

TerranearPMC Safety Share

Week of October 6, 2014 – Toxic Metals

All metals can be toxic; however, when taken in the right quantities some can be very beneficial. These include calcium, zinc, chromium, iron, sodium, magnesium, manganese, copper, selenium and molybdenum. All these metals are necessary to maintain a healthy life. But the amounts we need are quite minimal and in many cases, the required quantities are defined as “trace amounts.” Once we exceed the “health limit” we increase our risk of getting poisoned. As the renaissance physician/scientist, Paracelsus stated, “The dose makes the poison.”

In the 1939 play, “Arsenic and Old Lace” a tale is told of two elderly ladies that invite lonely old men to their home and offer some elderberry wine laced with arsenic. It was merely their way of providing empathy and compassion by ending their lonely lives. This story is often described as a “dark comedy,” portraying the humorous storyline of the antics of the two ladies while their nephew struggles with what to do out about their “good deeds” of putting suffering old men out of their lonely existence through impassioned poisoning. While this is an amusing story, intentional cases of causing the demise of others through secretly administering toxic metals has been serious business.

During the Middle Ages and Renaissance period, arsenic became a favored method for murder among ruling classes in Italy. Because the symptoms are similar to those of cholera, which was common at the time, arsenic poisoning often went undetected. By the 19th century, it had acquired the nickname "inheritance powder," as impatient heirs were known or suspected to use it to ensure or accelerate their inheritances.

Arsenic was, by no means, the only metal noted for its deadly properties, and not all of the times were such disastrous effects the result intentional harm. One of the first occupations where poisoning was prevalent, yet went unnoticed for centuries, was painters. Today many pathologists and historians think that history’s most famous painters were poisoned by the toxins in their paints. During the Renaissance and Baroque eras, painters obtained their paints by grinding and mixing pigments that were made from metals such as lead, cadmium, and mercury. Through the cumulative effects of skin absorption, inhalation of pigment dusts, as well as accidental ingestion, many of our great artists suffered illnesses that only today can we identify the cause-effect relationship. It has been suggested it was no coincidence that Vincent van Gogh’s insanity flared up during his most prolific two-year period and that Francisco Goya, who became deathly ill with a coma, partial paralysis, impaired vision and hearing, dizziness, paranoia, and hallucinations, were all symptoms of lead poisoning. As it turns out, Goya would cover his canvas with an undercoat of lead white, and painted in a furiously fast and messy way with brush, trowel, rag, mop, sponge, and hands, continuously splattering himself and everything nearby with his lead whites, cadmium yellows, and mercury reds.

One metal that is common in industrial and non-industrial applications is cadmium. Cadmium and its compounds are known to cause cancer while targeting the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems. First discovered in Germany in 1817, cadmium was originally used as a pigment. Since then, it has become an important metal in the production of nickel-cadmium (Ni-Cd) rechargeable batteries and as a sacrificial corrosion-



TerranearPMC Safety Share

protection coating for iron and steel. Cadmium is also used in nuclear reactors where it acts as a neutron absorber.

Hexavalent chromium [Cr(VI)] is one of the valence states (+6) of the element chromium. It is usually produced by an industrial process. Cr(VI) is known to cause cancer. In addition, it targets the respiratory system, kidneys, liver, skin and eyes. Chromium metal is added to alloy steel to increase its strength and corrosion resistance. A major source of worker exposure to Cr(VI) occurs during "hot work" such as welding on stainless steel and other alloy steels containing chromium metal. Cr(VI) compounds may be used as pigments in dyes, paints, inks, and plastics. It also may be used as an anticorrosive agent added to paints, primers, and other surface coatings. The Cr(VI) compound chromic acid is used to electroplate chromium onto metal parts to provide a decorative or protective coating. It almost common to find in many D&D projects at DOE and DoD facilities.

Probably the most popular and prevalent of the toxic metals is lead. Inorganic lead is a malleable, blue-gray, heavy metal that occurs naturally in the Earth's crust. Lead was one of the first metals used by humans and consequently, the cause of the first recorded occupational disease (noted to cause lead colic in a 4th century BC metal worker). It has only been during recent times that we have concluded that the great composer, Ludwig von Beethoven, suffered from lead poisoning as lead oxide was used to sweeten wine that was made in the Rhine region (pure cane sugar from Hawaii was an unknown commodity at that time). Lead enters the body primarily through inhalation and ingestion. Today, adults are mainly exposed to lead by breathing in lead-containing dust and fumes at work, or from hobbies that involve lead. Lead passes through the lungs into the blood where it can harm many of the body's organ systems. While inorganic lead does not readily enter the body through the skin, it can enter the body through accidental ingestion (eating, drinking, and smoking) via contaminated hands, clothing, and surfaces due to poor personnel hygiene habits. Workers may develop a variety of ailments, such as neurological effects, gastrointestinal effects, anemia, and kidney disease.

Mercury, the liquid metal (aka quicksilver) is naturally occurring and exists in several forms. These include elemental (pure mercury) as well as organic mercury compounds. It is interesting that inhaling elemental mercury is extremely harmful, while ingestion is not associated with any illnesses. However, ingestion of organic mercury (i.e. methyl mercury) is extremely toxic and can result in death through very small quantities. Mercury exposure can cause permanent nervous system and kidney damage. Exposure is most likely to occur during mining, production, and transportation of mercury, as well as gold and silver ore production. Mercury is commonly found in thermometers, manometers, barometers, gauges, valves, switches, batteries, and high-intensity discharge lamps. It is also used in amalgams for dentistry, preservatives, heat transfer technology, pigments, catalysts, and lubricating oils.

While many toxic metals have occupational exposure limits, such as OSHA PELs and ACGIH TLVs, when these metals are formulated with other materials to become intricate compounds, specific protective measures may not exist. This does not mean that such metallic compounds are not toxic; only that a "protective" exposure limit has not been established. This is one reason why it is important to work with your S&H professional to ensure proper protective measures are implemented to ensure your health will not be at risk when working with toxic metals.

Laughter is poison to fear - George R.R. Martin, *A Game of Thrones*

