The following information was generated from the Hazardous Substances Data Bank (HSDB), a database of the National Library of Medicine's TOXNET system (http://toxnet.nlm.nih.gov) on December 27, 2004.

Query: The chemical name was identified. The following terms were added from ChemIDplus:
copper oxide
copper monoxide
copper brown
CAS Registry Number: 1317-38-0

NAME: COPPER(II) OXIDE

HSN: 266
RN: 1317-38-0

NO:
This record contains information specific to the title compound. Users with an interest in this substance are strongly encouraged also to retrieve the record named COPPER COMPOUNDS, which has additional information relevant to the toxicity and environmental fate of copper ions and copper compounds. For information on the metal itself, refer to the COPPER, ELEMENTAL record.

HUMAN HEALTH EFFECTS:

TOXICITY SUMMARY:
For healthy, non-occupationally-exposed humans the major route of exposure to copper is oral. The mean daily dietary intake of copper in adults ranges between 0.9 and 2.2 mg. ... In some cases, drinking water may make a substantial additional contribution to the total daily intake of copper, particularly in households where corrosive waters have stood in copper pipes. ... All other intakes of copper (inhalation and dermal) are insignificant in comparison to the oral route. Inhalation adds 0.3-2.0 ug/day from dusts and smoke. Women using copper IUDs are exposed to only 80ug or less of copper per day from this source. The homeostasis of copper involves the dual essentiality and toxicity of the element. Its essentiality arises from its specific incorporation into a large number of proteins for catalytic and structural purposes. The cellular pathways of uptake, incorporation into protein and export of copper are conserved in mammals and modulated by the metal itself. Copper is mainly absorbed through the gastrointestinal tract. From 20 to 60% of the dietary copper is absorbed, with the rest being excreted through the feces. Once the metal passes through the basolateral membrane it is transported to the liver bound to serum albumin. The liver is the critical organ for copper homeostasis. The copper is partitioned for excretion through the bile or incorporation into intra- and extracellular proteins. The primary route of excretion is through the bile. The transport of copper to the peripheral tissues is accomplished through the plasma attached to serum albumin, ceruloplasmin or low-molecular weight complexes. ... The biochemical toxicity of copper, when it exceeds homeostatic control, is derived from
its effects on the structure and function of biomolecules, such as DNA, membranes and proteins directly or through oxygen-radical mechanisms. The toxicity of a single oral dose of copper varies widely between species. The major soluble salts (copper(II) sulfate, copper(II) chloride) are generally more toxic than the less soluble salts (copper(II) hydroxide, copper (II) oxide). Death is preceded by gastric hemorrhage, tachycardia, hypotension, hemolytic crisis, convulsions and paralysis. Long-term exposure in rats and mice showed no overt signs of toxicity other than a dose-related reduction in growth after ingestion. The effects included inflammation of the liver and degeneration of kidney tubule epithelium. Some testicular degeneration and reduced neonatal body and organ weights were seen in rats and fetotoxic effects and malformations were seen at high dose levels. Neurochemical changes have been reported after oral administration. A limited number of immunotoxicity studies showed humoral and cell-mediated immune function impairment in mice after oral intakes in drinking-water. Copper is an essential element and adverse health effects /in humans/ are related to deficiency as well as excess. Copper deficiency is associated with anemia, neutropenia and bone abnormalities but clinically evident deficiency is relatively infrequent in humans. Except for occasional acute incidents of copper poisoning, few effects are noted in normal /human/ populations. Effects of single exposure following suicidal or accidental oral exposure have been reported as metallic taste, epigastric pain, headache, nausea, dizziness, vomiting and diarrhea, tachycardia, respiratory difficulty, hemolytic anemia, hematuria, massive gastrointestinal bleeding, liver and kidney failure, and death. Gastrointestinal effects have also resulted from single and repeated ingestion of drinking-water containing high copper concentrations, and liver failure has been reported following chronic ingestion of copper. Dermal exposure has not been associated with systemic toxicity but copper may induce allergic responses in sensitive individuals. Metal fume fever from inhalation of high concentrations in the air in occupational settings have been reported. A number of groups are described where apparent disorders in copper homeostasis result in greater sensitivity to copper deficit or excess than the general population. Some disorders have a well-defined genetic basis. These include Menkes disease, a generally fatal manifestation of copper deficiency; Wilson disease (hepatolenticular degeneration), a condition leading to progressive accumulation of copper; and hereditary aceruloplasminemia, with clinical symptoms of copper overload. Indian childhood cirrhosis and idiopathic copper toxicosis are conditions related to excess copper which may be associated with genetically based copper sensitivity. These are fatal conditions in early childhood where copper accumulates in the liver. Other groups potentially sensitive to copper excess are hemodialysis patients and subjects with chronic liver disease. Groups at risk of copper deficiency include infants (particularly low birth weight/preterm babies, children recovering from malnutrition, and babies fed exclusively with cow's milk), people with maladsorption syndrome (e.g., celiac disease, sprue, cystic fibrosis), and patients on total parenteral nutrition. Copper deficiency has been implicated in the pathogenesis of cardiovascular disease. The adverse effects of copper must be balanced against its essentiality. Copper is an essential element for all biota. At least 12 major proteins require copper as an integral part of their structure. It is essential for the utilization of iron in the formation of hemoglobin, and most crustaceans and molluscs possess the copper-containing hemocyanin as their main oxygen-carrying blood protein. A critical factor in assessing the hazard of copper is its bioavailability. Adsorption of copper to particles and complexation by
organic matter can greatly limit the degree to which copper will be accumulated... At many sites, physicochemical factors limiting bioavailability will warrant higher copper limits. ... [Environmental Health Criteria 200: Copper pp. 1-11 (1998) by the International Programme on Chemical Safety (IPCS) under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation and the World Health Organization.]**PEER REVIEWED**

HUMAN TOXICITY EXCERPTS:

Verdigris, formed by atmospheric corrosion of the surface of metallic copper presumably composed of copper carbonates & oxides, causes immediate irritation & conjunctival inflammation when accidentally dropped or dusted on the eyes of patients, but the reaction subsides without permanent damage soon after the eye is cleaned by irrigation. /Verdigris/ [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986.260]**PEER REVIEWED**

The acute inhalation of copper fume during refining or welding processes may cause typical metal fume fever with upper respiratory irritation, chills, and aching muscles. A number of workers who developed copper fume fever had serum copper levels which averaged 1.26 mg/l. /Copper fume/ [Cohen SR; J Occ Med 16: 621-4 (1974) as cited in Basett RC; Biological Monitoring Methods for Industrial Chemicals p.88-9 (1980)]**PEER REVIEWED**

Inhalation of copper fume results in irritation of the upper respiratory tract and an influenza-like illness termed metal fume fever. Signs and symptoms of metal fume fever include chills, muscle aches, nausea, fever, dry throat cough, weakness, and lassitude. There is usually leucocytosis, which may amount to 12,000 to 16,000/ml; recovery is usually rapid, and there are no sequelae. Most workers develop an immunity to these attacks, but it is quickly lost; attacks tend to be more severe on the first day of the work-week. Other effects from copper fume are irritation of the upper respiratory tract, metallic or sweet taste, and in some instances discoloration of the skin and hair. Exposure of workers to concentrations of 1 to 3 mg/cu m for short periods resulted in altered taste response but no nausea; levels of from 0.02 to 0.4 mg/cu m produced no complaints. Transient irritation of the eyes has followed exposure to a fine dust of oxidation products of copper produced in an electric arc. /Copper fume/ [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) Publication No. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981.]**PEER REVIEWED**

Metal fume fever occurred among workers involved in cutting brass pipes with electric torches in an enclosed, poorly ventilated steam condenser. Symptoms most commonly reported among the 26 workers were fever, dyspnea, chills, headache, and nausea. Fourteen of the workers experienced the symptom of an unusual sweet or metallic taste in the mouth. Clinical signs were limited to wheezing or rales in eight patients; leucocytosis and an elevation of band cell forms were seen in a total of 24 workers. The average time between exposure and onset of symptoms was 5 hr. None of three workers who spent less than 1 hr in the condenser became ill, whereas 25 of the 26 who spent more than 1 hr became ill. Five of 12 workers had urine copper levels in excess of 0.05 mg/l /Copper fume/ [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York,
Agents assoc with incr risk of pancreatic cancer include ... copper fumes. 

SKIN, EYE AND RESPIRATORY IRRITATIONS:
Inhalation of copper fume results in the irritation of the upper respiratory tract. ... Contact with copper fumes will also cause irritation of the eyes, nose and throat. 

POPULATIONS AT SPECIAL RISK:
Persons at special risk include those with impaired pulmonary function, especially those with obstructive airway diseases, since the breathing of copper fume might cause exacerbation of symptoms due to its irritant properties.

PROBABLE ROUTES OF HUMAN EXPOSURE:
Exposure may occur in copper and brass plants and during the welding of copper alloys.

EMERGENCY MEDICAL TREATMENT:

LIFE SUPPORT:
- This overview assumes that basic life support measures have been instituted.
CLINICAL EFFECTS:
0.2.1 SUMMARY OF EXPOSURE
0.2.1.1 ACUTE EXPOSURE
A) ROUTES OF EXPOSURE - Copper compounds may be toxic by inhalation, ingestion, and skin or eye exposure. Copper salts are particularly irritating.
B) INHALATION - Exposure to fumes or dust may cause irritation of the nose and upper respiratory tract, as well as sneezing and coughing. Perforation of the nasal septum can also occur. 'Metal fume fever,' with respiratory and flu-like symptoms such as chills and muscle aches, may result from exposure to fumes or fine dust. The incidence of copper-induced metal fume fever is low due to the high temperatures required to volatilize copper.
C) INGESTION - Acute ingestion of copper salts can cause irritation, severe nausea and vomiting, salivation, abdominal pain, epigastric burning, hemolysis, gastrointestinal bleeding with hemorrhagic gastritis, hematemesis and melena, anemia, hypotension, jaundice, seizures, coma, shock and death. Hepatic and renal failure may develop several days after acute ingestion. Methemoglobinemia may rarely occur. Copper may produce a metallic or sweet taste.
D) DERMAL - Skin exposure may cause irritation, itching, eczema, allergic contact dermatitis, hypersensitivity, and a greenish discoloration of the hair, teeth and skin.
E) EYE - Exposure of the eyes to copper fumes or dust can cause irritation, conjunctivitis, palpebral edema, ulceration and corneal turbidity. Eye irritation, uveitis, abscess and loss of the eye may also occur from the mechanical action of lodged copper particles. Penetration of the eye by fine fragments can result in severe ocular damage. Corneal discoloration (Kayser-Fleischer ring) is a hallmark of Wilson disease.
0.2.3 VITAL SIGNS
0.2.3.1 ACUTE EXPOSURE
A) Increased temperature may be noted in some cases.
B) Hypotension may occur.
0.2.4 HEENT
0.2.4.1 ACUTE EXPOSURE
A) Eye exposure may produce irritation, conjunctivitis, palpebral edema, ulceration and corneal turbidity. Eye irritation, uveitis, abscess and loss of the eye may result from severe mechanical irritation.
0.2.5 CARDIOVASCULAR
0.2.5.1 ACUTE EXPOSURE
A) Hypotension, dysrhythmia and coronary artery disease have been linked with exposure to copper.
0.2.6 RESPIRATORY
0.2.6.1 ACUTE EXPOSURE
A) Metal fume fever, wheezing and rales have been reported in workers exposed to fine copper dust. Dyspnea has developed after oral copper exposure. Pulmonary edema and alveolar inflammation have been noted in animals.
0.2.7 NEUROLOGIC
0.2.7.1 ACUTE EXPOSURE
A) Central nervous system depression, seizures and headaches have been associated with copper exposure.

0.2.8 GASTROINTESTINAL
0.2.8.1 ACUTE EXPOSURE
A) Gastroenteritis with vomiting may occur after ingestion of some copper salts. Mucosal erosions, a metallic taste, burning epigastric sensation and diarrhea may also occur.

0.2.9 HEPATIC
0.2.9.1 ACUTE EXPOSURE
A) Hepatomegaly, liver tenderness, increased levels of transaminase and jaundice may occur on the second or third day after ingestion of copper salts. Childhood cirrhosis has been linked with ingestion of milk from copper or brass drinking vessels. Granulomas have also been associated with copper exposure.

0.2.10 GENITOURINARY
0.2.10.1 ACUTE EXPOSURE
A) Acute renal failure with oliguria followed by anuria may occur 24 to 48 hours after ingestion. Hemoglobinuria and hematuria may also occur.

0.2.13 HEMATOLOGIC
0.2.13.1 ACUTE EXPOSURE
A) Hemolysis and anemia have occurred and, rarely, methemoglobinemia.

0.2.14 DERMATOLOGIC
0.2.14.1 ACUTE EXPOSURE
A) Skin exposure can produce in severe irritation, itching, erythema, dermatitis and eczema; systemic toxicity may result.

0.2.21 CARCINOGENICITY
0.2.21.1 IARC CATEGORY
A) IARC Carcinogenicity Ratings for CAS7440-50-8 (IARC, 2004):
  1) Not Listed
0.2.21.2 HUMAN OVERVIEW
A) Increased deaths from cancers have been linked to exposure to copper, mixed with other exposures. However, copper is considered not classifiable as to human carcinogenicity.
0.2.21.3 ANIMAL OVERVIEW
A) Animal carcinogenicity studies of copper compounds have generally been negative, but many suffer from technical limitations and may be inadequate in some cases. Copper was equivocally tumorigenic when implanted in rats.

0.2.22 GENOTOXICITY
A) Mutagenic data for copper and its salts have been equivocal.

LABORATORY:
A) Obtain whole blood copper levels if symptomatic.
B) Obtain baseline liver function tests, renal function tests and CBC.

TREATMENT OVERVIEW:
0.4.2 ORAL EXPOSURE
A) DILUTION: Immediately dilute with 4 to 8 ounces (120 to
240 mL) of water or milk (not to exceed 4 ounces/120 mL in a child).

B) Emesis is rapid and spontaneous in most patients following ingestion of copper salts. Ipecac is CONTRAINDICATED after ingestion of caustic copper salts because of the risk of further injury to the gastrointestinal mucosa and the possibility of severe CNS changes.

C) Copper salts may be caustic agents, capable of extensive mucosal damage, including perforation of the gastrointestinal tract. Gastric lavage and administration of charcoal may cause further complications. However, some clinicians have successfully utilized these techniques. Once charcoal is given, it is difficult to observe endoscopy findings. These are controversial techniques, and are left to the final judgement of the treating physician.

1) Gastric lavage may be indicated after ingestion of non-corrosive forms of copper. Following ingestion of a corrosive copper compound, such as copper sulfate (cupric sulfate), gastric lavage is not indicated because the risk of causing perforation may outweigh the potential benefit of removing caustic material.

2) GASTRIC LAVAGE: Consider after ingestion of a potentially life-threatening amount of poison if it can be performed soon after ingestion (generally within 1 hour). Protect airway by placement in Trendelenburg and left lateral decubitus position or by endotracheal intubation. Control any seizures first.

a) CONTRAINDICATIONS: Loss of airway protective reflexes or decreased level of consciousness in unintubated patients; following ingestion of corrosives; hydrocarbons (high aspiration potential); patients at risk of hemorrhage or gastrointestinal perforation; and trivial or non-toxic ingestion.

D) HYPOTENSION: Infuse 10 to 20 mL/kg isotonic fluid. If hypotension persists, administer dopamine (5 to 20 mcg/kg/min) or norepinephrine (ADULT: begin infusion at 0.5 to 1 mcg/min; CHILD: begin infusion at 0.1 mcg/kg/min); titrate to desired response.

E) Keep patients who have ingested corrosive copper salts NPO following mucosal decontamination until after endoscopy consultation.

F) Consider endoscopy in patients who have ingested corrosive copper salts.

1) ENDOSCOPY: Perform within 24 hours to evaluate for burns in adults with deliberate ingestion or any signs or symptoms attributable to ingestion, and in children with stridor, vomiting, or drooling. Consider endoscopy in children with dysphagia, refusal to swallow, significant oral burns, or abdominal pain. If burns are found, follow 10 to 20 days later with barium swallow or esophagram.

G) The role of corticosteroids is controversial. Consider use in second-degree burns no more than 48 hours postingestion in patients without active upper gastrointestinal bleeding or evidence of
gastroesophageal rupture. Antibiotics are indicated for definite infection or patients with gastroesophageal perforation.

H) SURGICAL OPTIONS: Initially, if severe esophageal burns are found a string may be placed in the stomach to facilitate later dilation. Insertion of a specialized nasogastric tube after confirmation of a circumferential burn may prevent strictures. Dilation is indicated after 2 to 4 weeks if strictures are confirmed; if unsuccessful, either colonic intraposition or gastric tube placement may be performed. Consider early laparotomy in patients with severe esophageal and/or gastric burns.

I) There is little clinical experience in the use of chelators in the setting of acute copper intoxication. Data on efficacy is derived from patients with chronic copper intoxication (Wilson disease, Indian childhood cirrhosis) and animal studies. BAL, penicillamine, DMPS and EDTA have been used. D-penicillamine is considered the drug of choice for Wilson disease, a condition of chronic copper overload.

1) D-PENICILLAMINE: Use only if less toxic agents not available or not tolerated. USUAL DOSE: ADULT: 1000 to 1500 mg/day divided every 6 to 12 hours. CHILD: 10 mg/kg/day initially, gradually increase to 30 mg/kg/day divided in two or three doses as tolerated. Avoid if penicillin allergic. Monitor for proteinuria, hematuria, rash, leukopenia, thrombocytopenia.

2) Administer BAL (Dimercaprol) 3 to 5 mg/kg/dose IM every 4 hours for 2 days; then every 4 to 6 hours for an additional 2 days; then every 4 to 12 hours for up to 7 additional days.

RANGE OF TOXICITY:
A) Severe intoxication is associated with serum copper levels greater than 500 mcg/dL. The estimated lethal dose in an untreated adult is 10 to 20 g copper.

ANTIDOTE AND EMERGENCY TREATMENT:
Basic treatment: Establish a patent airway. Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if necessary. Administer oxygen by nonrebreather mask at 10 to 15 L/min. Monitor for shock and treat if necessary ... . For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport .... . Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Administer activated charcoal ... . /Copper and related compounds/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994.350]**PEER REVIEWED**

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious. Start an IV with lactated Ringer's /SRP: "To keep open", minimal flow rate/. Watch for signs of fluid overload. For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors if hypotensive with a normal fluid volume. Watch for signs of fluid overload .... . Use
proparacaine, hydrochloride to assist eye irrigation .... /Copper and related compounds/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994.351]**PEER REVIEWED**

ANIMAL TOXICITY STUDIES:

TOXICITY SUMMARY:

For healthy, non-occupationally-exposed humans the major route of exposure to copper is oral. The mean daily dietary intake of copper in adults ranges between 0.9 and 2.2 mg. ... In some cases, drinking water may make a substantial additional contribution to the total daily intake of copper, particularly in households where corrosive waters have stood in copper pipes. ... All other intakes of copper (inhalation and dermal) are insignificant in comparison to the oral route. Inhalation adds 0.3-2.0 ug/day from dusts and smoke. Women using copper IUDs are exposed to only 80ug or less of copper per day from this source. The homeostasis of copper involves the dual essentiality and toxicity of the element. Its essentiality arises from its specific incorporation into a large number of proteins for catalytic and structural purposes. The cellular pathways of uptake, incorporation into protein and export of copper are conserved in mammals and modulated by the metal itself. Copper is mainly absorbed through the gastrointestinal tract. From 20 to 60% of the dietary copper is absorbed, with the rest being excreted through the feces. Once the metal passes through the basolateral membrane it is transported to the liver bound to serum albumin. The liver is the critical organ for copper homeostatis. The copper is partitioned for excretion through the bile or incorporation into intra- and extracellular proteins. The primary route of excretion is through the bile. The transport of copper to the peripheral tissues is accomplished through the plasma attached to serum albumin, ceruloplasmin or low-molecular weight complexes. ... The biochemical toxicity of copper, when it exceeds homeostatic control, is derived from its effects on the structure and function of biomolecules, such as DNA, membranes and proteins directly or through oxygen-radical mechanisms. The toxicity of a single oral dose of copper varies widely between species. ... The major soluble salts (copper(II) sulfate, copper(II) chloride) are generally more toxic than the less soluble salts (copper(II) hydroxide, copper (II) oxide). Death is preceded by gastric hemorrhage, tachycardia, hypotension, hemolytic crisis, convulsions and paralysis. ... Long-term exposure in rats and mice showed no overt signs of toxicity other than a dose-related reduction in growth after ingestion ... The effects included inflammation of the liver and degeneration of kidney tubule epithelium. ... Some testicular degeneration and reduced neonatal body and organ weights were seen in rats ... and fetotoxic effects and malformations were seen at high dose levels. ... Neurochemical changes have been reported after oral administration ... A limited number of immunotoxicity studies showed humoral and cell-mediated immune function impairment in mice after oral intakes in drinking-water ... Copper is an essential element and adverse health effects /in humans/ are related to deficiency as well as excess. Copper deficiency is associated with anemia, neutropenia and bone abnormalities but clinically evident deficiency is relatively infrequent in humans. ... Except for occasional acute incidents of copper poisoning, few effects are noted in normal /human/ populations. Effects of single exposure following suicidal or accidental oral exposure have been reported as metallic taste, epigastric pain, headache, nausea, dizziness, vomiting
and diarrhea, tachycardia, respiratory difficulty, hemolytic anemia, hematuria, massive gastrointestinal bleeding, liver and kidney failure, and death. Gastrointestinal effects have also resulted from single and repeated ingestion of drinking-water containing high copper concentrations, and liver failure has been reported following chronic ingestion of copper. Dermal exposure has not been associated with systemic toxicity but copper may induce allergic responses in sensitive individuals. Metal fume fever from inhalation of high concentrations in the air in occupational settings have been reported. A number of groups are described where apparent disorders in copper homeostasis result in greater sensitivity to copper deficit or excess than the general population. Some disorders have a well-defined genetic basis. These include Menkes disease, a generally fatal manifestation of copper deficiency; Wilson disease (hepatolenticular degeneration), a condition leading to progressive accumulation of copper; and hereditary aceruloplasminemia, with clinical symptoms of copper overload. Indian childhood cirrhosis and idiopathic copper toxicosis are conditions related to excess copper which may be associated with genetically based copper sensitivity. These are fatal conditions in early childhood where copper accumulates in the liver. Other groups potentially sensitive to copper excess are hemodialysis patients and subjects with chronic liver disease. Groups at risk of copper deficiency include infants (particularly low birth weight/ preterm babies, children recovering from malnutrition, and babies fed exclusively with cow's milk), people with maladsorption syndrome (e.g., celiac disease, sprue, cystic fibrosis), and patients on total parenteral nutrition. Copper deficiency has been implicated in the pathogenesis of cardiovascular disease. The adverse effects of copper must be balanced against its essentiality. Copper is an essential element for all biota. At least 12 major proteins require copper as an integral part of their structure. It is essential for the utilization of iron in the formation of hemoglobin, and most crustaceans and mollusks possess the copper-containing hemocyanin as their main oxygen-carrying blood protein. A critical factor in assessing the hazard of copper is its bioavailability. Adsorption of copper to particles and complexation by organic matter can greatly limit the degree to which copper will be accumulated. At many sites, physiochemical factors limiting bioavailability will warrant higher copper limits. [Environmental Health Criteria 200: Copper pp. 1-11 (1998) by the International Programme on Chemical Safety (IPCS) under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation and the World Health Organization.]**PEER REVIEWED**

NON-HUMAN TOXICITY EXCERPTS:

Guinea-pigs exposed to copper(II) oxide aerosol at 1.6 mg/cu m... for 1 hour showed significant reductions in tidal volume, minute volume & lung compliance, both during & after exposure, while respiratory frequency was slightly but not significantly incr. [WHO; Environ Health Criteria 200: Copper p.102 (1998)]**PEER REVIEWED**

Symptoms of acute copper toxicity are sporadic fever, tachycardia, hypotension, hemolytic anemia with intravascular hemolysis, oliguria, uremia, coma, cardiovascular collapse, & death. The prompt emetic effect of copper limits its oral toxicity. /because it/ irritates the nerve endings in the stomach & initiates the vomiting reflex in higher animals. Inhalation of dusts & fumes ... cause congestion of nasal mucous membranes, ulceration & perforation of the nasal septum, & pharyngeal congestion. ... Highly water soluble copper salts are more
toxic than sparingly soluble salts; anions such as arsenite and chromate enhance apparent copper toxicity. /Soluble copper salts/ [Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, 2. New York: Plenum Press, 1978.27]**PEER REVIEWED**

Chronic poisoning is not uncommon in sheep grazed in orchards in which fruit sprays containing copper have been used. The spraying program is usually adjusted so that sheep are not introduced into the area until at least 5 days after the last spraying. Cases of poisoning are often accompanied by a history of dry weather, with no growth of herbage, so that animals are forced to consume old grass heavily contaminated with copper. /Copper containing pesticides/ [Clarke, M. L., D. G. Harvey and D. J. Humphreys. Veterinary Toxicology. 2nd ed. London: Bailliere Tindall, 1981.45]**PEER REVIEWED**

METABOLISM/PHARMACOKINETICS:

ABSORPTION, DISTRIBUTION & EXCRETION:
The pulmonary uptake of copper oxide /occurred/ in rats exposed to aerosols containing 50-80 mg/cu m. Animals were exposed for 15, 30, 45, or 60 minutes and killed immediately. Another group was exposed for 180 minutes and killed at 0, 3, 6, 12, 18, or 24 hours after exposure. Electron microscopic histologic examination showed that absorption of copper had occurred in animals exposed for 180 minutes. Copper oxide particles penetrated the epithelial cells of alveoli and were found in plasma 6 hours after exposure began. Copper oxide was also observed in the proximal convoluted tubules of the kidney. /Copper oxide/ [USEPA; Drinking Water Criteria Document for Copper (Final Draft) p.III-3 (1985) EPA-600/X-84-190-1]**PEER REVIEWED**


Cheviot ewes (mean live weight 50 kg) were given single doses of 0, 2.5, 5, 10, or 20 g cupric oxide particles in gelatin capsules while receiving a diet of marginal copper content based on pelleted oats. After 65 days, liver copper concentrations had increased curvilinearly in relation to dose and all ewes given 10 or 20 g cupric oxide particles showed increases of at least 13.4 mmol/kg dry matter (850 ppm). Liver copper concentrations had generally declined after 85 days but biochemical and histological evidence of copper toxicity was recorded in one ewe which had received 20 g cupric oxide particles. Despite marked variations between individual sheep, a dose of 0.1 g/kg liveweight (5 g) was considered to be safe and did not induce clinical copper toxicity in five sheep of the susceptible North Ronaldsay breed given the same basal diet. [Suttle NF; Res Vet Sci 42 (2): 219-23 (1987)]**PEER REVIEWED**

Crossbred steers, mean initial live weight 220 kg, were given a diet of barley and hay ad libitum. Each animal received a single oral does of 0, 5, 10, 20, or 40 g cupric oxide particles. A dose of 5 g cupric oxide particles increased liver copper stores for about 240 days and higher
doses increased liver stores for longer but 40 g was no more effective than 20 g (85 mg/kg live weight). Variation among individuals was marked but the highest liver copper concentration recorded (7.59 mmol/kg dry matter) produced no biochemical evidence of copper toxicity. Cupric oxide particles were separated into three fractions, clumps, short rods and long; and 5 mg/kg live weight of each fraction given to steers of 173 kg mean live weight. The form of the particles did not affect either their retention in the alimentary tract or the accumulation of copper in the liver. [Suttle NF; Res Vet Sci 42 (2): 224-7 (1987)]**PEER REVIEWED**

Ionic copper is absorbed from the stomach, duodenum, & jejunum. The initial absorption is about 30%, but the effective net absorption is only about 5% due to excretion of copper into the bile; biliary copper is bound to protein; this complex is not reabsorbed. Absorption is influenced by a number of factors including the chemical forms of copper: oxides, hydroxides, iodides, glutamates, citrates, & pyrophosphates of copper are readily absorbed, but copper sulfides & other water insoluble salts are poorly absorbed. Copper complexes of some amino acids are easily absorbed, whereas copper porphyrins present in meat are very poorly absorbed. /Soluble copper salts/ [Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, Z. New York: Plenum Press, 1978.26]**PEER REVIEWED**

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PHARMACOLOGY:

ENVIRONMENTAL FATE & EXPOSURE:

PROBABLE ROUTES OF HUMAN EXPOSURE:

NATURAL POLLUTION SOURCES:

ENVIRONMENTAL STANDARDS & REGULATIONS:
FIFRA REQUIREMENTS:
When applied to growing crops, in accordance with good agricultural practice, cupric oxide is exempt from the requirement of a tolerance. [40 CFR 180.1001(b) (7/1/2000)]**PEER REVIEWED**

As the federal pesticide law FIFRA directs, EPA is conducting a comprehensive review of older pesticides to consider their health and environmental effects and make decisions about their future use. Under this pesticide reregistration program, EPA examines health and safety data for pesticide active ingredients initially registered before November 1, 1984, and determines whether they are eligible for reregistration. In addition, all pesticides must meet the new safety standard of the Food Quality Protection Act of 1996. Pesticides for which EPA had not issued Registration Standards prior to the effective date of FIFRA, as amended in 1988, were divided into three lists based upon their potential for human exposure and other factors, with List B containing pesticides of greater concern and List D pesticides of less concern. Cupric oxide is found on List D. Case No: 4025; Pesticide type: Insecticide, fungicide, herbicide; Case Status: OPP is reviewing data from the pesticide's producers regarding its human health and/or environmental effects, or OPP is determining the pesticide's eligibility for reregistration and developing the Reregistration Eligibility Decision (RED) document.; Active ingredient (AI): Cupric oxide; Data Call-in (DCI) Date(s): 09/30/93; AI Status: The producers of the pesticide has made commitments to conduct the studies and pay the fees required for reregistration, and are meeting those commitments in a timely manner. [USEPA/OPP; Status of Pesticides in Registration, Reregistration and Special Review p.305 (Spring, 1998) EPA 738-R-98-002]**PEER REVIEWED**

CLEAN WATER ACT REQUIREMENTS:
Toxic pollutant designated pursuant to section 307(a)(1) of the Federal Water Pollution Control Act and is subject to effluent limitations. /Copper and cmpd/[40 CFR 401.15 (7/1/2000)]**QC REVIEWED**

FEDERAL DRINKING WATER STANDARDS:
EPA 1300 ug/l (Action Level) /Copper/[USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**

FEDERAL DRINKING WATER GUIDELINES:
EPA 1000 ug/l /Copper/[USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**

STATE DRINKING WATER GUIDELINES:
(AZ) ARIZONA 1300 ug/l /Copper/[USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**

ALLOWABLE TOLERANCES:
When applied to growing crops, in accordance with good agricultural practice, cupric oxide is exempt from the requirement of a tolerance. [40 CFR 180.1001(b) (7/1/2000)]**PEER REVIEWED**

CHEMICAL/PHYSICAL PROPERTIES:
MOLECULAR FORMULA:

Cu-O **PEER REVIEWED**

MOLECULAR WEIGHT:


COLOR/FORM:

Black to brownish-black amorphous or crystalline powder or granules [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996.446]**PEER REVIEWED**


BOILING POINT:


MELTING POINT:


DENSITY/SPECIFIC GRAVITY:


SOLUBILITIES:


Virtually insoluble in water or alcohols; copper(II) oxide dissolves slowly in ammonia solution but quickly in ammonium carbonate solution; it is dissolved by alkali metal cyanides and by strong acid solutions; hot formic acid and boiling acetic acid solutions readily dissolve the oxide.
SPECTRAL PROPERTIES:

OTHER CHEMICAL/PHYSICAL PROPERTIES:


Copper(II) oxide is decomposed to copper(I) oxide and oxygen at 1030 deg C and atmospheric pressure; the reduction can proceed at lower temperature in a vacuum; hydrogen and carbon monoxide reduce copper(II) oxide to the metal at 250 deg C and to copper(I) oxide at about 150 deg C; ammonia gas reduces copper(II) oxide to copper metal and copper(I) oxide at 425-700 deg C. [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.VA7 (86) 570]**PEER REVIEWED**

CHEMICAL SAFETY & HANDLING:

DOT EMERGENCY GUIDELINES:
Health: Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Avoid any skin contact. Effects of contact or inhalation may be delayed. Fire may produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-151]**QC REVIEWED**

Fire or explosion: Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. Containers may explode when heated. Runoff may pollute waterways. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-151]**QC REVIEWED**

Public safety: CALL Emergency Response Telephone Number. ... Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000
Protective clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations only; it is not effective in spill situations. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-151]**QC REVIEWED**

Evacuation: ... Fire: If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-151]**QC REVIEWED**

Fire: Small fires: Dry chemical, CO2 or water spray. Large fires: Water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. Fire involving tanks or car/trailer loads: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-151]**QC REVIEWED**

Spill or leak: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. DO NOT GET WATER INSIDE CONTAINERS. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-151]**QC REVIEWED**

First aid: Move victim to fresh air. Call 911 or emergency medical service. Apply artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer
oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. /Copper based pesticide, liquid, poisonous; Copper based pesticide, liquid, toxic; Copper based pesticide, solid, poisonous; Copper based pesticide, solid, toxic/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-151]**QC REVIEWED**

Health: Toxic; may be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Fire will produce irritating, corrosive and/or toxic gases. Vapors may cause dizziness or suffocation. Runoff from fire control or dilution water may cause pollution. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, poisonous, flammable; Copper based pesticide, liquid, toxic, flammable/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131]**QC REVIEWED**

Fire or explosion: Highly flammable: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapor explosion and poison hazard indoors, outdoors or in sewers. Those substances designated with a "P" may polymerize explosively when heated or involved in a fire. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated. Many liquids are lighter than water. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, poisonous, flammable; Copper based pesticide, liquid, toxic, flammable/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131]**QC REVIEWED**


Protective clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid,
Evacuation: ... Fire: If tank, rail car or tank truck is involved in a fire, isolate for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, poisonous, flammable; Copper based pesticide, liquid, toxic, flammable/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131]**QC REVIEWED**

Fire: CAUTION: All these products have a very low flash point. Use of water spray when fighting fire may be inefficient. Small fires: Dry chemical, CO2, water spray or alcohol-resistant foam. Large fires: Water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. Fire involving tanks or car/trailer loads: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, poisonous, flammable; Copper based pesticide, liquid, toxic, flammable/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131]**QC REVIEWED**

Spill or leak: Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Small spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean non-sparking tools to collect absorbed material. Large spills: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, poisonous, flammable; Copper based pesticide, liquid, toxic, flammable/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131]**QC REVIEWED**

First aid: Move victim to fresh air. Call 911 or emergency medical service. Apply artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer
oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. Wash skin with soap and water. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. /Copper based pesticide, liquid, flammable, poisonous; Copper based pesticide, liquid, flammable, toxic; Copper based pesticide, liquid, poisonous, flammable; Copper based pesticide, liquid, toxic, flammable/ [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131]**QC REVIEWED**

SKIN, EYE AND RESPIRATORY IRRITATIONS:
Inhalation of copper fume results in the irritation of the upper respiratory tract. ... Contact with copper fumes will also cause irritation of the eyes, nose and throat. /Copper fumes/ [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) Publication No. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981.2]**PEER REVIEWED**

EXPLOSIVE LIMITS & POTENTIAL:

HAZARDOUS REACTIVITIES & INCOMPATIBILITIES:


CUPRIC OXIDE IS REDUCED TO METALLIC COPPER WHEN HEATED WITH POTASSIUM @ TEMP BELOW ITS MP. REACTION PROCEEDS WITH VIVID INCANDESCENCE. [Fire


Interaction with hydroxylamine or hydrazine is vigorous. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 19901088]**PEER REVIEWED**

A pelleted mixture containing barium acetate, copper(II) oxide and yttrium oxide, ... was heated in a furnace, and a small explosion occurred during the early stages, 'from formation of pyrolysis products'. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990437]**PEER REVIEWED**


HAZARDOUS DECOMPOSITION:

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

PROTECTIVE EQUIPMENT & CLOTHING:
Wear appropriate eye protection to prevent eye contact. [NIOSH. NIOSH
Wear appropriate personal protective clothing to prevent skin contact.


Recommendations for respirator selection. 100 mg/cu m. Respirator Class(es): Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.76]**PEER REVIEWED**

Recommendations for respirator selection. Condition: Respirator Class(es): Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive pressure mode. Any supplied-air respirator that has a full face piece and is operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.76]**PEER REVIEWED**

PREVENTIVE MEASURES:

SRP: Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants. **PEER REVIEWED**


Work clothing that becomes wet or significantly contaminated should be removed and replaced. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.76]**PEER REVIEWED**


DISPOSAL METHODS:

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. **PEER REVIEWED**

Group III Containers (both combustible and non-combustible) that previously held organic mercury, lead, cadmium, arsenic, or inorganic pesticides should be triple rinsed, punctured and disposed of in a sanitary landfill. Non-rinsed containers should be encapsulated and buried at a specially designated landfill site. /Organic mercury, lead, cadmium, arsenic, or inorganic pesticides/ [40 CFR 165 (7/1/88)]**PEER REVIEWED**

Do not contaminate water by ... disposal of wastes near a body of water. /Copper oxides/ [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987.C-68]**PEER REVIEWED**

OCCUPATIONAL EXPOSURE STANDARDS:

OSHA STANDARDS:

Permissible Exposure Limit: Table Z-1 8-hr Time Weighted Avg: 0.1 mg/cu m. /Copper fume (as Cu)/ [29 CFR 1910.1000 (7/1/2000)]**PEER REVIEWED**

Permissible Exposure Limit: Table Z-1 8-hr Time Weighted Avg: 1 mg/cu m. /Copper dusts and mists (as Cu)/ [29 CFR 1910.1000 (7/1/2000)]**PEER REVIEWED**

THRESHOLD LIMIT VALUES:

8 hr Time Weighted Avg (TWA): 0.2 mg/cu m /Copper fume/ [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold
Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded. /Fume; Dusts and mists (as Cu)/ [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.6]**PEER REVIEWED**

NIOSH RECOMMENDATIONS:


IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

MANUFACTURING/USE INFORMATION:

MAJOR USES:
For Copper (II) oxide (USEPA/OPP Pesticide Code: 042401) ACTIVE products with label matches. /SRP: Registered for use in the U.S. but approved pesticide uses may change periodically and so federal, state and local authorities must be consulted for currently approved uses./ [U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Copper (II) oxide (1317-38-0). Available from the Database Query page at http://www.cdpr.ca.gov/docs/epa/epamenu.htm as of Sept 8, 2000.]**PEER REVIEWED**

As pigment in glass, ceramics, enamels, porcelain glazes, artificial gems; in mfr of rayon, other copper cmpd; in sweetening petroleum gases; in galvanic electrodes; as flux in copper metallurgy; as optical glass polishing agent; welding fluxes for bronze; to impart flux and abrasion resistance to glass fibers; in antifouling paints, pyrotechnic compositions; as exciter in phosphor mixtures; as catalyst for org reactions [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996.446]**PEER REVIEWED**


Restricted use as a fungicide, insecticide, miticide, molluscicide, and as a tadpole and shrimp deterrent for treatment of wood and for wood pressure treatment of wood rot/decay fungi, teredos, limnoria, and termites. /Osmose K-33 (40%, 50%, 60% and 72%) Wood Preservative/ [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Conditional and unclassified use in antifouling ship bottoms of fouling organisms. /Farboil Super Tropical Anti-Fouling 1260/ [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Conditional and restricted use as a fungicide, insecticide, and miticide in wood protection treatment by pressure of forest products: brown rot, white rot, wood rot/decay fungi, dry rot, and termites. /CCA Type A Wood Preservative Chromated Copper Arsenate (50% and 60%), Wolmanac conc (50%, 70% and 72%)/ [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**


Used as a precursor in a number of copper(II) salts; wood preservation; feed additive and as a pigment in glass, ceramic, and porcelain enamels; in combination with manganese dioxide, it is used as an oxidative catalyst for exhaust gas, in the removal of NOx, CO and O3, and in the purification of formaldehyde-containing waste gas; supported on aluminum phosphate, copper(II) oxide is active in reducing tar and polycyclic hydrocarbons in smoke by adsorption and catalytic conversion; copper(II) oxide is used as a catalyst in the preparation of acrylates and in the production of magnetic storage devices; it has limited application in the petroleum industry as a gas sweetener and is used in welding fluxes for bronze. [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.VA7 (86) 570]**PEER REVIEWED**

MANUFACTURERS:
American Chemet Corp., Hq, 400 County Line Rd., P.O. Box 437, Deerfield, IL 60015, (312)948-0800; Production site: East Helena, MT 59635 [SRI. 1999 Directory of Chemical Producers -United States. Menlo Park, CA. SRI Consulting 1999.533]**PEER REVIEWED**


Phibro-Tech Inc., One Parker Plaza, Fort Lee, NJ 07024, (201)944-6000; Production sites: Joliet, IL 60435; Santa Fe Springs, CA 90670; Sewaren, NJ 07077; Sumter, SC 29154; Union City, CA 94587; Quincy, IL 62306 [SRI. 1999 Directory of Chemical Producers -United States. Menlo Park, CA. SRI Consulting 1999.533]**PEER REVIEWED**


METHODS OF MANUFACTURING:


Copper (air oxidation); copper + ammonia + ammonium carbonate
Copper(II) oxide can be prepared pyrometallurgically by heating copper metal above 300 deg C in air; preferably 800 deg C is employed. Molten copper is oxidized to copper(II) oxide when sprayed into an oxygen containing gas. Ignition of copper(II) nitrate trihydrate at about 100-200 deg C produces a black oxide. Basic copper(II) carbonate, when heated above 250 deg C, produces a black oxide if a dense carbonate is employed; a brown material is produced when the light and fluffy carbonate is used. An alkali-free oxide can be prepared by ignition of copper(II) carbonate produced from ammonium carbonate and a copper(II) salt solution. Copper(II) hydroxide when heated above 100 deg C is converted to the oxide. Hydrometallurgy is the most common method for the production of copper(II) oxide. A solution of ammonia and ammonium carbonate in the presence of air effectively leaches metallic copper into solution, the solution is stripped of ammonia and carbon dioxide by steam injection or pressurized boiling to produce black copper(II) oxide. [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.VA7 (86) 570] **PEER REVIEWED**

Prepared by the decomposition of the carbonate or hydroxide at around 300 deg C or by the hydrolysis of hot copper salt solutions with sodium hydroxide. The black product of commerce is most often prepared by evaporation of copper(II) ammonium carbonate solutions or precipitation of copper(II) oxide from hot ammonia solutions by addition of sodium hydroxide. It is less often prepared by pyrometallurgical means. Copper metal heated in air to 800 deg C produces the copper(II) oxide. [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.V7 (93) 509] **PEER REVIEWED**

FORMULATIONS/PREPARATIONS:


Wolmanac concentrate (70%), for industrial use only, soluble concentrate, 23.8% arsenic pentoxide, 32.25% chromic acid, 12.95% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)] **PEER REVIEWED**

Wolmanac concentrate (72%), solution-ready to use, 24.48% arsenic pentoxide, 32.20% chromic acid, 13.32% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)] **PEER REVIEWED**
Osmose K-33 (72%) Wood Preservative, solution-ready to use, 32.5% Arsenic pentoxide, 25.4% Chromic acid, 14.1% Cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33-C (72%) Wood Preservative, soluble concentrate, 24.5% arsenic pentoxide, 34.2% chromic acid, 13.3% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose P-50 Wood Preservative, soluble concentrate, 20% chromic acid, 15.5% cupric oxide, 19% phosphoric acid [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33 (60%) Wood Preservative, solution-ready to use, 20% arsenic pentoxide, 29.9% chromic acid, 10.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33-A (50%) Wood Preservative, 7.3% arsenic pentoxide, 32.2% chromic acid, 10.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Boliden-CCA Wood Preservative, soluble concentrate, 34% arsenic pentoxide, 26.5% chromic acid, 14.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1988)]**PEER REVIEWED**

Boliden Salt K-33, soluble concentrate, 34% arsenic pentoxide, 26.5% chromic acid, 14.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

CCA Wood Preservative Chromated Copper Arsenate (60%), soluble concentrate, 9.9% arsenic pentoxide, 39.3% chromic acid, 10.8% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

CCA Type C Wood Preservative (60%), solution-ready to use, 20.1% arsenic pentoxide, 28.5% chromic acid, 11.4% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

U. S. IMPORTS:


LABORATORY METHODS:

SPECIAL REFERENCES:

SPECIAL REPORTS:

NAS; Medical and Biologic Effects of Environmental Pollutants Copper (1974)
USEPA; Drinking Water Criteria Document for Copper (Final Draft) (1985)
EPA-600/X-84-190-1

SYNONYMS AND IDENTIFIERS:

RELATED HSDB RECORDS:
1622 [COPPER]
1549 [COPPER (I) OXIDE] (I)
6944 [COPPER WORKING RECORD]

SYNONYMS:
BANACOBRU OL **PEER REVIEWED**
BLACK COPPER OXIDE **PEER REVIEWED**
Boliden-CCA Wood Preservative [Purdue University; National Pesticide
Information Retrieval System (1987)]**PEER REVIEWED**
CHROME BROWN **PEER REVIEWED**
CI PIGMENT BLACK 15 **PEER REVIEWED**
CI 77403 **PEER REVIEWED**
Wolmanac concentrate [Purdue University; National Pesticide Information
Retrieval System (1987)]**PEER REVIEWED**
COPPER BROWN **PEER REVIEWED**
COPPER MONOXIDE **PEER REVIEWED**
COPPER(2+) OXIDE **PEER REVIEWED**
COPPER OXIDE (CUO) **PEER REVIEWED**
CUPRIC OXIDE **PEER REVIEWED**
NATURAL TENORITE [Weast, R.C. (ed.) Handbook of Chemistry and Physics,
REVIEWED**
Boliden Salt K-33 [Purdue University; National Pesticide Information
Retrieval System (1987)]**PEER REVIEWED**
Farboil Super Tropical Anti-Fouling 1260 [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

CCA Type C Wood Preservative [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33 Wood Preservative [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33-A Wood Preservative [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33-C Wood Preservative [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose P-50 Wood Preservative [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

**FORMULATIONS/PREPARATIONS:**


Wolmanac concentrate (70%), for industrial use only, soluble concentrate, 23.8% arsenic pentoxide, 32.25% chromic acid, 12.95% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Wolmanac concentrate (72%), solution-ready to use, 24.48% arsenic pentoxide, 32.20% chromic acid, 13.32% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33 (72%) Wood Preservative, solution-ready to use, 32.5% Arsenic pentoxide, 25.4% Chromic acid, 14.1% Cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33-C (72%) Wood Preservative, soluble concentrate, 24.5% arsenic pentoxide, 34.2% chromic acid, 13.3% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose P-50 Wood Preservative, soluble concentrate, 20% chromic acid, 15.5% cupric oxide, 19% phosphoric acid [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Osmose K-33 (60%) Wood Preservative, solution-ready to use, 20% arsenic pentoxide, 29.9% chromic acid, 10.5% cupric oxide [Purdue University;
Osmose K-33-A (50%) Wood Preservative, 7.3% arsenic pentoxide, 32.2% chromic acid, 10.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

Boliden-CCA Wood Preservative, soluble concentrate, 34% arsenic pentoxide, 26.5% chromic acid, 14.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1988)]**PEER REVIEWED**

Boliden Salt K-33, soluble concentrate, 34% arsenic pentoxide, 26.5% chromic acid, 14.5% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

CCA Wood Preservative Chromated Copper Arsenate (60%), soluble concentrate, 9.9% arsenic pentoxide, 39.3% chromic acid, 10.8% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

CCA Type C Wood Preservative (60%), solution-ready to use, 20.1% arsenic pentoxide, 28.5% chromic acid, 11.4% cupric oxide [Purdue University; National Pesticide Information Retrieval System (1987)]**PEER REVIEWED**

SHIPPING NAME/ NUMBER DOT/UN/NA/IMO:
UN 2775; Copper based pesticide, solid, toxic.

IMO 6.1; Copper based pesticide, solid, toxic; Copper based pesticides, liquid, toxic, flammable; Copper based pesticides, liquid, toxic, flammable, flash point 23 deg C or more.

UN 2776; Copper based pesticide, liquid, flammable, toxic, flash point less than 23 deg C

IMO 3.0; Copper based pesticide, liquid, flammable, toxic, flash point less than 23 deg C

UN 3009; Copper based pesticides, liquid, toxic, flammable, flash point 23 deg C or more

UN 3010; Copper based pesticides, liquid, toxic.

STANDARD TRANSPORTATION NUMBER:
49 233 34; Copper based pesticides (insecticides, agricultural, not elsewhere classified, other than liquid)

ADMINISTRATIVE INFORMATION:

HAZARDOUS SUBSTANCES DATABANK NUMBER: 266

LAST REVISION DATE: 20030214

LAST REVIEW DATE: Reviewed by SRP on 1/20/2001

UPDATE HISTORY:
Complete Update on 02/14/2003, 1 field added/edited/deleted.
Complete Update on 10/16/2002, 1 field added/edited/deleted.
Complete Update on 08/06/2002, 1 field added/edited/deleted.
Complete Update on 05/13/2002, 1 field added/edited/deleted.
Complete Update on 08/16/2001, 1 field added/edited/deleted.
Complete Update on 08/09/2001, 1 field added/edited/deleted.
Complete Update on 08/07/2001, 52 fields added/edited/deleted.
Field Update on 05/16/2001, 1 field added/edited/deleted.
Field Update on 09/12/2000, 1 field added/edited/deleted.
Complete Update on 03/09/2000, 1 field added/edited/deleted.
Complete Update on 02/08/2000, 1 field added/edited/deleted.
Complete Update on 02/02/2000, 1 field added/edited/deleted.
Complete Update on 11/18/1999, 1 field added/edited/deleted.
Complete Update on 09/21/1999, 1 field added/edited/deleted.
Complete Update on 08/26/1999, 1 field added/edited/deleted.
Complete Update on 07/20/1999, 7 fields added/edited/deleted.
Complete Update on 05/04/1999, 1 field added/edited/deleted.
Complete Update on 03/19/1999, 1 field added/edited/deleted.
Complete Update on 01/27/1999, 1 field added/edited/deleted.
Complete Update on 06/02/1998, 1 field added/edited/deleted.
Complete Update on 03/25/1998, 4 fields added/edited/deleted.
Field Update on 02/25/1998, 1 field added/edited/deleted.
Field Update on 10/17/1997, 1 field added/edited/deleted.
Field Update on 09/17/1997, 1 field added/edited/deleted.
Field Update on 08/13/1997, 5 fields added/edited/deleted.
Field Update on 05/01/1997, 2 fields added/edited/deleted.
Field Update on 03/06/1997, 1 field added/edited/deleted.
Complete Update on 06/27/1996, 1 field added/edited/deleted.
Complete Update on 06/18/1996, 1 field added/edited/deleted.