Hexavalent Chromium and Manganese Update

Background

Hexavalent Chromium (CrVI) is a form of the metal chromium that rarely occurs naturally and is most commonly produced by industrial processes. It has the ability to gain electrons from other elements (a strong oxidizer) which means it can react easily with them. Because of its ability to react with other elements, it can produce hard coatings, which is why it is used in paints for boats, cars and airplanes. Hexavalent chromium fume (a small metal particle) can also be generated when performing “hot work” such as welding on stainless steel or melting chromium metal. In these situations the chromium is not originally hexavalent, but the high temperatures involved in the process result in oxidation that converts the chromium to the hexavalent state. These properties are also what make it a health hazard. Hexavalent Chromium is often referred to as Hex Chrom, Hex Chrome, Chromium 6, Hexa Chrom, Cr(VI), or HexChrome.

Manganese is a grey-white metal resembling iron. Manganese is used extensively to produce a variety of important alloys and to desulfurize and deoxidize steel. Manganese is also in many welding rods and filler metals to promote hardness. Manganese oxide fume is formed when manganese metal is heated and reacts with oxygen in the air such as occurs during welding. One of the more recent ailments identified by the National Institutes of Health (www.nih.gov) that can afflict welders is manganism, also known as welder's disease. Overexposure to manganese fume has been linked to weakness/lethargy, speech and psychological disturbances, paralysis, and tremors.
To help reduce the risk of adverse health effects caused by exposures to airborne materials such as Cr(VI) and manganese, the United States Occupational Safety and Health Administration (OSHA) has established permissible exposure limits (PELs) which are law. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) sets threshold limit values (TLVs) which are airborne exposure limit guidelines. TLVs are often used by industrial hygienists because they are evaluated on a more frequent basis than OSHA PELs.

Standards, Regulations and Enforcement

**Cr(VI)**

On February 28th, 2006 (OSHA) published the final Hexavalent Chromium (CrVI) Standard. There are three versions of the standard: General Industry (1910.1026), Construction (1910.1126), and Shipyards (1515.1026). The requirements of each standard are very similar.

All CrVI inhalation exposure is covered by these rules, with the exception of exposures from Portland Cement and application of regulated pesticides, e.g. treatment of wood with pesticides (exposures resulting from sawing or sanding treated wood are covered). The OSHA PEL for all industries is 5 micrograms per cubic meter of air (5 μg/m³), reduced from 52 μg/m³, a difference of an order of magnitude. The PEL is a time weighted average (TWA) meaning it is a concentration limit for a conventional 8-hour workday and 40-hour workweek. The action level, or the level where many of the requirements of the standard such as medical surveillance may be required, is 2.5 μg/m³. There is no short term exposure limit (STEL).

The effective dates for implementing interim control measures, including respiratory protection were as follows:

- Employers with more than 20 employees – November 27, 2006
- Employers with less than 20 employees – May 30, 2007

Feasible engineering controls to effectively reduce hexavalent chromium exposures to acceptable levels must be in place by May 31, 2010. Where engineering controls are not feasible other controls, such and administrative controls and/or personal protective equipment (PPE) must be implemented.

OSHA has implemented a new National Emphasis Program (NEP) to identify and reduce or eliminate the health hazards associated with occupational exposure to hexavalent chromium and other toxic substances commonly found in conjunction with hexavalent chromium. This NEP, which is effective February 23, 2010 will target industries where overexposures to hexavalent chromium are known to occur.

A copy of this instructional manual can be found at: www.osha.gov/OshDoc/Directive_pdf/CPL_02-02-076.pdf
Manganese

The current OSHA PEL for manganese is 5 milligrams per cubic meter of air (5 mg/m³). This PEL is a ceiling limit which means the exposure shall at no time exceed the exposure limit given for that substance. OSHA has had the same exposure limit for manganese since 1971.

The ACGIH TLV for manganese is aTWA limit of 0.2 mg/m³. The 2010 edition of the ACGIH TLVs and BEIs includes a proposed revision to the manganese TLV. This Notice of Intended Change (NIC) includes revising the current TLV-TWA for total manganese to 0.2 mg/m³ for the inhalable fraction, and 0.02 mg/m³ for the respirable fraction. The ACGIH’s proposals should be considered trial values, and will remain on the NIC for approximately one year. If ACGIH neither finds nor receives any substantive data that changes its scientific opinion regarding an NIC TLV, then the value is recommended for adoption by ACGIH. If they find or receive substantive data that changes its scientific opinion regarding the NIC TLV, the recommendation could change to be either retained or withdrawn from the NIC. The respirable fraction is the smallest size fraction typically sampled, thus representing fume particles. This would most likely be the limit used for evaluating welding exposures.

Respiratory Protection for Cr(VI) and Manganese Exposure

In many cases, changes in manufacturing processes and engineering controls alone can't reduce exposure levels to below the OELs. In such cases, it may be appropriate to use respiratory protection. For any particular application, an array of respirator types that provide an appropriate level of protection are available. The cost of these respirators may vary from around $1 for a basic negative-pressure, disposable, filtering facepiece to $1,000 or more for a powered or supplied-air system. Respirators should be selected based on results from air sampling and the necessary assigned protection factor (APF) as established within OSHA 29 CFR 1910.134. OSHA requires employers to implement a written respiratory protection program when respiratory protection is used. Elements of the written program include respirator selection, use, care and maintenance, medical evaluation, training, and fit testing.

Respirator Selection for Hexavalent Chromium Exposures

The table below shows suggested respiratory protection for hexavalent chromium up to the maximum use concentrations based on the OSHA APFs and PEL of 5 µg/m³.

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Respiratory Protection</th>
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<tbody>
<tr>
<td>≤ 50 µg/m³</td>
<td>Half Facepiece with N, R, or P class particulate filter (includes filtering facepiece respirator)</td>
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<tr>
<td></td>
<td>Any other respirator with an APF ≥ 10</td>
</tr>
<tr>
<td>≤ 125 µg/m³</td>
<td>Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece, Hood/Helmet, or Loose Fitting Facepiece</td>
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</tbody>
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Continuous flow supplied-air system with Full Facepiece, Hood/Helmet or Loose Fitting Facepiece

≤ 250 μg/m³
- Full Facepiece with N, R, or P class particulate filter
- PAPR with HEPA Filter and Full Facepiece or Hood/Helmet
- Continuous flow supplied-air system with Full Facepiece or Hood/Helmet

≤ 5000 μg/m³
- PAPR with HEPA Filter and Full Facepiece or Hood/Helmet
- Continuous flow supplied-air system with Full Facepiece or Hood/Helmet

(1) Manufacturer must provide evidence that hood/helmet respirator systems meet APF of 1,000

Respirator Selection for Manganese Oxide Fume Exposures

The table below shows suggested respiratory protection for manganese up to the maximum use concentrations based on the OSHA APFs and ACGIH TLV of 0.02 mg/m³ for respirable fraction.

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Respiratory Protection</th>
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<tbody>
<tr>
<td>≤ 0.2 mg/m³</td>
<td>Half Facepiece with N, R, or P class particulate filter (includes filtering facepiece respirator) Any other respirator with an APF ≥ 10</td>
</tr>
<tr>
<td>≤ 0.5 mg/m³</td>
<td>Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece, Hood/Helmet, or Loose Fitting Facepiece Continuous flow supplied-air system with Full Facepiece, Hood/Helmet or Loose Fitting Facepiece</td>
</tr>
<tr>
<td>≤ 1 mg/m³</td>
<td>Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece or Hood/Helmet Continuous flow supplied-air system with Full Facepiece or Hood/Helmet</td>
</tr>
<tr>
<td>≤ 200 mg/m³</td>
<td>PAPR with HEPA Filter and Full Facepiece or Hood/Helmet Continuous flow supplied-air system with Full Facepiece or Hood/Helmet</td>
</tr>
</tbody>
</table>

(1) Manufacturer must provide evidence that hood/helmet respirator systems meet APF of 1,000

Summary

Cr(VI) and Manganese are found in many manufacturing processes. The recent proposed changes to manganese exposure levels may have an affect on various industries and industrial processes. As a precaution, review MSDS sheets for materials containing these substances in manufacturing processes. If there are questions regarding the air quality, it may be a good idea to discuss the option of air sampling with an industrial hygienist to better determine the levels of contaminants within a given process. If the air sampling results indicate exposure levels above the occupational exposure limit (either PEL or TLV, whichever the employer is using), changes to manufacturing processes, use of other engineering controls or PPE may be suitable choices to reduce employee exposures to acceptable levels.

Further questions regarding this article or selection of respiratory protection may be directed to 3M OH&ESD Technical Service at 1-800-243-4630.