1 Chemical agents by sector affected

1.1 Chemical agents by sector affected

As shown in the table below, there are a number of sectors that are affected by more than one of the chemical agents being considered by this study. The use of the relevant chemical agents in the sectors are considered in more detail to determine whether they would be subjected to a heavier burden should the OELs for these chemical agents be lowered in the future.

Table 1-1: Chemical agent by sector affected

Sector	Arsenic	Beryllium	Cadmium	Formaldehyde	Chromium (VI)	MOCA
Manufacture of glass or glass products	X	X	X			
Manufacture of chemicals and chemical products	X		X	X		
Manufacture of basic metals/foundries	X	X	X			
Copper production	*X*	*X*	*X*			
Zinc production	*X*		*X*			
Other non-ferrous metals	*X*	*X*				
Ferrous metal	*X*	*X*				
Aluminium		X				
Refining cadmium			X			
Manufacture of fabricated metal products				X	X	
Manufacture of transportation		X	X	X	X	
Manufacture of electronic equipment	X	X	X	X		
Manufacture of medical devices		X				
Manufacture of construction products		X	X	X		
Manufacture of textiles				X		
Manufacture leather				X		
Manufacture of wood and wood products	X (legacy)			X		
Manufacture of paper and paper products				X		
Manufacture of pharmaceutical products and preparations				X		
Manufacture of rubber and plastic products				X		X
Manufacture of furniture				X		

Table 1-1: Chemical agent by sector affected						
Sector	**Arsenic**	**Beryllium**	**Cadmium**	**Formaldehyde**	**Chromium (VI)**	**MOCA**
Welding, thermal cutting and similar processes	X				X	
Mining sector	X		X			
Recycling activities	X	X	X			
Laboratory use, inc veterinary activities	X	X		X		X
Food preservatives				X		
Power sector	X					
Taxidermists/preservators	X (legacy)			X		

1.1.1 Manufacture of basic metals/foundries

As three of the six chemical agents are metals, arsenic, beryllium and cadmium, there are some similarities with regard to work exposure as part of their production processes and applications.

The manufacture of basic metals, or foundries, is a sector that has the potential to be affected by lower OELs for a number of the chemical agents, specifically arsenic, beryllium and cadmium. Exposure to these chemical agents can occur during several processes involved in basic metal production:

- Primary production: extraction of the metals from the ore, as well as being present as contaminants in other metal ores;
- Secondary production: chemical agents may be present as alloys or impurities in recycled material, for example waste electrical and electronic equipment (WEEE); and
- Production and casting of alloys.

These processes are relevant for a number of non-ferrous metals such as zinc, copper, lead, and ferrous metals. The level of exposure is directly linked to the metal, for example, exposure to arsenic is higher for copper than other non-ferrous metals, as the arsenic content of some ores, such as lead and zinc, is generally lower.

It would be expected that the foundries would be involved with a range of non-ferrous and ferrous metals and as such experience a heavier burden if arsenic, beryllium and cadmium OELs were lowered.

1.1.2 Welding, thermal cutting and similar processes

Following on from the production process, whether this is primary, secondary or alloys, the resulting metal products may be subject to welding, thermal cutting and similar processes, which are necessary for their transformation or incorporation into the final end-product. However, exposure through such activities is predominantly an issue for activities involving metals containing chromium (high alloy steels). Worker exposure in relation to the other chemical agents is considered to be minimal. The vast majority of welding companies are SMEs (DVS, 2017, pers. communication; HSE, 2010).

1.1.3 Manufacture of glass or glass products

The production of glass is a major application for arsenic compounds, the most common being arsenic acid and diarsenic trioxide, which are used as fining agents in the production of glass. According to information from industry, arsenic compounds are used for the manufacture of optical glasses, glass-ceramics (e.g. for glass ceramic hobs), pharmaceutical glasses, and display glass. Beryllium is used in the production of specialist glass products, including porcelain electrical supply and motor vehicle brake systems. Cadmium, in the form cadmium carbonate, is used in the production of frit. These are specialist glasses, and it may be the case that specialist glass manufacturing companies use more than one of the chemical agents in their production processes. Such companies are more likely to be small and medium sized enterprises. As such, lowering the OEL for these chemical agents could place a heavier burden on specialist companies in the glass sector.

1.1.4 Manufacture of chemicals and chemical products

Arsenic, cadmium and formaldehyde are known to be used in the manufacture of chemicals and chemical products. For example, arsenic compounds are used in the production of other arsenic

chemicals and ultra-pure arsenic metal (ECHA, 2016). Available information indicates that occupational exposure to arsenic could potentially take place when sulphuric acid is produced for use in the non-ferrous metal sector, in particular in the copper sector. Cadmium is mechanically or chemically transformed into specialised compounds, mainly for the battery, PV panels and pigments sectors. Formaldehyde is used to make a number of chemical products, notably:

- Fertilisers
- Methylene dianiline (MDA) and diphenylmethane diisocyanate (MDI), (MDA is used in the manufacture of MDI which is used in insulation foams, paints and coatings, adhesives for wood panels, automotive seats, bedding and mattresses),
- Paints, varnishes and similar coatings, printing inks and mastics
- Soaps and detergents, cleaning and polishing preparations, perfumes and toilet preparations
- Explosives

Given the range of products which the chemical agents are used to manufacture it is possible that some manufacturers will manufacture more than one of the affected products and be more severely impacted by the lowering of OELs. However, it is also possible that companies will specialise in a particular type of products and only be affected by one of the chemical agents.

1.1.5 Manufacture of transportation equipment

Beryllium, cadmium and formaldehyde are all important for the manufacture of components for transportation equipment, such as airbags, ABS, bushings and bearings in aircraft landing gear, surface treatment for connectors and fasteners, power steering and electronic control systems, wheels, and anti-lock brakes. As such, companies involved in the manufacture of components for transportation equipment are likely to experience a heavier burden should the OELs for beryllium, cadmium and formaldehyde be lowered.

1.1.6 Manufacture of electronic equipment

Arsenic, beryllium and cadmium are all used as specialist metals or alloys in a wide range of electrical and electronic components such as semiconductors, copper foils, batteries, electrical connectors and printed circuit boards. Polyoxymethylene resins from formaldehyde are also used in the manufacture of electrical and electronic appliance parts (moulding). The greatest risk of exposure is linked to the manufacturing of the components rather than from working with completed components. Manufacturers of electronic components, may therefore be affected to a greater degree by the lowering of the OELs for these chemical agents.

1.1.7 Construction products

Construction products can contain several of the chemical agents of interest. Formaldehyde based foams (urea-formaldehyde and phenol formaldehyde) are used as building materials, insulator materials, and can also be used as an adhesive in mineral wools which have applications as thermal insulators. Cadmium is used in cement and clinker production. However, considering known cases, it is most likely that the construction product manufacturers would only manufacture one of these products.

1.1.8 Recycling activities

A number of the chemical agents are contained within products and as recycling of waste products becomes more important, especially for specialist materials, there is the risk to workers within this sector of being exposed. Companies recycling WEEE have been identified as being at risk. For example, arsenic is intentionally used in some electronic components and some exposure to arsenic during dismantling and recycling activities may take place. Consultation for this study indicated that exposure to cadmium can occur as a result of shredding older TVs (CRTs) and small Ni-Cd batteries which have accidentally not been removed during the recycling process.

Other materials also pose a risk, such as glass. Two Portuguese glass manufacturers contacted as part of the stakeholder consultation confirmed that arsenic compounds were not used, however there were significant emissions of arsenic reported to the E-PRTR from the companies.

Companies involved in recycling activities of WEEE and metals are likely to experience a heavier burden should the OELs for the chemical agents in question be lowered.

1.2 Risk management measures (RMMs)

As highlighted above, it may be the case that manufacturers of basic metals (foundries), glass, chemicals and chemical products, electronic equipment, transportation equipment, as well as those involved in recycling activities may experience a heavier burden should the OELs for the chemical agents be lowered. However, it is important to also consider whether the risk management measures (RMMs) put in place to protect workers and minimise exposure, would be effective against more than one chemical agent, thus reducing the costs to companies.

The CMD provides a hierarchy of measures to be applied by employers, these are the same for arsenic, beryllium and cadmium, as shown in the table below. These also apply to MOCA.

Table 1-2: Hierarchy of measures to be applied by the employers, as listed in the CMD

Type of measure	RMMs specified in the CMD	RMMs in use for inorganic arsenic compounds
Reducing the quantities of the chemical agents used (substitution and material reduction)	(a) limitation of the quantities of a carcinogen or mutagen at the place of work;	Substitution Reworking processes
Reducing the number of workers exposed	(b) keeping as low as possible the number of workers exposed or likely to be exposed;	Reworking processes
Reducing the concentration of the chemical agents at the workplace	(c) design of work processes and engineering control measures so as to avoid or minimise the release of carcinogens or mutagens into the place of work;	Reworking processes
	(d) evacuation of carcinogens or mutagens at source, local extraction system or general ventilation, all such methods to be appropriate and compatible with the need to protect public health and the environment;	Local exhaust ventilation Full enclosure Partial enclosure Open hood Pressurised and sealed enclosure Simple worker's cab General dilution ventilation
	(e) use of existing appropriate procedures for the measurement of carcinogens or mutagens, in particular for the early	Organisational measures

Table 1-2: Hierarchy of measures to be applied by the employers, as listed in the CMD		
Type of measure	**RMMs specified in the CMD**	**RMMs in use for inorganic arsenic compounds**
	detection of abnormal exposures resulting from an unforeseeable event or an accident;	
	(f) application of suitable working procedures and methods;	Organisational measures
Reducing the exposure of workers by protective measures	(g) collective protection measures and/or, where exposure cannot be avoided by other means, individual protection measures;	Personal protective equipment Breathing apparatus Mask with HEPA filter Simple mask
	(h) hygiene measures, in particular regular cleaning of floors, walls and other surfaces;	Organisational measures
	(i) information for workers;	Organisational measures
	(j) demarcation of risk areas and use of adequate warning and safety signs including 'no smoking' signs in areas where workers are exposed or likely to be exposed to carcinogens or mutagens;	Organisational measures
	(k) drawing up plans to deal with emergencies likely to result in abnormally high exposure;	Organisational measures
Other measures	(l) means for safe storage, handling and transportation, in particular by using sealed and clearly and visibly labelled containers;	Organisational measures
Source: CMD		

Application of some of these measures would be provide protection to workers from more than one chemical agent, notably, reducing the number of workers exposed, reducing the exposure of workers by protective measures and other measures.

Some of the measures are more closely linked to the process and the use of the chemical agent and are unlikely to reduce exposure to anything other than the intended chemical agent, i.e. reducing the quantities of the chemical agents used (substitution and material reduction) or reducing the concentration of the chemical agents at the workplace.

Similarly, the recommended risk management measures for formaldehyde are:

- Ensure the ventilation of stores and work areas; and
- Handle formaldehyde in accordance with good hygiene and safety practice[1].

The dossier also recommends personal protection equipment (such as hand, eye and body protection) and respiratory protection to reduce exposure to formaldehyde.

[1] ECHA (2017b): Formaldehyde REACH dossier. Available at: https://echa.europa.eu/registration-dossier/-/registered-dossier/15858/3/1/6

Exposure to chromium VI is only relevant for workers involved in welding, thermal cutting and similar processes. Research and stakeholder consultation has indicated that this activity presents a minimal risk of exposure for the other chemical agents, as such the RMMs have not been considered.

1.3 Competitiveness

Clearly, there are some risk management measures that employers can implement that will protect workers from exposure to a number of chemical agents. This is beneficial to companies as the costs of compliance would be reduced and it is more efficient than implementing a series of measures over time as the need arises. There could also be costs savings to employers by reducing the time necessary to train employees about new measures and practices.

Where it is possible to reduce exposure by reducing the amount or concentration of the chemical agent, and this may not always be the case, this is likely to incur a cost for each chemical agent with a lowered OEL. The process of reducing the use of a chemical agent or substituting is not standard and may be more costly for some chemical agents than others. It could even be the case that implementing such measures could result in cost savings through reduced raw material inputs, cheaper alternatives and improved efficiency.