Tube testing kits. Sampling test tubes were placed in the Accuro hand pump. Each individual test required a specific number of pump stokes, example Carbon Monoxide tests required 1 stroke of the pump to obtain reading. Readings of all tests undertaken were then corrected by making adjustment by using the formula factor F = 1013 / Actual Atmospheric Pressure. The Atmospheric Pressure obtained from the Weather Centre for the West Midland gave a reading of 995 therefore Factor F = 1.018

4.0 LEGISLATION and GUIDANCE

The COSHH Regulations 2002 (as amended) requires employers to carry out a suitable and sufficient assessment of the risk to the 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 controls.

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 ACOP are set out below for your reference.

Principle Reference	Principle	ACOP/Guidance Reference
	Good practice in 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 ranked in order: the first is not more important than the last, although there is logic to their overall presentation	Paragraph 298
A	Design and operate processes and activate to minimise emission, release and spread of substances hazardous to health.	Paragraphs 299-305
B	Take into account all relevant routes of exposure (Inhalation, Skin absorption and Ingestion) when developing control measures	Paragraphs 306-317
C	Control exposure by methods that are proportionate to the health risk	Paragraphs 318-323
D	Chose the most effective and reliable control options, which minimise the escape and spread of substances hazardous to health.	Paragraphs 324-335
E	When adequate control of exposure cannot be achieved by other means, provide, in combination with other control measures suitable personal protective equipment.	Paragraphs 336-345
F	Check and review regularly, all elements of control measures for their continuing effectiveness.	Paragraphs 346-350
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 risk	Paragraphs 351-355
H	Ensure that the introduction of control measures does not increase the overall risk to health and safety	Paragraphs 356-357

Under COSHH Regulations a single type of occupational exposure limit is specified for substances hazardous by inhalation, this is the Workplace Exposure Limit (WELs). 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 a reference period.

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.

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)

5.0 WELDING FUME

Welding fume consists of a mixture of airborne gases and fine particles which if inhaled or swallowed may result in risks to health. The amount of risk will depend on: The composition of the fume, The quantity of fume in the air breathed, The length of exposure to the fume.

The main health effects of exposure to welding fume are:
Irritation of the Respiratory Tract. Gases or fine particles can cause dryness of the throat, tickling, coughing, difficulty with breathing and tightness in the chest.

Metal Fume Fever The commonest cause of metal fume fever occurs when welding galvanised steel. The inhalation of many freshly formed metallic oxides, such as those of cadmium, zinc and copper may lead to acute flu like illness termed metal fume fever. With the exception of exposure to cadmium fume serious complications are rare.

Systematic Poisoning This can result from the inhalation or swallowing of substances contained in welding fume such as lead, hexavalent chromium, fluorides, barium and cadmium. The presence of these substances in the welding fume depends on the welding process being used and the material being welded.

Long Term or Chronic Effects The inhalation of welding fume can lead to the development of benign X ray changes referred to as Siderosis. It is a subject of current concern that welders have an increased risk of developing cancer as certain constituents of some welding fumes such as hexavalent chromium and nickel may be carcinogenic.

As yet no Workplace Exposure Limit (WEL) has currently been set for general welding fume. Although historically an Occupational Exposure Standard was set at 5mg,m^{-3}, however individual fume components have been assigned WELs.

Substance	8 hour TWA mg,m^{-3},	15 min STEL mg,m^{-3},	Risk phrases And notations
Iron Oxide	5	10	-
Manganese	0.5	-	-
Chromium VI	0.05	-	Carc, Sen. BMGV
Nickel	0.5	-	Carc, Sk
Ozone	-	0.2ppm	-
Nitrogen Oxide	3ppm	5ppm	TLV

KEY:

Sk	Can be absorbed through the skin
Sen	Capable of causing occupational asthma
Carc	Capable of causing cancer and/or genetic damage
BMGV	Biological Monitoring Guidance Values are listed in Table 2 of EH40
TLV	Threshold Limit Value set by American Conference Industry Hygienist (ACGIH)

6.0 RESULTS

Alcontrol welding bay results.

Samples were taken in Bays 2,5,6 Concentrations of welding fume and metal species monitored are as follows

Bay 2

Activity	MIG welding mild steel gantry grating panels.	
Welding Fume Exposure	**mg,m^{-3}** 5.3	**WEL** N/A
Iron Oxide Exposure	**mg,m^{-3}** 2.6	**WEL** 52%
Manganese Exposure	**mg,m^{-3}** 0.16	**WEL** 32%
Chromium VI	**mg,m^{-3}** 0.006	**WEL** 12%
Nickel Exposure	**mg,m^{-3}** 0.006	**WEL** 1%

Bay 5

Activity	MIG welding floor grating panels.	
Welding Fume Exposure	**mg,m^{-3}** 4.2	**WEL** N/A
Iron Oxide Exposure	**mg,m^{-3}** 2.0	**WEL** 40%
Manganese Exposure	**mg,m^{-3}** 0.24	**WEL** 48%
Chromium VI	**mg,m^{-3}** 0.003	**WEL** 6%
Nickel Exposure	**mg,m^{-3}** <d.i.	**WEL** <1%

Bay 6

Activity	MIG welding mild steel gantry grating panels.	
Welding Fume Exposure	**mg,m^{-3}** 7.5	**WEL** N/A
Iron Oxide Exposure	**mg,m^{-3}** 3.3	**WEL** 66%
Manganese Exposure	**mg,m^{-3}** 0.48	**WEL** 96%
Chromium VI	**mg,m^{-3}** <d.i.	**WEL** <6%
Nickel Exposure	**mg,m^{-3}** <d.i.	**WEL** <1%

KEY
No WEL set for total welding fume.
WEL for Iron Oxide = 5 mg,m^{-3} 8 hour TWA
WEL for Manganese = 0.5 mg,m^{-3} 8 hour TWA
WEL for ChromiumVI =0.05 mg,m^{-3} 8 hour TWA
WEL for Nickel = 0.5 mg,m^{-3} 8 hour TWA
< d.i. = Below the limit of detection.

Results are averages over the sampling period of two hours, but have been compared directly with the 8 hour TWA WEL as they are representative of the tasks performed.

ADGS Air Sampling of General Workshop

Air samples were taken at three points within the workshop, Outside Bay 2, Outside employees rest room and by Cross cut saw in middle of workshop. At each sampling station four samples were taken to identify the following particulates. Carbon Monoxide, Nitrous Fumes, Oxygen, Ozone.

Measurement and Evaluation

Temperature 16°C
Atmospheric Pressure 995

Readings of all tests undertaken were then corrected by making adjustment by using the formula factor F = 1013 / Actual Atmospheric Pressure. The Atmospheric Pressure obtained from the Weather Centre for the West Midland gave a reading of 995 therefore
Factor F = 1013 / 995 = 1.018
Result = factor F x Tube calibration reading

Outside Bay 2

Carbon Dioxide

Measuring range	10 – 250ppm
Number of Pump Strokes	1
Time duration	80 seconds
Colour change	White → Brownish-Green
Result	No change of colour,Below limit of detection

Nitrous Fume

Measuring range	5 - 100ppm
Number of Pump Strokes	5
Time duration	60 seconds
Colour change	Greyish - Green → Bluish - Green
Result	No change of colour, Below limit of detection

Ozone

Measuring range	5 - 100ppm
Number of Pump Strokes	5
Time duration	60 seconds
Colour change	Greyish - Green → Bluish - Green
Result	No change of colour, Below limit of detection

Oxygen

Measuring range	5 – 23 Vol-%
Number of Pump Strokes	1
Time duration	60 seconds
Colour change	Blue-Black → White
Result	Tube reading 21 x Factor F 1.018 = 21.37%

Outside Employees Rest Room

Carbon Dioxide

Measuring range	10 – 250ppm
Number of Pump Strokes	1
Time duration	80 seconds
Colour change	White → Brownish-Green
Result	No change of colour,Below limit of detection

Nitrous Fume

Measuring range	5 - 100ppm
Number of Pump Strokes	5
Time duration	60 seconds
Colour change	Greyish - Green → Bluish - Green
Result	No change of colour, Below limit of detection

Ozone

Measuring range	5 - 100ppm
Number of Pump Strokes	5
Time duration	60 seconds
Colour change	Greyish - Green → Bluish - Green
Result	No change of colour, Below limit of detection

Oxygen

Measuring range	5 – 23 Vol-%
Number of Pump Strokes	1
Time duration	60 seconds
Colour change	Blue-Black → White
Result	Tube reading 22 x Factor F 1.018 = 22.39%

By Cross Cut Saw

Carbon Dioxide

Measuring range	10 – 250ppm
Number of Pump Strokes	1
Time duration	80 seconds
Colour change	White → Brownish-Green
Result	No change of colour,Below limit of detection

Nitrous Fume

Measuring range	5 - 100ppm
Number of Pump Strokes	5
Time duration	60 seconds
Colour change	Greyish - Green → Bluish - Green
Result	No change of colour, Below limit of detection

Ozone

Measuring range	5 - 100ppm
Number of Pump Strokes	5
Time duration	60 seconds
Colour change	Greyish - Green → Bluish - Green
Result	No change of colour, Below limit of detection

Oxygen

Measuring range	5 – 23 Vol-%
Number of Pump Strokes	1
Time duration	60 seconds
Colour change	Blue-Black → White
Result	Tube reading 22 x Factor F 1.018 = 22.39%

7 CONCLUSION and RECOMMENDATIONS

Conclusion

It would appear that PcP Gratings are a proactive company with regards to the health and safety of their employees and take their responsibilities very seriously when it comes to carrying out risk assessments and complying with regulations.

As mention earlier in the report there are no current Workplace Exposure Limits (WEL) for total welding fume and can only be compared to the Occupational Exposure Standard of 5mg,m^{-3}. Against this standard welding fume exposure could be considered on the high side by some observers. All other individual metal species were found to be within their WEL limits.

All employees are issued with the appropriate personal protective equipment to carry out their work in a safe manner. It is however important that all employees use their equipment correctly and inform management immediately if replacement equipment is required.

Recommendations

Refresher training on the correct use personal protective equipment.

Management to ensure that appropriate personal protective equipment is used at all times.

Employees to be reminded of their duty to use all personal protected equipment provided to carry out the work in a safe manner.

Employees to use at all appropriate times the Nederman extraction unit when welding.

If it is impractical to use Nederman extraction for a particular piece of work then respiratory protection needs to be used. The following types could be used.
Positive pressure air fed filtering back pack connected to welding visor. All in one filtering visor (could be used with hand held welding shield)
Disposable dust mask (at least FFP2 type).