

CADMIUM

Cadmium is a chemical element with the symbol Cd and atomic number 48. The soft, bluish-white transition metal is chemically similar to the two other metals in group 12, zinc and mercury.

Cadmium is a non-essential and toxic element for humans mainly affecting kidneys and the skeleton. It is also a carcinogen by inhalation. Cadmium is accumulated in bone and may serve as a source of exposure later in life.

CADMIUM (Cd)

Color: Soft blue
Crystal Structure: Hexagonal
Atomic Number: 48
Atomic Weight: 112.411 g•mol⁻¹
Density: 8.65 g•cm⁻³
Melting point: 594.22 K, 21.07 °C, 09.93 °F
Boiling point: 1040 K, 767 °C, 1413 °F

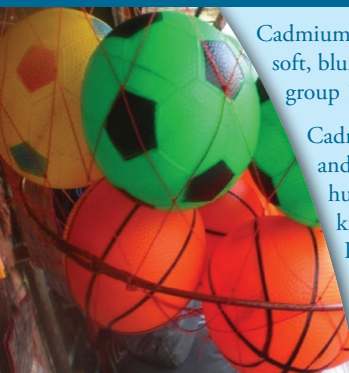
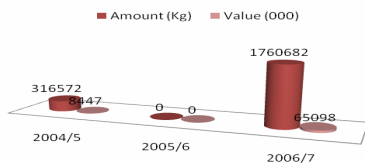
In the environment, cadmium is toxic to plants, animals and micro-organisms. Being an element, cadmium is persistent – it cannot be broken down into less toxic substances in the environment. The degree of bioavailability and potential for effects varies depending on the form of cadmium.

Uses of Cadmium and Its Compound

About three-quarters of all the cadmium used is in batteries, predominantly in rechargeable nickel-cadmium batteries. Most of the remaining quarter is used mainly for cadmium pigments, coatings and plating, and as stabilizers for plastics. Other uses include electroplating (6% cadmium), Cadmium oxide in black and white television phosphors and in the blue and green phosphors for color television picture tubes, Cadmium sulfide (CdS) as a photoconductive surface coating for photocopier drums. It can be used in some semiconductors such as cadmium sulfide, cadmium selenide, and cadmium telluride, which can be used for light detection or solar cells. HgCdTe is sensitive to infrared. Cadmium used in plating on iron and steel; and as an alloying element of some lead, copper and tin alloys. It is also used as a barrier to control neutrons in nuclear fission.

Cadmium pigments and stabilizers are important additives in certain specialized plastics, glasses, ceramics and enamels to achieve bright colors along with long service lives, even in very demanding applications.

Import of Nickel-Cadmium Accumulators (Batteries)



Import of Nickel-cadmium accumulators (UNT)

	Year 2004/5	Value (000)	Year 2006/7	Value (000)
Japan			207476	1595
China			974579	1090
Singapore			3	11
Malaysia			525285	2773
UAE			20	61
UK			1	494
India (DRP)	8700	581	5318	26317
Indonesia			48000	208
Overseas Rechargeable Batteries	307872	7866		32549
TOTAL	316572	8447	1760682	65098

Toxicity of Cadmium

Cadmium poisoning is an occupational hazard associated with industrial processes such as metal plating and the production of nickel-cadmium batteries, pigments, plastics, and other synthetics. The primary route of exposure in industrial settings is inhalation. Inhalation of cadmium-containing fumes can result initially in metal fume fever but may progress to chemical pneumonitis, pulmonary edema, and death.

Cadmium is also a potential environmental hazard. Human exposures to environmental cadmium are primarily the result of the burning of fossil fuels and municipal wastes. However, there have been notable instances of toxicity as the result of long-term exposure to cadmium in contaminated food and water.

Cadmium and several cadmium-containing compounds are known carcinogens and can induce many types of cancer.

The kidney is the critical target organ for the general population as well as for occupationally exposed populations. Cadmium is known to accumulate in the human kidney for a relatively long time, from 20 to 30 years, and, at high doses, is also known to produce health effects on the respiratory system and has been associated with bone disease. Most of the available epidemiological information on cadmium has been obtained from occupationally exposed workers or on Japanese populations in highly contaminated areas.

Most studies have centred on the detection of early signs of kidney dysfunction and lung impairment in the occupational setting, and, in Japan, on the detection and screening for bone disease in general populations exposed to cadmium-contaminated rice. More recently, the possible role of cadmium in human carcinogenesis has also been studied in some detail.

Research has found that cadmium toxicity may be carried into the body by zinc binding proteins; in particular, proteins that contain zinc finger protein structures.

Tobacco smoking is the most important single source of cadmium exposure in the general population. It has been estimated that about 10% of the cadmium content of a cigarette is inhaled through smoking. The absorption of cadmium from the lungs is much more effective than that from the gut, and as much as 50% of the cadmium inhaled via cigarette smoke may be absorbed.



On average, smokers have 4-5 times higher blood cadmium concentrations and 2-3 times higher kidney cadmium concentrations than non-smokers.

Despite the high cadmium content in cigarette smoke, there seems to be little exposure to cadmium from passive smoking. No significant effect on blood cadmium concentrations could be detected in children exposed to environmental tobacco smoke.

Exposure Pathways

Factors influencing cadmium absorption are the form in which cadmium is present in the food, and the iron status of the exposed individual. In contrast, from 30% to 64% of inhaled cadmium is absorbed by the body, with some variation as a function of chemical form, solubility and particle size of the material inhaled. Thus, a greater proportion of inhaled cadmium is retained by the body than when cadmium is taken in by ingestion. For the non-occupationally exposed individual, inhalation exposure to cadmium does not usually contribute significantly to overall body burden. The exception to this generalisation is the cigarette smoker.

There are multiple sources of cadmium exposure in the general population. Attention is drawn to the following:

- Food accounts for approximately 90 per cent in the general, non-smoking population
- Cadmium in crops is due to the uptake of cadmium from soils and the rate of uptake is influenced by factors such as soil pH, salinity, humus content, crop species and varieties and the presence of other elements (e.g., zinc). Tobacco is an important source of cadmium uptake in smokers and may also affect non-smokers through passive exposure to secondary smoke.
- Less than 10 per cent of the total exposures among general populations occur due to inhalation of low levels of cadmium in ambient air and through drinking water
- The kidney burden resulting from cumulative exposure to cadmium can be assessed by measuring cadmium in urine

Way Forward

The specific methods for controlling cadmium releases from these sources fall generally under the following four groups described below:

- Reducing consumption of raw materials and products that include cadmium as impurity;
 - Substitution (or elimination) of products, processes and practices containing or using cadmium with non-cadmium alternatives;
 - Controlling cadmium releases through low-emission process technologies and cleaning of off-gases and wastewater;
 - Management of cadmium-containing waste.
- The World Health Organisation (WHO) has established a provisional tolerable weekly intake (PTWI) for cadmium at 7 µg/kg of body weight. This PTWI weekly value corresponds to a daily tolerable intake level of 70 µg of cadmium for the average 70-kg man and 60 µg of cadmium per day for the average 60-kg woman.
- Cadmium Intake From Cigarette Smoking - Smokers absorb amounts of cadmium comparable to those from food, about 1 to 3 µg of cadmium per day, from the smoking of cigarettes. It has been reported that one cigarette contains about 1 - 2 µg of cadmium and that about 10% of the cadmium content is inhaled when the cigarette is smoked (WHO 1992). Cigarette construction, the use of filters and variations in the cadmium contents of tobaccos could decrease cadmium exposure by this route, but in general cigarette smoking is a habit which can more than double the average person's daily cadmium intake. Cigarette smokers WHO are also occupationally exposed may increase their total cadmium intake even further.

More Information:



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