CYANIDE

Identity

Name (parent)	Hydrogen cyanide	Potassium cyanide
UN number	1613	1680
CAS number	74-90-8	151-50-8
Intervention value (AGW in mg/m^3)	10	n/a
Structure	CHN	KCN

Occurrence

Chemical state (at 20°C)	Liquid	Solid
Physical appearances	Colorless liquid with a faint bitter almond odor. Very volatile	White solid with a faint bitter almond odor
Industrial products	Cyanide is used or produced in various occupational settings where activities include electroplating, some metal mining and gas works operations, metallurgy, metal cleaning, certain pesticide applications, tanning, photography, and photoengraving. Fire fighters are exposed since HCN is a product of combustion and often released during fires	

Physicochemical properties

Molecular weight	27.0	65.1
Vapor pressure (mbar at 20°C)	830	Negligible
Octanol/water partition coefficient (log Ko/w)	0.7	- 1.69 (estimated, NIOSH)
Water solubility (in g/100 mL at 25 °C)	Completely soluble	Completely soluble

Toxicokinetics (parent)

Uptake by inhalation	Hydrogen cyanide is rapidly absorbed after inhalation, 58% of hydrogen cyanide is retained in the lungs after inhalation exposure, cited in ATSDR [1]. Cyanide salts (such as potassium cyanide) can be absorbed following the inhalation of cyanide-containing aerosols [2].
Uptake by skin absorption	Uncommon exposure route, but uptake of cyanide through the intact skin is possible [3]. Potassium cyanide has a corrosive effect on the skin, which increases absorption through the skin.
Uptake via gastrointestinal tract	Soluble cyanide salts (such as potassium cyanide) are rapidly absorbed in the gastro-intestinal tract, cited in ATSDR [1]. The dogs dosed with 8.4, 4.4, or 1.6 mg HCN/kg, had absorbed 17, 24,

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	and 72%, respectively of the dose given, before dying, cited in ATSDR [1].
Distribution	Cyanide is rapidly distributed throughout the body by blood. Cyanide does not accumulate in the human body [1].
Metabolism	The principal pathway of cyanide metabolism is conversion to thiocyanate catalyzed by either rhodanese (thiosulfate sulfurtransferase) or by 3-mercaptopyruvate sulfurtransferase. Minor pathways: conversion to 2-aminothiazoline-4-carboxylic acid, incorporation into a 1-carbon metabolic pool, combining with hydroxocobalamin to form cyanocobalamin (vitamin B12), [1].
Excretion via lungs	Minor excretion route; excretion of cyanide, thiocyanate and CO_2. In rats subcutaneously injected with [^{14}C] sodium cyanide, 4% of injected dose was exhaled, mostly as CO_2 (90% as CO_2 and 9% as cyanide) [4].
Excretion via urine	Primary excretion route: thiocyanate and other metabolites are excreted in urine. In rats subcutaneously injected with [^{14}C] sodium cyanide, 58% of the injected dose was excreted in urine within 24 hours (79 % as thiocyanate) [4].
Excretion via feces	Minor excretion route. In rats subcutaneously injected with [^{14}C] sodium cyanide, 1.2% of the injected dose was excreted in feces within 24 hours [4].

Toxicodynamics

Toxicity	Target organ system: cardiovascular system, central nervous system and respiratory system.
Classifications for carcinogenicity	Not classified by IARC
Classifications for reprotoxicity	Not classified
Classifications for sensitizing properties	Not classified

Biological monitoring

Biomarkers	**Cyanide in whole blood**	**Thiocyanate in urine**	**Thiocyanate in serum**
Molecular weight	27.0	58.08	58.08
Involved enzymatic metabolism	-	Cytochrome P-450 system	Cytochrome P-450 system
Biological material	Blood	Urine	Blood
Type of sample	Whole blood	Spot urine	Serum
Sampling strategy	< 1 h	< 1 h	< 1 h
Excretion pattern	Plasma half-life: 20 - 60 minutes, cited in ATSDR Monoexponential decay with a half-life of 1.14 (95% CI: 0.84 – 1.80) [5] (determined in a male after a suicide attempt)	Elimination thiocyanate *(in serum)*: 2.7 days ± 1.1 [6]	Elimination thiocyanate (in serum): 2.7 days ± 1.1 [6]

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Materials	Vacutainer tubes containing EDTA	Polystyrene universal container	A vacuum tube without anticoagulant
Transportation	4 °C	At room temperature (within 7 days) [7]	4 °C
Storage	-20°C	- 20°C	-20°C
Stability	Poor stability [8] 2 weeks at -20°C [9]	14 days at 4 °C > 6 month at -20°C [7]	Not known
Measurement principle	Colorimetric Fluorescence Amperometry IC-UV/fluorescence (silver electrode) HS-GC-ECD [10] SPME-GC-NPD [11] HS-SPME-GC-MS [12]	Colorimetric König reaction, after anion exchange. Absorbance is measured at 608 nm [10]	Colorimetric reaction with ferric ions in acid, absorption measured at 455 nm
Aliquot for 1 analysis	5 mL	20 mL	5 mL
Limit of quantification	LOQ in water: 0.01 µg/mL (HS-SPME-GC-MS) [12] LOD: 0.7 ng/mL (HS-GC-NPD) [10] LOD: 2.8 ng/mL / LOQ: 3.1 ng/mL (SPME-GC-NPD) [11]	1 µg/mL [10]	Not reported
Recommended adjustments	n/a	- Specific gravity - Adjustment for creatinine - Correction for contribution of smoking	n/a
Preferred units for expression of results	mg/L	mg/L	mg/L
Conversion factor	1 mg/ L = 0.037 mmol/L	1 mg/L = $17.22 * 10^{-3}$ mmol/L	1 mg/L = $17.22 * 10^{-3}$ mmol/L
Biological exposure value US	n/a	n/a	n/a
Biological exposure value Germany [13]	n/a	n/a	n/a
Background value	10 µg / 100 mL (nonsmokers) 50 µg / 100 mL (smokers) [2]	2.5 mg / g creatinine (non-smokers) [2]	n/a
Remark	Not specific for cyanide exposure because of natural thiocyanogenic glucosides and cyanogenic glucosides ingredients in the diet that also lead to formation of cyanides. Active smoking an use of the drug sodium nitroprusside also leads to formation of cyanide.		

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