

B. Cadmium

CAS Number 7440-43-9

1. Overview

Cadmium, a natural metal found in the earth's crust, is extracted during the refining of other metals, including zinc, lead and copper (Centers for Disease Control and Prevention [CDC], 2010). According to the U.S. Agency for Toxic Substances and Disease Registry (ATSDR), 83% of extracted cadmium is used in batteries, 8% in pigments, 7% in plating and coatings, and the remainder in plastics and other applications (Agency for Toxic Substances and Disease Registry [ATSDR], 2008).

Cadmium enters the body through ingestion or inhalation. Cadmium levels in blood reflect recent exposures, while levels of cadmium in urine reflect body burden from longer term exposures (Organisation for Economic Co-operation and Development [OECD], 2004). With repeated exposure, cadmium can accumulate in the body, especially in the kidney and liver, with potential of remaining in the body for several decades (ATSDR, 2008; OECD, 2004). The kidney can be damaged after over-exposure to cadmium (ATSDR, 2008; CDC, 2010). Cadmium can also cause malformation of bone, bone loss or decrease in bone strength. Further, there is some limited evidence that cadmium is a neurotoxin and an endocrine disruptor (ATSDR, 2008). In animal laboratory studies, cadmium has been found to be absorbed more readily by younger animals (ATSDR, 2008). Children have more years to accumulate cadmium and to manifest related health effects, making cadmium in children's products a concern.

Cadmium has been found to cause lung cancer in some workers who have been exposed to it occupationally. It has been named a known carcinogen by the Department of Health and Human Services' National Toxicology Program (NTP) (National Toxicology Program [NTP], 2005), as well as being named a Group 1 carcinogen by the International Agency for Research on Cancer (IARC) (International Agency for Research on Cancer [IARC], 1997), and a probable carcinogen by the Environmental Protection Agency (EPA) (Environmental Protection Agency [EPA], 1992).

Because cadmium has some properties that are similar to lead, cadmium could be used as a substitute for lead in products. After the Consumer Product Safety Improvement Act (CPSIA) of 2008 lowered the limit of lead allowable in children's products, there was concern that cadmium would be used as an alternative. In the early part of 2010, the Consumer Product Safety Commission (CPSC) issued six recalls related to cadmium in children's products. A survey of children's products by the Associated Press, and later by the Canadian government, reported finding some children's products with high cadmium content, sometimes topping 90% (Health Canada, 2010; Pesce, 2010). While currently no federal standard related to cadmium in children products exists, an industry standard is under development. In the interim, four state governments, including Minnesota, have attempted to limit children's exposure to cadmium through state law. Federal and state policies related to cadmium will be discussed further below in Section 5 "Regulations" and Section 6 "Action Plans".



Cadmium is being named a Priority Chemical by Minnesota Department of Health (MDH) because of its potential health effects, including kidney and bone damage, its ability to accumulate and remain in the body, and its use in products intended for children.

Further information about toxicity, potential exposure pathways, and current state and federal actions is provided below.

2. Exposure and Environmental Disposition

(Note: This section includes examples of exposure and environmental information for cadmium. This summary is not intended to be comprehensive.)

a. Centers for Disease Control and Prevention (CDC)

(1) Agency for Toxic Substances and Disease Registry (ATSDR)

Cadmium that enters the body tends to accumulate in the kidney and liver. Cadmium in the kidneys can have a half-life of several decades. Cadmium in the blood indicates recent exposures, while cadmium in the urine is related to the concentration of cadmium in the kidneys (ATSDR, 2008).

(2) National Health and Nutrition Examination Survey (NHANES)

NHANES data show levels of cadmium detected in humans have been declining since 2001. People of age 20 years and older had higher blood cadmium levels than people of younger ages. Females had slightly higher levels than males (CDC, 2010).

b. Consumer Product Safety Commission (CPSC)

A report by the CPSC determined that a test method for chemicals such as cadmium migrating from small swallowed items should be based on solubility in an acidic solution for 24 hours. CPSC has requested that an industry trade group make recommendations about voluntary cadmium standards (Consumer Product Safety Commission [CPSC], 2010a).

c. Environmental Protection Agency (EPA)

(1) Inventory Update Reporting (IUR)

Data from the 2006 IUR indicate that cadmium was produced or imported into the U.S. in a range of 1 million to 10 million pounds. EPA rules in place during the 2006 inventory did not require use information to be reported for inorganic chemicals like cadmium. Cadmium usage information will be required in the 2011 reporting period under current EPA rules (EPA, 2010a).

(2) Office of Pollution Prevention and Toxics (OPPT)

Products containing cadmium, such as jewelry, can be put in a child's mouth and result in oral exposure (EPA, 2010c).

(3) Toxic Release Inventory (TRI)

There were no cadmium or cadmium compound releases reported for Minnesota in 2009 (EPA, 2010d). Cadmium was reported released in Minnesota from 1988-1994, with the highest release in 1990 of 1,612 pounds. This release was a transfer to a landfill (EPA, 2010e). For cadmium compounds, there were releases reported in 1988-1995 and 2005. The greatest release was 4,693 pounds reported in 1991. This release was primarily to landfills (EPA, 2010e).

d. National Institutes of Health (NIH)

National Library of Medicine (NLM)

(a) Hazardous Substances Data Bank (HSDB)

Cadmium has been found in fish (Hazardous Substance Data Bank [HSDB], 2010).

(b) Household Product Database

This database shows only two products, a glaze with less than 1% cadmium and a concrete material with an unspecified amount of cadmium. However, as noted in the Household Product Database background information, products for which a material safety data sheet (MSDS) is not created are not included. Therefore, jewelry and novelty glassware would not likely be listed (NLM, 2010a; NLM, 2010b).

3. Toxicity

(Note: This section provides examples of toxicity information from several sources. This summary is not intended to be comprehensive.)

a. Centers for Disease Control and Prevention (CDC)

(1) Agency for Toxic Substances and Disease Registry (ATSDR)

Cadmium can cause tissue damage leading to decreased function of the kidney. The effects of low level cadmium exposure over time on the kidney are not entirely understood. However, it is possible that adults exposed to cadmium as children might be at higher risk for the renal toxicity of cadmium than people exposed only as adults. Exposure to cadmium can also cause bones to weaken (ATSDR, 2008).

(2) National Health and Nutrition Examination Survey (NHANES)

NHANES reports that the kidney is the critical target of cadmium exposure. At high exposures, such as those encountered occupationally, irreversible proteinuria signals renal damage. Indicators of renal damage from environmental exposure levels are not as well understood. Effects on bone density have been reported from exposure to cadmium in areas with soil contamination (CDC, 2010).

b. Environmental Protection Agency (EPA)

Integrated Risk Information System (IRIS)

EPA Reference Dose:

5×10^{-4} mg/kg/day (water) (proteinuria)

1×10^{-3} mg/kg/day (food) (proteinuria) (EPA, 1994)

Cadmium is a probable human carcinogen (EPA, 1992).

c. National Institutes of Health (NIH)

National Toxicology Program (NTP)

NTP has determined that cadmium is a known human carcinogen via inhalation.

d. World Health Organization (WHO)

International Agency for Cancer Research (IARC)

Cadmium is classified as a Group I carcinogen: carcinogenic to humans (IARC, 1997).

4. Statutory Requirements

In relation to Minn. Stat. 2010 116.9401-116.907, cadmium met the following criteria:

Statute	Information	References
Minn. Stat.2010 116.9401		
Subd. (e)(1) harm the normal development of a fetus or child or cause other developmental toxicity	Development: Nervous system and skeletal system	ATSDR 2008
Subd. (e)(2) cause cancer, genetic damage, or reproductive harm	Cancer: EPA B1: Probable carcinogen	EPA 1992
	Cancer: NTP: Known human carcinogen (inhalation)	NTP 2005
	Cancer: IARC: Group 1: Carcinogenic to humans (inhalation)	IARC 1997
Subd. (e)(3) disrupt the endocrine or hormone system		
Subd. (e)(4) damage the nervous system, immune system, or organs, or cause other systemic toxicity	Neurobehavioral	ATSDR 2008
	Bones, kidney	ATSDR 2008 CDC 2010
Subd. (e)(5) be persistent, bioaccumulative, and toxic	(Designated as a Persistent Bioaccumulative and Toxic (PBT) Priority Chemical in the EPA National Waste Minimization Program)	EPA 2009
Subd. (e)(6) be very persistent and very bioaccumulative		
Minn. Stat. 2010 116.9403		
Subd. (a) (1): has been identified as a high-production volume chemical by the United States Environmental Protection Agency	1 to 10 million pounds	EPA 2010b
Subd (2) Meets any of the following criteria:		
Subd. (a)(2)(i): the chemical has been found through biomonitoring to be present in human blood, including umbilical cord blood, breast milk, urine, or other bodily tissues or fluids	Blood, kidney, liver, umbilical cord blood	CDC 2010 HSDB 2010

Statute	Information	References
Subd. (a)(2)(ii): the chemical has been found through sampling and analysis to be present in household dust, indoor air, drinking water, or elsewhere in the home environment		
Subd. (a)(2)(iii): the chemical has been found through monitoring to be present in fish, wildlife, or the natural environment	Fish (also a naturally occurring element)	HSDB 2010

5. Current Regulations

a. Federal

There are currently no mandatory federal regulations for cadmium in children's products, though the CPSIA requires a standard, which is currently under development. Progress is described below in Section V "Planned Actions".

b. States

Minnesota

During the 2010 Minnesota Legislative Session, a law (Minn. Stat. 2010 325E.3891) limiting the amount of cadmium permitted in jewelry intended for children age 6 or younger was passed. The law states:

Cadmium in any surface coating or accessible substrate material of metal or plastic components of children's jewelry shall not exceed 75 parts per million, as determined through solubility testing for heavy metals defined in the ASTM International Safety Specification on Toy Safety, ASTM standard F-963 and subsequent versions of this standard, if the product is sold in this state unless this requirement is superseded by a federal standard regulating cadmium in children's jewelry. (Minn. Stat. 2010 325E.3891, Sub.2)

This Minnesota law takes effect on January 1, 2011.

Many states have laws prohibiting certain metals, including cadmium, in packaging. The following states have legislation related to cadmium in other products to which children might be exposed. (Most information below was obtained from the Lowell Center for Sustainable Production's US State Chemicals Policy database, available from <http://www.chemicalspolicy.org/chemicalspolicy.us.state.database.php>.)

California

Year: 2010

S.B. 929, 2009-10 Leg., Reg. Sess. (Cal. 2010)

In fall 2010, the governor of the State of California signed a bill that will limit cadmium levels in jewelry intended for children 6 years of age or younger. Under the new law, cadmium can comprise no more than 0.03% of total composition. This law will go into effect in January 2012 (California Department of Toxic Substances Control, 2011).

Because California has a large market share in the United States, standards passed in California are usually also applied to products sold outside of California. The effect is to apply the standard throughout the United States.

Year: 2010 (Amendment)

Cal. Health & Safety Code §§ 108550-108585 (2008)

Prohibits the manufacture or sale of any toy contaminated with any toxic substance, coated with paints and lacquers containing compounds of lead, or coated with soluble compounds of antimony, arsenic, cadmium, mercury, selenium or barium.

Connecticut

Year: 2010

H.B. 5314, 2010 Gen. Assemb., Feb. Sess. (Conn. 2010)

Prohibits the manufacture, sale, or distribution of any children's jewelry that contains cadmium at more than .004 percent by weight.

Illinois

Year: 2010

H.B. 5040, 96th Gen. Assemb., Reg. Sess. (Ill. 2010)

Prohibits the manufacture, sale, or distribution of children's jewelry containing cadmium. Authorizes the Illinois Environmental Protection Agency to participate in an interstate clearinghouse to promote safer chemicals in consumer products.

Washington

Year: 2008

2008 Wash. Sess. Laws 288.

Contains limits on lead, cadmium, or phthalates in children's products. (Largely preempted by the Federal Consumer Product Safety Improvement Act of 2008.)

(Lowell Institute for Sustainable Production, 2010)

6. Planned Actions

a. Federal

The CPSIA referred to industry standards under ASTM F963-08 to limit cadmium in coatings or accessible substrates of children's products. However, in August 2010 there was a petition from the Empire State Consumer Project, Sierra Club, and others, requesting the CPSC issue a ban of cadmium in toy metal jewelry containing more than trace amounts of the substance (Federal Register, 2010). Petitioners also requested that the CPSC ban cadmium at levels applicable to lead if there is currently insufficient information available to determine appropriate levels of cadmium in products. This petition was open for comment until October 18, 2010.

In October 2010, the CPSC announced that it would defer regulation of cadmium in children's products and allow a voluntary industry standard to be developed and implemented. The CPSC also announced an acceptable daily intake (ADI) for cadmium of 0.1 ug/kg/day (CPSC, 2010a).

The Environmental Protection Agency also received a petition from this group requesting that EPA use its authority under the Toxic Substances Control Act (TSCA) to require submission of health and safety studies. EPA has granted the petition and plans to collect information and to work with CPSC. If CPSC does not act, EPA announced that it intends to publish a rule under TSCA section 6 (EPA, 2010c).

The CPSC made six recalls of consumer products, including five jewelry items for children and one type of glassware in 2010 (CPSC, 2010b). Many of the recalled items were manufactured outside of the U.S.

b. Retailers

Some retailers have begun requiring manufacturers to meet standards for cadmium set by the European Union (Pritchard, 2010; Walmart Stores, 2010). The standard passed by California in 2010 (see above) will take effect in 2012. This standard is stricter than the European Union standard because it limits total cadmium; not only cadmium in the coating or accessible substrate. Because California standards sometimes are applied nationally, this might affect retailer policy on cadmium.

7. Conclusion

Cadmium is being named a Minnesota Priority Chemical because of its potential health effects, including kidney and bone damage, its ability to accumulate and remain in the body, and its use in products intended for children. After Minnesota's statute related to cadmium in children's jewelry takes effect January 1, 2011 and national standards are developed, cadmium will be limited in children's products, but assurance of compliance will be needed. It will also be important to ensure that cadmium in products not covered by the regulations or guidance do not pose a threat to children.

New findings on cadmium toxicity and exposure routes will be monitored, as will developments in federal and state policy.

8. References

ATSDR. 2008. U.S. Agency for Toxic Substances and Disease Registry. Toxic Substances Portal. Toxicological Profile for Cadmium. Retrieved from <http://www.atsdr.cdc.gov/toxprofiles/TP.asp?id=48&tid=15>. Accessed October 13, 2010.

California Department of Toxic Substances Control. 2011. Cadmium in Children's Jewelry. Retrieved from <http://www.dtsc.ca.gov/PollutionPrevention/ToxicsInProducts/Cadmium.cfm> Accessed on January 11, 2011.

CDC. 2010. U.S. Centers for Disease Control and Prevention. National Report on Human Exposures to Environmental Chemicals: Cadmium. Retrieved from http://www.cdc.gov/exposurereport/data_tables/Cadmium_ChemicalInformation.html. Accessed December 3, 2010.

- CPSC. 2010a. Consumer Product Safety Commission. Cadmium in Children's Metal Jewelry. October 2010. Retrieved from <http://www.cpsc.gov/LIBRARY/FOIA/FOIA11/os/cadmiumtoy.pdf> Accessed December 1, 2010.
- CPSC. 2010b. Consumer Product Safety Commission. Final Recall Products (recalled after 10/01/01) by Hazard Type: Cadmium. Retrieved from <http://www.cpsc.gov/cgi-bin/haz.aspx> Accessed December 1, 2010.
- EPA. 1992. U.S. Environmental Protection Agency. Integrated Risk Information System. Carcinogenicity Assessment for Lifetime Exposure: Cadmium. Retrieved from <http://www.epa.gov/ncea/iris/subst/0141.htm>. Accessed November 24, 2010.
- EPA. 1994. U.S. Environmental Protection Agency. Integrated Risk Information System. I.A. Reference Dose for Chronic Oral Exposure (RfD): Cadmium. Retrieved from <http://www.epa.gov/ncea/iris/subst/0141.htm>. Accessed November 24, 2010.
- EPA. 2009. U.S. Environmental Protection Agency. Wastes-Hazardous Wastes – Waste Minimization: Priority Chemicals. Accessed from <http://www.epa.gov/epawaste/hazard/wastemin/priority.htm>. Accessed December 6, 2010.
- EPA. 2010a. U.S. Environmental Protection Agency. Inventory Update Reporting. About Submissions. Retrieved from <http://www.epa.gov/iur/pubs/guidance/aboutsub.html>. Accessed December 3, 2010.
- EPA. 2010b. U.S. Environmental Protection Agency. Inventory Update Reporting: 2006: For 2006. Retrieved from <http://www.epa.gov/iur/tools/data/index.html>. Accessed October 15, 2010.
- EPA. 2010c. U.S. Environmental Protection Agency. Lead and Cadmium in Toy Jewelry. Retrieved from <http://www.epa.gov/lead/pubs/toyjewelry.htm>. Accessed on October 13, 2010.
- EPA. 2010d. U.S. Environmental Protection Agency. Toxic Release Inventory (TRI). TRI Explorer: Releases: Chemical Report: 2009 Cadmium and Cadmium Compounds, Minnesota. Retrieved from <http://www.epa.gov/triexplorer>. Accessed December 22, 2010.
- EPA. 2010e. U.S. Environmental Protection Agency. Toxic Release Inventory (TRI). TRI Explorer: Releases: Trends 1988-2009 Minnesota: Cadmium and Cadmium Compounds. Retrieved from <http://www.epa.gov/triexplorer>. Accessed on December 22, 2010.

- Federal Register. 2010. Docket No. CPSC-2010-0087. Vol. 75, No. 160, August 18, 2010, p. 51246. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2010-08-19/pdf/2010-20599.pdf>. Accessed December 2, 2010.
- HSDB. 2010. Hazardous Substances Data Bank. Cadmium. Retrieved from TOXNET query "7740-43-9" at <http://toxnet.nlm.nih.gov>. Accessed December 2, 2010.
- Health Canada. 2010. Consumer Product Safety. Backgrounder for cadmium in children's jewelry. Retrieved from http://www.hc-sc.gc.ca/cps-spc/advisories-avis/info-ind/cadmium_jewellery-bijoux2-eng.php Accessed December 6, 2010.
- IARC. 1997. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 58: Beryllium, Cadmium, Mercury, and Exposures in the Glass Manufacturing Industry. Retrieved from <http://monographs.iarc.fr/ENG/Monographs/vol58/volume58.pdf>. Accessed December 2, 2010.
- Lowell Center for Sustainable Production. 2010. United States US State Chemical Policy database: Enacted legislation for lead. Retrieved from <http://www.chemicalspolicy.org/chemicalspolicy.us.state.database.php> Accessed November 29, 2010.
- NLM. 2010a. National Library of Medicine. About the Household Products Database. Retrieved from <http://hpd.nlm.nih.gov/about.htm>, Accessed November 4, 2010.
- NLM. 2010b. National Library of Medicine, Household Products Database. Cadmium. Retrieved from <http://hpd.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=85&query=cadmium&searchas=TblChemicals>. Accessed November 4, 2010.
- NTP. 2005. National Toxicology Program. 11th Report on Carcinogens (RoC). Retrieved from <http://ntp.niehs.nih.gov/index.cfm?objectid=32BA9724-F1F6-975E-7FCE50709CB4C932>. Accessed October 28, 2010.
- OECD. 2004. Organization for Economic Cooperation and Development. SIDS Initial Assessment Profile: Cadmium Oxide and Cadmium Metal. Retrieved from <http://webnet.oecd.org/hpv/UI/handler.axd?id=63737ee4-5232-497b-a94e-5d49255994d8>. Accessed December 2, 2010.
- Pritchard, J. (2010, April 29). Wal-mart to limit toxic cadmium in kids' products. Fox News. Retrieved from <http://www.wncn.com/news/consumer/Wal-Mart-to-limit-toxic-cadmium-in-kids-products-92414509.html>. Accessed December 1, 2010.
- Pesce, N.L., (2010, January 11). Toxic lead replaced by even more toxic cadmium in children's toys, trinkets. *New York Daily News*. Retrieved from <http://www.nydailynews.com/lifestyle/health/2010/01/11/2010-01->

[11 toxic lead replaced in childrens toys trinkets by something even worse cadmium.html](#). Accessed December 1, 2010.

Walmart Stores. (2010, May 19). Walmart Statement on Media Reports Regarding Cadmium in Children's Product. Retrieved from <http://walmartstores.com/pressroom/news/9912.aspx>. Accessed December 7, 2010.