Health & Safety Guidance

Health & Safety

Controlling hazardous substances in foundries

Introduction

In 2017 the Health and Safety Executive (HSE) conducted research to identify benchmarks of exposure control for the foundry industry which could be used to develop examples of good control practice, and to review and update existing guidance. The specific objectives were:

- To visit a selection of foundries undertaking high health risk processes to measure worker exposure levels to key hazardous substances and to identify good control practice
- To establish a reference baseline exposure dataset and identify controls that are technically achievable and reasonably practicable to implement, based on the measurements and observations.
- To use these examples of good control practice to develop task-specific control benchmarks

Foundry workers are potentially exposed to a wide range of substances hazardous to health including: respirable crystalline silica (RCS) and other mineral dusts, metal fume and dust, polycyclic aromatic hydrocarbons (PAHs), welding fumes, oil mist, aromatic amines, benzene, binding agents (organic chemicals, tar, coal) and other constituents of ferrous foundry particulate (FFP) all of which can cause occupational diseases such as cancer and chronic obstructive pulmonary disease (COPD).

This project was developed by CHASAC (Castings Health and Safety Advisory Committee), a tripartite partnership working group, on which Unite is represented, to target key health issues in foundries.

Key Messages

Exposure control options across the numerous foundry processes and tasks are significantly different and not 'one size fits all'. Common issues have been identified and the key messages are:

- All stakeholders at all levels, including the shop floor, trade unions, management and trade associations have been fully engaged with this work. This was a key factor in bringing about workplace improvements. For the wider industry to achieve a similar success it will also require positive engagement at all levels.
- Reasonably practicable measures exist that can ensure adequate control of exposure for all the foundry processes examined in this project, where there is the potential for worker exposure to hazardous substances that can cause cancer and/or serious respiratory disease.
- The correct use and maintenance of engineering controls and personal protective equipment (PPE) is critical to the success of any control strategy. There is scope for significant improvements in this area.
- Examples of good practice exist across the sector, but more could be done to share and adopt this good practice in a consistent way to ensure that exposures are controlled to as low as reasonably practicable.
- Benchmarks of control can be identified for specific foundry tasks and selected substances, which, if followed, should adequately control exposure to hazardous substances and reduce the future burden of ill-health in the industry.

Table 1. Findings, outcomes and recommendations

	Finding	Outcome	Recommendations
1	Manual mould making with sand was found to cause significant exposure to inhalable dust. This was not expected as the sand / resin / catalyst mixture was typically damp.	Compressed air was used to blow loose sand off moulds at all foundries carrying out manual mould making. The high velocity of the compressed air would re-suspend this dust into the airborne phase. The position of the dispense point of the mixer was such that the sand mixture often passed downwards through the workers' breathing zone.	Other methods to remove the loose sand should be considered if possible. Some foundries have investigated the use of a vacuum but found it to be inefficient. Identified benchmark control standards are: • Provide engineering controls such as enclosure or extraction for compressed air blow down of moulds • Ensure that the dispense point of the mixer is as close as possible to the mould box • Dispense the sand mixture at as slow a speed as practicable to reduce dust generation • Use respiratory protective equipment (RPE) to control exposure to particulate as a last resort
2	Carbon monoxide was identified as a component of fume released at casting, cooling and knockout.	There is the potential for workers in the vicinity of these areas to be exposed to carbon monoxide.	Local exhaust ventilation (LEV) may not be practicable at all foundries; hence the identified benchmark standard of control for this exposure would be to provide effective general ventilation to dilute levels of carbon monoxide.
3	Employers used consultants for exposure monitoring. HSE does not consider some of the monitoring methods used as valid.	Employers were using potentially unreliable data in their risk assessments.	When commissioning exposure monitoring, employers should request that inhalable FFP / dust is sampled using validated methods.
4	Employers used consultants to carry out LEV thorough examination and test (TExT). Some of these reports were unsuitable and could not be deemed as a TExT.	The businesses concerned did not have a TExT in accordance with Regulation 9 of the Control of Substances Hazardous to Health (COSHH) Regulations.	Employers should ensure that the consultant they employ is aware that a TExT (and report) in accordance with Regulation 9 is required. The benchmark standard of control would be to ensure that they are competent to provide that service.
5	A previous HSE investigation found benzene exposures at one foundry greater than the workplace exposure limit (WEL) during casting when using benzene sulphonic acid (BSA) catalyst. A re-visit carried out as part of this study after the company had substituted the BSA for xylene sulphonic (XSA) found that benzene exposures were significantly reduced.	This was a successful example of substitution.	Replacing BSA with another catalyst that does not contain benzene must be considered (as a benchmark standard of control) where reasonably practicable. It is however appreciated that this is not straightforward and care needs to be taken so the quality of the casting is not affected.
6	LEV design could be improved in most foundries. Examples of incorrect LEV design at some foundries included poor containment or capture (dependent upon the type of hood).	Some systems could be re-designed with little effort (such as adjustments to booths) and some others had more fundamental design issues, such as the incorrect type of hood used in the first place.	When choosing LEV, the energy of the work process and the size of the contaminant cloud are amongst the factors that should be taken into consideration.

7	LEV maintenance was not carried out on a regular basis at all foundries.	Not all employers carried out in-house maintenance checks and damaged LEV was noted at most. The latter will affect system performance and in some cases lead to additional exposures.	Foundries are a harsh environment for LEV systems. The benchmark standard of control is to carry out regular maintenance and visual checks for wear and tear to keep them performing as they should
8	There were deficiencies in PPE programmes at some foundries.	Incorrect gloves used when moulding, core making and knockout which would not offer sufficient protection against binder chemicals, some of which are known skin sensitisers. Workers wore their own clothes in some foundries. This can lead to contamination being spread away from the workplace. Gloves and RPE were removed frequently throughout the shift and often left on workbenches when not in use. Five employers had no formal maintenance regimes in place for re-usable RPE. At two foundries this included breathing air quality checking for air fed RPE.	Employers should ensure that the PPE chosen offers adequate protection for the task, is properly stored to prevent contamination and is well maintained. Face-fitting needs to be carried out for tight fitting RPE. The benchmark standards of control for PPE are task specific.
9	Not all workers wore available PPE, some wore it incorrectly.	The incorrect use of PPE highlighted a lack of training and / or supervision. One employer acknowledged that refresher training could be beneficial.	Employers should review their training provision so they meet their statutory duties under the COSHH Regulations 2002 (as amended)1, to provide employees with training sufficient enough for them to know how and when to use control measures.
10	Incorrect use of LEV included not moving captor hoods close to the workpiece, standing between the extraction and the workpiece and using fans in the vicinity of the extraction.	The incorrect use of LEV highlighted a lack of training and / or supervision	
11	Exposures from some automated processes were not significantly different to those from corresponding manual processes. However this may be attributed to poor maintenance.	Automation of a process removes operator contact (and also reduces the number of workers exposed). Automation of some processes was rare (moulding, fettling), whereas for some others (shotblasting and core making) automation was common. Automation can, for some tasks, reduce exposure to hazardous substances, however, instances of poor maintenance were observed which lead to exposures greater than existing exposure limits.	Employers should ensure that they have procedures in place to ensure good maintenance of automated systems to prevent exposure to the operators. being spread away from the workplace.

From “Exposure to Substances Hazardous to Health in Foundries” Research Report 1115 HSE 2017
http://www.hse.gov.uk/research/rrpdf/rr1115.pdf

HSE's Conclusion

This work has identified benchmarks of control for specific foundry tasks and selected substances, which, if followed, should adequately control exposure to hazardous substances and reduce the future burden of ill-health in the industry. Exposure to a range of substances hazardous to health occurs in foundries. The risk management approach should take into consideration the whole range of substances that can give rise to long latency health risks and all routes of exposure.

This project has helped HSE and the foundry industry to obtain a better understanding of occupational exposure to substances in the foundry process that can cause cancer and respiratory disease. There are some work tasks that the foundry industry has long recognised as having health risks, such as furnace work, knockout, fettling and shotblasting. However this study has highlighted other sources of inhalation exposure to dusts and RCS (compressed air blow down and position of dispense point, both in mould making), and potential dermal exposure to chemicals, including sensitisers (core making).

Compressed air should not be used to blow down loose sand on moulds without adequate control. Exposures to manganese greater than the WEL were measured. As the majority of these elevated exposures were from workers at a foundry casting manganese steel, it can be assumed that the higher the manganese content the greater the potential for exposure. This is especially important for finishing activities such as fettling and welding.

There is the potential for workers in the vicinity of casting and cooling to be exposed to CarbonMonoxide. Where BSA is used in the binder system, benzene exposures can be significantly reduced by switching to XSA. This is not a simple substitution as preparatory work needs to be carried out to ensure that the correct mix is used so as not to affect the quality of the casting.

The importance of LEV design, the different hood types (and their limitations) and maintenance were not always fully understood when purchasing and using LEV. A better awareness would ensure that the correct LEV is designed, purchased, installed, commissioned, maintained, used and tested as intended in order to be an effective control.

In some cases consultants (employed by the foundries) were not supplying a compliant TExT (Regulation 9 of COSHH). A number of air sampling reports also contained inhalable FFP / dust measurements that were not collected using validated measurement methodology.

Dry sweeping was carried out at most foundries. This dust can contain RCS and metals from foundry feedstock. This task was the cause of an exposure to lead greater than the OEL. Dry sweeping re-suspends settled dust into the airborne phase. Dry sweeping should not be allowed and, instead, vacuum equipment to dust class M (medium hazard) classification should be used.

Whilst most foundries had acted upon their consultant's recommendations in exposure monitoring reports, the findings of these reports were not always clearly linked to risk assessment and ongoing reviews of control efficacy.

Advice to Unite Reps

- Reps should ensure that foundry employers are aware of the HSE research
- Reps should check that foundry employers have conducted risk assessments in line with the findings of the HSE research
- Reps should check that employers have implemented all relevant recommendations arising from the HSE research report