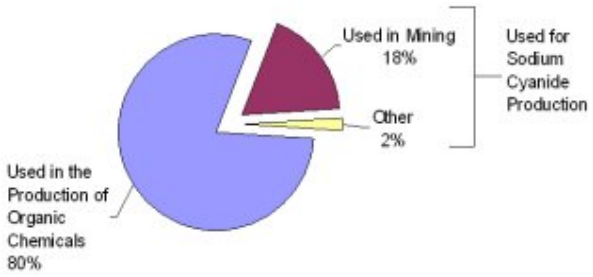
Summary Fact Sheet on Cyanide

Cyanide

The word 'cyanide" can stir people's emotions. This is not surprising, given the less desirable aspects of its historical use, and the many myths and misconceptions relating to cyanide.

Introduction.

The cyanide process of gold recovery enabled a higher percentage of gold and silver to be extracted from hard rock, making many operations viable that would otherwise have had to close. Cyanide is used in the electroplating industries, the tanning industry and in specialized laboratories. A complex cyanide, Prussian blue, is used for dyeing jeans.



(Source: Cyantists website)

Historical use.

The first Cyanidation plant in the world was established close to Waihi, at the Crown Mine at Karangahake, in 1889. By 1892 there were six cyanide plants on the Ohinemuri Goldfield, plus others at Thames and Coromandel. The process was a great success, as the recovery of gold improved from 40%-50% to 85%-95%. During this time tailings containing cyanide were deposited directly into the Ohinemuri River from various mining operations. Despite this practice, there have been no long term adverse environmental effects from cyanide use.

There are now thousands of operating and closed mine sites around the world which have used cyanide - and they will tell the same story - no long term adverse environmental effects from cyanide use.

Given its past history, it is no wonder that cyanide can be perceived with alarm by the public. As a deadly poison, cyanide has been associated with events such as World War Two genocide, Middle Eastern wars, and the Jonestown suicides.

Hydrogen cyanide vapour has been used to fumigate buildings and ships, to exterminate rabbits, rodents, and large predators, and in horticultural practice to control insect pests that have developed resistance to other pesticides (Ballantyne, 1988). Sodium cyanide was used for about 50 years by the US Fish and Wildlife Service to control coyote numbers and so protect livestock.

Myths and misconceptions.

Due to its historic uses, there are a number of myths and misconceptions relating to the toxicity of cyanide. It is important to realise that cyanide:

- occurs naturally
- is not toxic in all forms or all concentrations
- does not persist in the environment
- is not cumulative
- should not be confused with acid drainage
- is not a heavy metal
- is not radioactive
- can be manufactured, stored, transported, used and disposed of in a safe manner.

Natural sources of cyanide.

Cyanide and chemically related compounds are formed, excreted and degraded in nature by hundreds of species of bacteria, algae, fungi, plants and insects (Knowles, 1976 and US Fish and Wildlife Service, 1991). As a result, low levels of cyanide can appear in naturally occurring surface or groundwater samples which normally would not be expected to contain it.

At least 1,000 species of plants and micro-organisms from 90 families have been shown to contain one or more of nearly twenty compounds capable of producing cyanide (Seigler, 1976). About 800 species of higher plants from 70 to 80 families, including agriculturally important species such as the cassava, flax, sorghum, alfalfa, bamboo, peach, pear, cherry, plum, corn, potato, cotton, almond, and beans are Cyanogenic (Eyjolfsson, 1970). Cyanide poisoning of livestock by forage sorghums and other cyanogenic plants is well documented (Mudder 1997).

COMMON FOODS THAT HAVE HIGH LEVELS OF CYANIDE

(Source**:** Cyantists website)

Cassava: 104 mg CN/ 100 g plant tissue

Wild Cherries: 140-370 mg CN/ 100 g plant material

Almonds: 250 mg CN/100g plant tissue

Lima Beans: 100-300 mg CN/ 100g plant tissue

Sorghum: 250 mg CN/ 100 g plant tissue

Fungi and bacteria are prevalent producers of cyanide. In addition to plants and micro-organisms, insects have been shown to produce cyanide. Species of centipedes, millipedes, beetles, moths and butterflies synthesize and excrete cyanide for defensive purposes (Duffey, 1981).

Coffee and table salt also contain cyanide. Laetrile (an anti-cancer preparation made from apricot kernels) and sodium nitroprusside (a drug used to reduce high blood pressure), release cyanide upon metabolism (ATSDR, 1995).

Cigarettes Contain Hydrogen Cyanide

Airborne sources of cyanide arise from fires and cigarette smoke. In a pack that declares "Carbon monoxide 15-28mg" the smoker will be inhaling the following:

	Emission Levels	
	Previous	**Current**
Tar	8 mg	8 - 29 mg
Nicotine	1 mg	1 - 2.6 mg
Carbon Monoxide	9 mg	9 - 27 mg
Formaldehyde	n/a	0.035 - 0.13 mg
Hydrogen Cyanide	n/a	0.073 - 0.25 mg
Benzene	n/a	0.034 - 0.08 mg
Emission levels for a cigarette sold in Canada.		
* Providing a low and high range for emission levels of these toxic chemicals is reflective of how people smoke differently and provides a better idea of the range of toxic chemicals to which people are exposed when smoking. The best way to reduce the potential health risks associated with these toxic chemicals is to quit!		

Source: Canadian Government, Health Canada

General Environmental Considerations

Cyanide has been used in the mining industry for over a hundred years. In New Zealand, where cyanide was first used to produce gold, despite the lack of stringent environmental safeguards for old mining operations, there are no long term adverse environmental effects from the use of cyanide in the mining industry. The same applies to Bulgaria where cyanide was used at a number of operations in the first half of last century - the water downstream from these is drinkable - today.

- There is no evidence that cyanide is teratogenic, mutagenic, carcinogenic, or bioaccumulative in humans, animals, or aquatic life (Smith & Mudder 1994).
- There are no reports of cyanide biomagnification or cycling in living organisms, probably owing to its rapid detoxification (Hagelstein 1997).

The majority of the absorbed cyanide reacts with thiosulphate in the presence of enzymes to produce thiocyanate, which is excreted in the urine over several days. Owing to this rapid detoxification, animals can ingest high sub lethal doses of cyanide over extended periods without harm (Eisler 1991).

Effect of Cyanide on plant growth.

Studies of plant growth trials undertaken on tailings of both grass and native species in both fertilized tailings, and tailings with compost added have been undertaken. Pasture yields from plots without compost were 11,000 kilograms per hectare, compared to 14,000 kilograms per hectare from compost added plots. The survival rate of native plants in tailings was 100%.

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Modified after: Newmont Waihi Gold Limited

CYANIDE FACTS

Q & A

What is cyanide?

Cyanide is a general term for a group of chemicals containing carbon (C) and nitrogen (N). Cyanide compounds include both naturally occurring and human-made chemicals. Naturally, cyanide can be produced by certain bacteria, fungi, algae, and it is found in a number of foods and plants. The principal human-made cyanide forms are hydrogen cyanide (HCN), sodium cyanide (NaCN) and potassium cyanide (KCN). Hydrogen cyanide is a colorless gas with a faint, bitter, almond-like odor. Cyanide is acute toxic and is lethal if ingested or inhaled.

What happens to cyanide when released to the environment?

Cyanides are not persistent in water or soil. Cyanides may accumulate in bottom sediments, but residues are generally as low as <1 mg/kg even near polluting sources. Majority of an accidental release of cyanide is volatilised to the atmosphere where it is quickly diluted and degraded by ultra violet. Other factors, such as biological oxidation, precipitation and the effects of sunlight also contribute to cyanide degradation. There is no evidence of bioaccumulation in the food chain, and hence, secondary poisoning does not occur.

How is it used?

Cyanide combines with many organic and inorganic compounds. Because of its unique properties, cyanide is used in the manufacture of metal parts and numerous common organic products. About 1.4 million tonnes of hydrogen cyanide (HCN) are produced annually worldwide, of which only about 20% is converted into sodium cyanide (NaCN) and mainly used in the extraction of precious metals such as gold and silver, and others (e.g. copper). The remaining 80 % of the hydrogen cyanide (HCN) is used in electroplating, metallurgy, and in the production of a wide range of chemicals, such as plastics, fire retardant, cosmetics, dyes, nylon, paints, pharmaceuticals, Plexiglas, rocket propellant, and road and table salts.

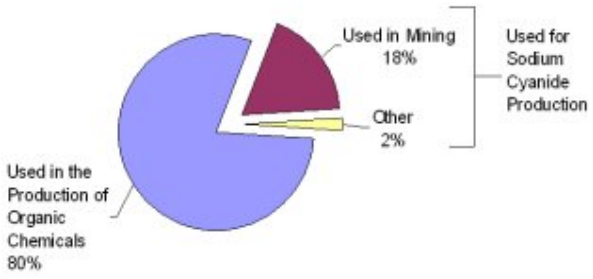

Figure: Industrial use of cyanide production.

Sources: Terry Mudder; The Management of Cyanide in Gold Extraction (ICME)

Why is cyanide dangerous?

Cyanide is a fast acting poison in the human body. It affects our ability to breathe. Severe breathing difficulties develop very rapidly when cyanide is swallowed, inhaled or absorbed through the skin. Highly poisonous cyanide gas can be produced when cyanide solids or liquids are mixed with moisture in air, or with steam, acid, acid fumes or if air is bubbled through a cyanide solution. Cyanide gas is highly flammable and reacts violently in some situations (e.g., a large amount of cyanide gas mixed with air may suddenly explode). There is an extremely high risk of explosion if cyanides are exposed to heat or flames.

How is cyanide used in mining?

Cyanide is one of only a few chemical reagents that dissolves gold in water. It is a common industrial chemical that is readily available at a reasonably low cost. For both technical and economic reason, cyanide is the chemical of choice for the recovery of gold from ores. In gold mining, a dilute cyanide solution is sprayed on crushed ore that is placed in piles, commonly called heaps, or mixed with ore in enclosed vats. The cyanide attaches to minute particles of gold to form a water-soluble, gold-cyanide compound from which the gold can later be recovered. Cyanide is used in a similar manner to extract silver from ores. In the extraction of non-precious metals, such as copper, nickel, cobalt, and molybdenum, cyanide is used in the milling and concentration processes to separate the desirable metals from the wastes. Consequently, cyanide and related compounds often are contained in mine tailings.

What are the cyanide extraction processes?

The most common processes that use cyanide to extract gold are Merrill-Crowe recovery which uses zinc powder to precipitate the gold from solution, Carbon in Column (CIC), Carbon in Pulp (CIP), Carbon in Leach (CIL) a variation of CIP, and Heap Leaching. The CIP process is currently one of the most favoured in modern large scale mines, a general description of which is provided below.