

Copper



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INTRODUCTION

Copper occurs naturally in many minerals such as cuprite, malachite, azurite, chalcopyrite, chalcocite and bornite. Copper is obtained from the ore by smelting or by flotation and extraction methods.

In the USA it is estimated that 60% of copper metal is eventually recycled. Thus, scrap is a significant part of the copper supply.

USES

Copper is one of the most important metals because of its durability, ductility, malleability, and electrical and thermal conductivity. Copper and its alloys have many uses in the electrical and construction industries, as parts for machinery, in water pipes, roof coverings and household goods.

Copper compounds are used in fungicides and algicides, metal finishing, mineral froth flotation, wood preservatives and water treatment.

OCCUPATIONAL EXPOSURE

Industrial exposures to copper are not usually major hazards. Inhaled dusts and fumes can cause irritation of the eyes and respiratory tract. Exposure to fresh copper fume can give rise to metal fume fever, a transient flu-like illness with no recognised chronic effects. Worksafe Australia recommended

exposure standards (time weighted average) for copper fume and copper dusts are 0.2 mg/m³ and 1 mg/m³ respectively. Allergic contact dermatitis has been reported from direct contact with copper.

ENVIRONMENTAL EXPOSURE

Humans are exposed to copper mainly via food and drinking water. Air levels in rural areas are generally below 10 ng/m³ (nanograms per cubic meter), although in urban areas average levels are 20-200 ng/m³ and may be over 1000 ng/m³ depending on proximity to smelters, power plants, and incinerators. Copper occurs naturally at levels of about 50 ppm in soils and parent rock, while in mineralised areas levels may be very much higher.

Copper concentrations in uncontaminated surface waters are usually less than 0.01 mg/L. Depending on factors such as hardness, pH, anion concentrations, oxygen concentration, temperature and the condition of the reticulation system, drinking water may contain several milligrams of copper per litre. In major Australian reticulated supplies, total copper concentrations range up to 0.8 mg/L, but with typical concentrations of about 0.05 mg/L.

The National Health and Medical Research Council (NHMRC) Australian Drinking Water Guidelines recommend a Guideline Value of 1 mg/L for copper. This level is based on health considerations and the prevention of adverse taste and laundry staining characteristics. Some foods such as liver from sheep, pigs and calves, and veal are especially rich in copper, with levels of 10-100 mg/Kg. Chocolate and its products, tea and coffee may contain more than 10 mg/Kg. Most other foods contain less than 10 mg/Kg, with a median value around 2 mg/Kg.

HEALTH EFFECTS

Copper Deficiency

Deficiency of copper is characterised by hypochromic anaemia, abnormalities of connective tissue and central nervous system disorders. It is observed rarely in humans.

Copper Excess

Copper is an essential element, being necessary in various proteins and enzymes. Balance studies on adults suggest an essential daily intake of 1-5 mg. The absorption and retention rates for copper depend on daily intake. The normal human liver regulates the amount of copper in the body and excretes any excess through the biliary system. As a consequence of these mechanisms, copper overload is unlikely. In humans with certain rare genetic conditions (copper

metabolic disorders) this element can accumulate and cause disease.

The taste threshold for copper is reported in various publications as between 3 and 5 mg/L. Exposure to levels of greater than 2 mg/L can cause ill effects in some people, depending on binding and the chemical form of the copper. Acute symptoms from excessive ingested copper are nausea, vomiting and diarrhoea due to local irritation. Doses of copper above 50 mg/Kg body weight can be lethal. LD₅₀ values in experimental animals range between 15 and 416 mg/Kg body weight depending on the species and anion of the copper salt administered.

Most cases of copper poisoning have involved young children whose food was prepared in copper or brass pots. Exposure to concentrations above 3 mg/L in drinking water for a number of months can cause liver damage in young infants. Infants under one year old are especially susceptible because they have not developed the homeostatic mechanisms for clearing copper from the body and controlling its entry via the intestinal tract. Cirrhosis of the liver, which may be fatal, can be a consequence of chronic copper toxicity.

Copper was not found to be carcinogenic in tests with mice and dogs. The results of bacterial mutagenicity tests have been

generally negative. Tests for mutagenicity using mammalian cells, both *in vitro* and *in vivo*, have given predominantly positive results.

The provisional maximum tolerable daily intake for copper is 0.5 mg/Kg body weight (Joint Expert Committee on Food Contaminants and Additives), which corresponds to 30 mg of copper per day for an adult weighing 60 Kg. The basis for this estimate is a no observable adverse effect level of 5 mg/Kg body weight/day for liver toxicity in a one year study in dogs. The provisional tolerable daily intake is the amount estimated to be safe and without appreciable risk to health when ingested over an entire lifetime.

MONITORING

Copper levels can readily be measured in tissues, body fluids and excreta. There is significant sex, diurnal, day-to-day, and/or week-to-week variation in blood values for copper.

Reported levels of copper in whole blood are 160-3480 Fg/L and in serum 700-1400 Fg/L (men) and 850-1550 Fg/L (women). Increased whole blood

and serum copper levels have been reported following ingestion of 1-30g of copper. Increased copper in serum and in hair has been seen in occupationally exposed workers.

LEGISLATION

Copper nitrate in preparations containing copper chloride for the treatment of footrot in sheep is in Schedule 6 of the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP). Copper sulphate is in Schedule 5 of the SUSDP except:

- a) in preparations for internal use; or
- b) in preparations containing 5 per cent or less of copper sulphate.

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