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Revision Memo

12/98 **Table 1** has been updated to address current toxicologic information and expanded to include additional substances.

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SCOPE

This section covers the airborne contaminant exposure limits and a brief review of the potential toxic effects of many of the chemical substances that may be found in refineries and chemical plants. The organic and inorganic substances in these tables are potential components of raw materials, feedstocks, intermediate streams, and products of petroleum and chemical processing operations.

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INTRODUCTION

EXPOSURE LIMITS OF AIRBORNE CONTAMINANTS

Chemical substances (including feedstocks, intermediates, and products) are safely and widely used in refineries and chemical plants. Worker exposure to chemical substances can be controlled through good facility design in conjunction with good employee work practices. Engineering control guidelines in [Section XVIII-B2](#) are intended to help control worker exposure through appropriate use of low-emissions equipment and systems.

In order to evaluate exposures and the potential need for control, exposure limits for hazardous materials have been established through several organizations. These exposure limits are regularly revised based on the latest human or animal studies or industrial experience. The most current standard should be referred to in exposure evaluation situations.

EXXON OCCUPATIONAL EXPOSURE LIMITS

Exxon Occupational Exposure Limits, OELs, are the Company equivalent of the ACGIH TLVs and are adopted for substances which do not have TLVs or where there may be reason to modify a TLV. OELs are Time-Weighted Averaged concentrations for an 8-hour workday, 40-hour workweek, except where noted, as in the case of benzene.

OELs also list "skin" notations, CAS Numbers (Chemical Abstract Services), "skin cancer" notations and references to EBSI document numbers or Chemical Health Information Systems (CHINS) Data Sheet Numbers.

Current OEL information is also available from the local Industrial Hygiene contact, regional Industrial Hygiene Coordinators, or EBSI.

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INTRODUCTION

EXPOSURE LIMITS OF AIRBORNE CONTAMINANTS (Cont)

THRESHOLD LIMIT VALUES

The American Conference of Governmental Industrial Hygienists (ACGIH) annually updates and publishes the Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents. These TLVs are guidelines to assist in the control of health hazards. TLVs refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects. Because of wide variation in individual susceptibility, it is felt that a small percentage of workers may experience discomfort or aggravation of a pre-existing condition at or below the TLV.

Three categories of TLVs are used: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling Limit (TLV-C).

TLV-TWA is the time Weighted Average concentration for a normal 8-hour workday and 40-hour workweek. To determine if the actual TWA exposure exceeds the recommended limit, the following calculation is used:

$$TWA = \frac{C_1T_1 + \dots + C_nT_n}{T_1 + T_2 + \dots + T_n}$$

where: C = Concentration of the contaminant to which a worker is exposed for a time period, T.
T = Time period.

If the calculated TWA does not exceed the TLV, the daily exposure is considered acceptable.

Short Term Exposure Limit (TLV-STEL) is a 15 minute, time-weighted average exposure which should not be exceeded even if the 8-hour TWA is not exceeded. Exposures to the STEL should not occur more than four times daily nor more frequently than every hour.

Ceiling Limit (TLV-C) is an airborne concentration that should not be exceeded during any part of the workday.

In addition to the three major categories of TLVs, a "skin" notation may be associated with the TLV. This designation indicates the potential for a significant contribution to the overall exposure by the cutaneous route and the mucous membranes, including the eyes, by direct contact with the liquid, or possibly the vapor. The fact that some materials may be irritants or sensitizers or cause dermatitis has no relevance to the "skin" designation.

Potential Carcinogens: TLVs for chemical substances with carcinogenic potential are identified by an "A" notation. Several categories are defined: Confirmed Human Carcinogen (A1), Suspected Human Carcinogen (A2), Animal Carcinogen (A3), Not Classifiable as a Human Carcinogen (A4), and Not Suspected as a Human Carcinogen (A5). See Appendix A of the TLVs (Ref. #1) for additional details.

Mixtures: In evaluating exposures in refinery and chemical plant facilities, many process streams contain mixtures for which there are no TLVs. If the substances in the mixture affect the same organ systems, the combined additive effect of exposure should be considered. For a mixture with components of similar toxicological effects:

$$\frac{C_1}{TLV_1} + \frac{C_2}{TLV_2} + \dots + \frac{C_n}{TLV_n}$$

where C_1 is the concentration and TLV_1 is the corresponding TLV of the constituent component substances in the mixture. If the sum of the fractions exceed one, the threshold limit value of the mixture is exceeded.

For many Exxon products and streams that are mixtures of petroleum products, the Exxon Occupational Exposure Limits should be used.

The current TLVs and the Documentation of the TLVs (a concise summary of the toxicological basis of each TLV - Reference #2) are available from the local Industrial Hygiene contact, regional Industrial Hygiene Coordinators or from Exxon Biomedical Sciences, Inc. (EBSI). TLV booklets can be obtained directly from the ACGIH Technical Information Office, 6500 Glenway Avenue, Bldg. D-7, Cincinnati, Ohio 45211 or through EBSI Information Services.

LOCAL REGULATIONS

In addition to the ACGIH TLVs and Exxon OELs, standards or exposure limits may also exist in the local country or area. In the U.S., workplace exposure limits for chemicals are contained in Part 1910 of the Occupational Safety and Health Administration (OSHA) regulations.

There may be circumstances when the exposure limit for the same substance differs among standards. In this case, it is good practice to consider the use of the lowest or most conservative limit since it affords the worker the best level of protection and assures regulatory compliance. Under all circumstances, local regulations must be followed.

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ADJUSTMENTS TO EXPOSURE LIMITS FOR NON-REGULAR WORK SHIFTS

Application of exposure limits (TLVs or OELs) to workers on work schedules markedly different from the conventional 8-hour work day, 40-hour work week requires particular judgment in order to provide protection equal to that provided on conventional work shifts. For tentative guidance, the ACGIH refers industrial hygienists to the Brief and Scala model where the TLV or OEL is multiplied by a reduction factor, RF:

$$\text{Adjusted TLV} = \text{TLV} \times \text{RF}$$

$$\text{RF} = \frac{8}{\text{hours worked}} \times \frac{\text{hours off work}}{16}$$

The Brief and Scala model reduces the exposure limit proportionately for both increased exposure time and reduced recovery (non-exposure) time. The Brief and Scala model is easier to use, but more conservative, than other pharmacokinetic-based adjustment models. Additional information on exposure limit adjustment is available from Industrial Hygiene Contacts, Regional Industrial Hygiene Coordinators, or EBSI.

TOXIC EFFECTS

- ♦ The statements that follow in **Table 1** are intended as an overview of potential toxic effects of many chemical substances on the TLV list. The summary paragraphs are advisory and are not intended as complete toxicity profiles. Additional, more complete, information may be found in the references. Individuals interested in applying exposure limits for the practice of industrial hygiene are encouraged to consult with their industrial hygiene contact and to review the documentation of the exposure limits.

**TABLE 1
TOXIC EFFECTS**

ACETIC ACID	Acetic Acid is a colorless liquid with a pungent, vinegar-like odor. Exposure can take place through inhalation. Acetic acid can produce irritation of the eyes, nose, throat, and lungs. Inhalation of concentrated vapors can cause severe damage to the lining membranes of the nose, throat, and lungs. Repeated or prolonged exposure can cause darkening and irritation of the skin, erosion of the exposed front teeth, and chronic inflammation of the nose, throat, and respiratory tract. Contact with concentrated acetic acid may cause severe damage to the skin and eyes.
ACETONE	Acetone is a flammable liquid with a sweet, fruity odor and a pungent taste. It can enter the human body via inhalation. Repeated skin contact produces a dry, scaly, and fissured dermatitis. High vapor concentrations cause narcosis with symptoms of headache, nausea, light-headedness, vomiting, dizziness, incoordination, and unconsciousness.
ACETONITRILE	Acetonitrile is a flammable, explosive, colorless liquid with a faint acrid odor. The main route of entry to the human body is via inhalation. Repeated and prolonged exposure can produce eye and skin irritation. Exposure to high concentrations can cause nausea, vomiting, headache, sneezing, weakness, and light-headedness. Toxic effects may be similar to those produced by other cyanides (e.g., tissue oxidation inhibition, and death due to chemical asphyxiation).
ACETYLENE	Acetylene is a clear highly flammable gas with a strong garlic type odor that enters the body via inhalation only. It is a simple asphyxiant. Only acute effects are known with this gas, due either to the intoxication properties which can produce unconsciousness in 5 minutes on exposure to 35% acetylene, or lack of oxygen due to higher levels producing less than 19.5% available oxygen (simple asphyxiant). There is no evidence that repeated exposure to tolerable levels of acetylene has any deleterious effects on health.
ACRYLIC ACID	Acrylic Acid is a clear, colorless, hygroscopic liquid with an acrid odor. Acrylic acid enters the body via the skin or inhalation and is a severe eye, skin, and respiratory tract irritant. No chronic effects are known at tolerable levels.
ACTIVATED CARBON	Activated Carbon is a black, amorphous powder or granular solid. Activated carbon dust enters the body via inhalation. It is a slight irritant to the eyes as the result of the abrasive action of the dust particles, but no skin hazard is expected in normal industrial use. Chronic inhalation effects are unknown.
ALUMINUM ALKYLs	Aluminum Alkyl catalysts are liquids in solution with hexane, and polymerize ethylene/propylene in the Vistalon process. The lower and molecular weight alkyls are pyrophoric when undiluted. There is little toxicity information on aluminum alkyls, but skin contact can result in deep burns and scarring. Similarly, eye contact can result in severe burns and permanent eye damage. Fumes are severely irritating and can cause lung damage. Upon decomposition, aluminum alkyls give off Al ₂ O ₃ fumes that can cause "fume fever." Chlorinated alkyls, similar to those used in Vistalon, contribute HCl irritation upon alkyl decomposition, causing extreme skin, eye, and mucous membrane irritation and burns.

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TABLE 1
TOXIC EFFECTS (Cont)

ALUMINUM CHLORIDE	Aluminum Chloride is a white, crystalline solid. It enters the body via inhalation as a dust. Aluminum chloride's toxicity is based on its forming hydrochloric acid when it comes in contact with moisture in the respiratory tract or on the skin. Therefore, it is an extreme skin, eye, and mucous membrane irritant.
ALUMINUM OXIDE	Aluminum Oxide catalyst dust is a white powder that enters the body via inhalation. There are no clinical studies implicating aluminum oxide as a cause of pneumoconiosis in man, but toxicity may result from inhalation of dust, and the threshold limit is at the level of an "inert" or nuisance dust. Excessive exposures can cause skin and mucous membrane irritation.
AMMONIA	Ammonia is a colorless gas with an extremely pungent odor. Ammonia vapors enter the body by the inhalation route. At low concentrations, it is an irritant.
AMMONIUM PERSULFATE	Ammonium Persulfate is an odorless, colorless crystal that is readily soluble in water. All persulfates are strong oxidizing agents, and cause irritation to the skin, eyes, and mucous membranes. Some persulfates have caused liver and kidney damage after ingestion.
ANILINE	Aniline is a light yellow liquid with a characteristic odor. Exposure occurs via inhalation and skin absorption. The liquid is mildly irritating to the eyes and may cause corneal damage. Mild exposure to aniline causes cyanosis (bluish skin coloration due to reduced hemoglobin in the blood), and acute exposure can cause methemoglobinemia resulting in hypoxia (inadequate amounts of oxygen in the blood). Weakness, dizziness, coma, and death may result.
ANTHRAQUINONE DISULFONIC ACID (ADA)	There is no information available regarding the toxic effects of ADA, other than it may cause slight to moderate irritation of the skin and moderate irritation to the eyes.
ANTIMONY	Antimony is a silvery-white soft metal and its salts are solids that can form dusts. Exposure is primarily inhalation. Antimony is an irritant of the mucous membranes, eyes, and skin and may cause pneumonitis. Adverse cardiovascular effects have been observed following repeated exposure to high levels of antimony compounds. Symptoms of oral poisoning include vomiting, bloody stools, pulmonary congestion, coma, and possibly death due to circulatory or respiratory failure.
ARSENIC	Metallic arsenic is a steel gray, brittle metal; arsenic trichloride is an oily liquid; arsenic trioxide is a crystalline solid. Exposure can occur through inhalation and ingestion. Trivalent arsenic compounds are corrosive to the skin. The moist mucous membranes are more sensitive to the irritant action. Arsenic trioxide is capable of producing skin sensitization and contact dermatitis. Inorganic arsenic compounds are recognized as skin and lung carcinogens in humans. Overexposure to arsenic compounds can cause hyperpigmentation and hyperkeratosis (thickening) of the skin. Arsenic trichloride can cause severe damage to the respiratory tract.
ARSINE	Arsine is a colorless, heavier than air gas with a disagreeable garlic-like odor that enters the body via inhalation. Acute or chronic exposure to arsine causes massive destruction of the red blood cells and may cause anemia. The symptoms following acute exposure include headache, weakness, abdominal pain, nausea, and dark red urine. Death may result from renal shutdown or cardiac failure.
ASPHALT FUMES	Vapors and fumes arising from heated asphalt are known to be both eye and lung irritants. Inflammations of the tonsils, respiratory irritation, and nosebleeds have been reported in workers exposed to asphalt fumes in an enclosed workspace. In addition, some of the materials used to cut back asphalts may contain significant quantities of polynuclear aromatics, some of which are potent carcinogens.
BENZENE	Benzene is a clear, volatile, highly flammable liquid. Exposure mainly occurs through inhalation. Long term exposures to low concentrations may cause damage to the blood-cell-forming system. Chronic overexposure can result in many kinds of blood disorders, including aplastic anemia and leukemia. It may also cause adverse reproductive effects. Typical symptoms of acute overexposure are headaches, nausea, loss of appetite, central nervous system depression, and abdominal discomfort; with more severe exposure, there may be weakness, blurring of vision, and difficulty in breathing. Benzene is listed by ACGIH as a "suspected human carcinogen."
BENZOYL PEROXIDE	Benzoyl Peroxide is a white crystalline solid or granular powder with a faint odor of benzaldehyde. It enters the body via inhalation. The principal toxicity is related to irritation and sensitization. Benzoyl peroxide causes irritation of the mucous membranes, eyes, and skin, and may cause sensitization dermatitis. There is not enough information available to assess the chronic toxicity of benzoyl peroxide. No chronic effects have been seen at high concentrations in a chronic rat feeding study.
BERYLLIUM	Beryllium is a silvery-white metal with slight solubility in hot water. All beryllium compounds are soluble somewhat in water. Exposure can occur through inhalation. It is suspected as a potential carcinogen for humans. Brief exposure to high concentrations of the metal fumes or compounds can produce acute inflammation of the lungs. Chronic inhalation exposure may result in berylliosis, marked by cough, chest pain, shortness of breath, and damage to lung tissue. Skin contact with soluble salts can produce primary irritant or sensitization dermatitis.

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**TABLE 1
TOXIC EFFECTS (Cont)**

✦ BORIC ACID (OR BORON OXIDE)	Boric Acid is a white crystal or powder. Boric acid enters the body via inhalation. The toxicity of this material is slight to moderate; chronic effects are unknown. Acute, excessive exposure will result in slight to moderate eye, skin, and mucous membrane irritation.
✦ BORON TRIFLUORIDE	Boron Trifluoride is a colorless gas that fumes in moist air causing a pungent, irritating odor. Boron trifluoride and its hydrolysis products, i.e., boric acid, hydrogen fluoride, and fluoboric acid, enter the body via inhalation, and are severe irritants to the lungs, eye, and the skin. Boron trifluoride causes pneumonia in animals, both at acute doses (15 ppm) and chronic exposure (1.5 ppm). Chronic exposure also cause dental fluorosis.
BROMINE	Bromine is a heavy, corrosive, dark-brown, fuming liquid with an extremely pungent, penetrating odor. Bromine emits heavy, dark-brown fumes. This material enters the body via inhalation, dermal or oral exposure. It is highly corrosive to the eyes, mucous membranes, lungs, and skin. Symptoms in humans at 1-10 ppm exposure include dizziness, headaches, stomach pain, diarrhea, and measles-like eruptions on the face and trunk. Pneumonia may be a late complication of severe exposure.
1,3-BUTADIENE	1,3-Butadiene is a colorless, flammable gas with a mild, aromatic odor. The principal route of exposure is inhalation of the gas or vapor. 1,3-Butadiene is slightly irritating to the eyes and mucous membranes; skin contact with liquid butadiene can cause dermatitis and frost bite. At very high concentrations, it acts as a narcotic, producing fatigue, headaches, unconsciousness, respiratory paralysis, and death. Recent chronic inhalation studies with rats demonstrated that butadiene caused nephropathy (disease of the kidneys) and increased incidence of cancer in various organs. 1,3-Butadiene has been shown to cause a carcinogenic response in mice. Recent studies also indicate that 1,3-Butadiene affects fetal and/or maternal development at similar concentrations. Butadiene is listed by the ACGIH as a "suspected human carcinogen."
✦ BUTANE	Butane is a colorless, odorless, flammable gas that can enter the human body via inhalation. Butane is a simple asphyxiant and exposure to high vapor concentrations can result in drowsiness and narcosis.
BUTENES	Butenes are colorless, odorless gases or liquids. They enter the body via inhalation and are simple asphyxiants and can cause anesthetic effects at high concentrations.
BUTYL ALCOHOLS (N-BUTYL, SEC-BUTYL, TERT-BUTYL)	n-Butyl, sec-butyl, and tert-butyl alcohols are all colorless liquids that enter the body via inhalation. N-Butyl alcohol is also absorbed through the skin and is an irritant of the eyes and mucous membranes. All three butyl alcohols are central nervous system depressants.
BUTYL MERCAPTAN	Butyl Mercaptan is a colorless liquid with a skunk-like odor. The most common route of exposure is via inhalation. In the range of low concentrations, it causes irritation of mucous membranes; at higher concentrations, it can cause narcosis and CNS depression.
BUTYL RUBBER	See nuisance dust.
✦ BUTYLATED HYDROXYTOLUENE (BHT)	BHT is a white to yellow crystalline solid or powder with a slight phenolic odor and is insoluble in water. See nuisance dust.
CADMIUM	Cadmium is a soft, silver-white metal. Exposure to cadmium dust or fumes is via inhalation. Cadmium is a pulmonary irritant: the fume is a more severe irritant than the dust due to the smaller particle size. Pulmonary edema (fluid in the lungs) is caused by acute inhalation of cadmium. Chronic inhalation has caused fiber formation in the lungs, and toxic effects to the kidney, liver, reproduction system, and central nervous system of animals. Occupational exposure to cadmium has been implicated in a significant increase in prostate and respiratory tract cancer. Cadmium has been proposed by the ACGIH as a "suspected human carcinogen."
CALCIUM CHLORIDE	See nuisance dust.
✦ CALCIUM HYDROXIDE	Calcium Hydroxide is a relatively strong base and hence, a moderately caustic irritant to all exposed surfaces of the body, including the eyes and respiratory tract.
✦ CALCIUM STEARATE	Calcium Stearate is a fine, white to yellowish bulky powder. See nuisance dust.
CARBON DIOXIDE	Carbon Dioxide is a colorless, odorless, and non-combustible gas. It is a simple asphyxiant. Continuous exposure to 1.5 percent CO ₂ may cause changes in some physiological processes, such as an increase in heart rate. Exposure to a concentration of 5 percent can cause shortness of breath and headaches, while concentrations of 10 percent can produce unconsciousness and even death from oxygen deficiency.
✦ CARBON DISULFIDE	Carbon Disulfide is a colorless to faint yellow liquid with a sweet ether-like odor in pure form and a foul smell in commercial and reagent grades. Carbon disulfide enters the body via inhalation or skin absorption. Vapor is a severe irritant to the eyes, skin, and mucous membranes. Skin contact with the liquid may cause blistering, sensitization, and localized peripheral nerve degeneration. Chronic exposure to carbon disulfide can cause psychological problems, nerve disorders (tremors and loss of reflexes), and cardiovascular diseases (coronary heart disease). Carbon disulfide has been reported to cause adverse reproductive effects in animals.

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CARBON MONOXIDE	Carbon Monoxide is a colorless, odorless, and tasteless gas. Carbon monoxide gas enters the body via inhalation. It causes asphyxiation by combining with the hemoglobin in the blood. The affinity of CO for hemoglobin is 220 times greater than that of oxygen for hemoglobin. This reduces the ability of the blood to supply sufficient oxygen to the body tissues. The typical symptoms of CO poisoning include headaches, dizziness, drowsiness, nausea, vomiting, collapse, coma, and death.
CARBON TETRACHLORIDE	Carbon Tetrachloride is a colorless liquid. Carbon tetrachloride exposure can occur through inhalation or skin absorption. It causes central nervous system depression, liver and kidney damage, and liver cancer in laboratory animals. Carbon Tetrachloride is listed by the ACGIH as a "suspected human carcinogen." Many materials within the general class of organic chlorides can cause central nervous system depression and liver and kidney injuries. Ethylene trichloride and ethylene dichloride have caused cancer in animal tests.
CARBONYL SULFIDE	Carbonyl Sulfide is a colorless gas with a foul, slightly ether-like odor. However, carbonyl sulfide does not offer adequate sensory warning at low concentrations. It is a slight irritant to the lungs, and after prolonged exposure, it acts principally upon the central nervous system with death resulting mainly from respiratory paralysis.
CHLORINE	Chlorine is a highly irritating, greenish-yellow gas. It enters the body via inhalation. Chlorine is a potent irritant to the eyes, skin, and respiratory tract. Mild mucous membrane irritation may occur at 0.2 to 16 ppm; eye irritation at 7 to 8 ppm; and throat irritation at 15 ppm. Concentrations of 1000 ppm may cause death, primarily due to lung damage.
CHLOROBUTYL RUBBER	See nuisance dust.
CHLORODIFLUOROMETHANE	Chlorodifluoromethane, or Freon 22, is a colorless, nonflammable gas with a faint odor similar to carbon tetrachloride. It is not an irritant of the eyes, skin, or respiratory tract. High concentrations (> 5%) of chlorodifluoromethane can cause central nervous system depression, narcosis, and at higher concentrations, asphyxiation. Skin exposure to the liquid can cause frostbite, and decomposition products (caused by excessive heat or exposure to acids) are irritating and highly toxic.
CHROMIUM OXIDE	Chromium Oxide (Cr ₂ O ₃) is a green, crystalline solid. Chromium salts can enter the body via inhalation, dermal contact and ingestion. The chromium (III) compounds are less toxic than chromium (VI) compounds. Chromium (VI) trioxide is a crystalline solid that forms chromic acid when dissolved in water. It enters the body via inhalation, and is a severe irritant to the nose, lungs, and skin as a dust or a mist. Chromium (VI) compounds have caused lung and kidney damage, tooth discoloration, dermal sensitizing and severe eye injury. Certain water insoluble chromium (VI) compounds are listed by the ACGIH as "confirmed human carcinogens."
CITRIC ACID	Citric Acid is a colorless to white granular fine crystalline powder. See nuisance dust.
COAL DUST	Coal Dust is a combustible, mineral solid. Exposure to coal dust can occur via inhalation. The inhalation of coal dust causes coal workers pneumoconiosis, also known as black-lung disease, which is a chronic, progressive, irreversible disease which significantly decreases pulmonary function.
COBALT	Cobalt Oxide and sulfide are dark gray/black crystals that are insoluble in water and soluble in acids. Dust or fumes enter the body through inhalation. Cobalt dust is mildly irritating to the eyes and skin. It can cause allergic sensitivity in some workers. Chronic inhalation of cobalt dust may cause an asthma-like disease with cough and labored breathing. This disease may progress to pneumonia and formation of scar tissue in the lungs.
COBALT/MOLYBDENUM	Cobalt/molybdenum ("cobalt/moly") on alumina catalyst contains 3-5% cobalt oxide and 11-20% molybdenum trioxide on an alumina support. The catalyst is used in several different units, but primarily in hydrotreating, where the catalyst promotes hydrogenation reactions and the removal of sulfur and nitrogen from petroleum compounds. Cobalt/moly catalyst is blue. See separate entries for cobalt, molybdenum, and aluminum oxide. Spent cobalt/moly catalyst may contain residual hydrocarbons, nickel and vanadium metals (if used in a Residfiner), and/or cobalt and nickel carbonyls. See other table entries for the metal carbonyls.
COBALT PHTHALOCYANINE	Sulphonated Cobalt Phthalocyanine, a dark blue solid, is the major constituent of Merox catalyst, which removes mercaptan compounds from petroleum distillates. It is an irritant to the skin and eyes, and can cause skin staining and dermatitis from contact with the powder or solution. It is moderately toxic via inhalation and ingestion. Hazardous decomposition products include HCN, SO _x , NO _x .
COBALT SULPHATE	Cobalt Sulphate is a pink to red solid powder that is used as a catalyst in the oxo alcohol unit. Cobalt sulphate is soluble in water. It is unclear whether cobalt salts exhibit the same toxic properties as cobalt metal and fume. Some cobalt salts can raise the amount of red blood cells in the body and cause acute lung irritation. At present, the cobalt sulphate TLV should be on an "as cobalt" basis.