**Hazards and Toxic effects on the different Living organism of Cadmium and its related safety Assessment.**

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**Abstract**

Cadmium element is harmful, non-essential and dangerous for human health, Soil and aquatic life. Cd play negative role for soil organisms and soil ecology, other impacts of Cd like low grade of bone mineralization, high rate of fractures, increased rate of osteoporosis, and intense bone associated pain. Cd has good corrosive resistance properties, and working as stabilizers for PVC. Cd exposure cause pathophysiological damages as well as growth rate reduction in fish and long-term exposure can include larval mortality and temporary reduction in growth, fluid replacement, supplemental oxygen, and mechanical ventilation may effective if Cd poisoning occur and gastric lavage also beneficial soon after exposure.

**Key words:** Cd effects, Sources of Cd, Toxicity, Uses

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**Introduction**

Cd is a by-product of zinc, or lead refining and easily to recyclable. It can be found in soil because insecticides, fungicides, sludge, and commercial fertilizers that use Cd in agriculture***Baby, J., et al. 2010***. Cd play negative role for soil organisms and soil ecology, Cd element is harmful, non-essential and dangerous for human health ***Magrath, S.P. 1999*** it has good corrosive resistance properties, especially in high stress environments like as marine and aerospace applications for high safety or reliability is required; the coating is preferentially corroded if damaged. Cd is also used as pigments, and stabilizers for PVC.

**Routes of Cd exposure**

Cd is used in industrial purpose for a long time period and its toxicity focused in the middle of the last century. As discussed in introductory part Cd found in ores of zinc, copper and lead. Volcanic activity is also one of the natural reasons for a temporary increase of Cd concentration in environment. Excessive accumulation of Cd in the body should be regarded as potentially toxic.

**By the Natural Environment**

Groundwater rarely contains high levels of Cd, till the mining or industrial wastewater, or seepage from hazardous waste sites are not involved. Cd dissolved from water lines in presence of Soft or acidic water, Cd levels are also increased in water decaying in household pipes. But these sources not reported as clinical Cd poisoning, Cd exists as small particles in air as Cd oxide which fume are the result of soldering, smelting, or other high-temperature industrial processes.

**By the Food Chain**

Certain plants such as tobacco, rice, other cereal grains, potatoes, and other vegetables take up Cd from the soil***.*** Cd is also found in meat, especially liver and kidney. Some areas, Cd concentrations are raised in shellfish and mushrooms.

**Chemical Properties**

Cd is transition metal which contain 1 mmHg pressure at 394ºC. Cd is odorless and corrosive resistant. its oxides and Cd metal are insoluble in water. The oxidation state of Cd is (+2). Solid Cd is not flammable but powdered of Cd will burn and produce corrosive and toxic fumes ***National Toxicology Program 2004 & Schaefer, H. R., et al 2020****.* But some salts of Cd are water soluble as Cd chloride, Cd sulfate and Cd nitrate; But some other salts of Cd which is insoluble in water as they interact with acids, light or oxygen then more soluble. The melting point of Cd is 321۫ 0C.

***Cd Half-Life***

Cd half-life in the kidney is between 6 to 38 years; and in the liver is between 4 - and 19 -years ***Schaefer, H. R., et al 2020****.*

**Hazardous of Cd**

Cd dust or fumes damage the fertility, and organs of the unborn child and cause long-lasting harmful effects on aquatic life so a precautionary system is necessary.

**Effects on the environment**

After a threshold level of heavy metal concentration, could be dangerous to aquatic and human health and also affect the ecological balance. When heavy metals are not metabolized by the body, they become toxic and accumulate in the soft tissues. The aquatic organism takes heavy metals through three ways: the body surface, gills and food **Baby, J., *et al.2010*** Human exposure like as combustion of fossil fuel, phosphate fertilizers, production of iron and steel, cement production and related activities, and municipal solid waste also **Morrow, H. 2010**

**Effect on human health**

Heavy metals may enter the human body via food, water, air, or absorption through the skin when they come in contact with humans in agriculture and in manufacturing, pharmaceutical, industrial, or residential settings. Cd considers as a carcinogen and cause lung cancer **Liu, W. 2010** If Cd is inhalation of fine dust and fumes, or ingestion of highly soluble Cd compounds **Morrow, H. 2010** And after inhalation of metal fume and cause pneumonitis, pulmonary edema, and death **Hayes****A.W*. 2008*** Cd is an endocrine disruptor and some experimental studies show that it can interact with different hormonal signaling pathways. For example, Cd can bind to the estrogen receptor alpha, **Fechner, P.;** ***et al. 2011 &* Stoica, A.; *et al. 2000*** and affect signal transduction along the estrogen and MAPK signaling pathways at low doses. **Ali, I.; *et al. 2010,*** **Ali, I.; *et al. 2012 &* Johnson, M. D.; *et al. 2003***

**Effects of Cd in reproductive biology**

Cd affects the ovarian steroidogenic pathway in rats. Piasek et al. evaluated the direct effects of in vitro Cd exposure on steroidogenesis in rat ovaries. Mostly Cd affect the productions of progesterone and testosterone **Piasek M, *et al.* *1999*Using** of low dosage of Cd stimulate the ovarian progesterone biosynthesis, in spite of high dosages inhibit it **Henson MC *et al. 2004* after** some study find out Cd is a potent nonsteroidal estrogen in vivo and in vitro. Cd precipitation increased uterine wight in rat and enhanced mammary development also **Johnson MD, *et al. 2003***

**Respiratory Effects**

Pulmonary disease can result inhalation exposure to high concentrations of Cd compounds;

Production of Cd alloy, Cd coated steel welding, smelting and refining of Cd***.***TheInitial symptoms of Cd poisoning, flu-like illness- chills, fever, and myalgias. Later symptoms like chest pain, cough, and dyspnea **Davison, A. G, *et al.1988***

**Gastrointestinal Effects**

Take the acidic food or beverages, cigrates and improper stored contains food with Cd coating **Bowers, N., *et al. 1997*** Cause irritates the gastric epithelium and show the symptoms of gastrointestinal effect nausea, vomiting, abdominal cramps and pain, diarrhea, and tenesmus **Schaefer, H. R., *et al*. 2020 & Saini, S., *et al. 2020*** Cd ingested in high doses irritates the gastric epithelium. **Nordberg GF 2004**

***Fig. 1 Effect on Human Health by Cd***



***Fig. 2 Effected organs by Cd***

**Effect on Aquatic Ecosystem**

When Cd enter in freshwaters, bulk of the metal is precipitate and be located in the bottom of sediments. so, sediment is main source of Cd for aquatic environment **WHO, 2000.** Cd effected the aquatic organisms directly or indirectly lethal and can influence populations and ecosystems. Cd consider as a pollutant and so can alter the trophic levels for centuries and freshwater organisms such as fish **Sorensen, E.M.B. 1991** Cd uptake from sediment bottom and feeding by fauna and sediment-rooted flora and then circulate the food chain to fish, with the specific pathways which dependent upon the present species **Irwin, R.J*. et al 1997***

**Toxicity of Cd in freshwater fish**

As Cd is a toxic element and act as tensioning agent for fish **Annabi, A., *et al. 2013*** the results Cd exposure causes pathophysiological damages as well as growth rate reduction in fish **Hansen, J.A., *et al.2002***in mammals and fishCd cause hepatic and renal injuries with the probable to induce oxidative stress **Kim, J.H., *et al.2010***

Cd causes hypocalcemia when interacts with the calcium and during its metabolism process. The higher concentrations of calcium in water protect fish from Cd uptake. After exposed over a long period of time the lower concentration of Cd would be chronically toxic. when the animal is Effects of long-term exposure can include larval mortality and temporary reduction in growth. Cd would be acute toxic but animal may die high concentration over a short period of time **AMAP.,** **1998**. After above discussion the impact of Cd on aquatic organisms depends on chemical forms of Cd which contain different toxicities and bio-concentration factors. This form binds with metallothionein and decreases its toxicity normally takes place in the liver of fish. However, higher concentration of Cd produces toxic effects. **Bradl, H., 2005 & Wright, D.A. *et al.*** **2002**



**Fig. 3 Effect of Cd on Aquatic Life**

**Safety Assessment: -**

if the dust/fumes of Cd Oxide are inhaled it may cause cancer. Cd dust or fumes damage the fertility, and organs of the unborn child and cause long-lasting harmful effects on aquatic life so a precautionary system is necessary. Not only Cd but also any chemical species before handling first we understand the handling procedure and safety measures and then use it **Soni, R. K., *et al. 2021&* Singh, O. 2021** Before handling the Cd First read and understand the safety precaution. Chose a well-ventilated area for Cd-related work. wear always respiratory safety mask for breathing, when using this product wash your hands properly before eating, drinking or smoking. as Cd get moisture should be explosively so avoid moisture or another surface because it may leave traces and can accumulate, so ensure that any effluent or solid waste disposal, and consider dry covered area.

Substance like polyphenolic compounds mostly present in plants prevents the harmful effect of Cd, polyphenolic compound involves in biological activity and has antioxidant properties. Such compound has at least one aromatic ring with active phenolic group. Some relevant substance which contains polyphenolic group examples are given below.

Cloves, Plums, Cocoa Powder, Apples, Walnuts, Almond, Green olives, Spinach, Red Onion, Red Wine, Green Tea, Black Tea, Coffee, Black Chokeberry and Peppermint etc.

**Applications/ Uses**

Normally Cd is used as electric batteries, pigments, ***Buxbaum, Gunter; et al 2005.*** Cd used ascoating agents, **Smith C.J.E.; *et al. 1999***

Another use of Cd is electroplating. In Nuclear fission work as Neutron absorber **Scoullos, Michael J.; *et al.*** **2001**

Batteries; Nickel-Cd, **Krishnamurthy, N. *et al. 2013***

In Television technology, as QLED TVs, **Maynard, Andrew**.2017

In medical field cd used as Anticancer drugs, **Abyar, Selda; *et al.*** 2019

In past years Cd oxide used in black and white television **Lee, Ching-Hwa; *et al. 2002***

photoconductive surface used CdS coating for photocopier drums. **Miller, L. S.; *et al. 1991***

Cd was used as heat, light, and weathering stabilizers in PVC **Jennings, Thomas C. 2005**

**FUTURE DIRECTIONS**

Cd toxicity relation in plants is a key source for future research direction and how to mitigate this toxicity-related problem. Understand the interaction of water quality conditions and Cd in fish as well as the occurrence of the others metal interaction, protection, future threats, and the genetic influence of Cd bioaccumulation. Invents new agricultural tools for mitigating Cd identification, genetic reasons which improve more resistant species in the future.

**Conclusion**

The nonbiodegradable toxic nature of Cd is a very serious problem for rising countries. it effects on photosynthesis process in plants, and crops productivity also not only in the harvest but is also harmful to human health major known reason is Cigarette smoking, which cause lung or kidney disease. use new methods for mitigating Cd-related problems like microbial remediation, and phytodegradation, implement Cd counter agricultural tools. The European Commission has proposed much stricter limits transitioning from 60 to 20 mg Cd/kg. Fluid replacement, supplemental oxygen, and mechanical ventilation may effective. And In cases of ingestion, gastric decontamination by emesis or gastric lavage may be beneficial soon after exposure.

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