Cyanide Code for Gold and Silver Mining

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ICMI AUDITOR FOR CN PRODUCTION, TRANSPORTATION, GOLD MINING OPERATIONS

Agenda

1. How about Cyanide?
2. Who is ICMI?
3. What is “The Code“?
4. ICMI Requirements
5. Types of Certifications

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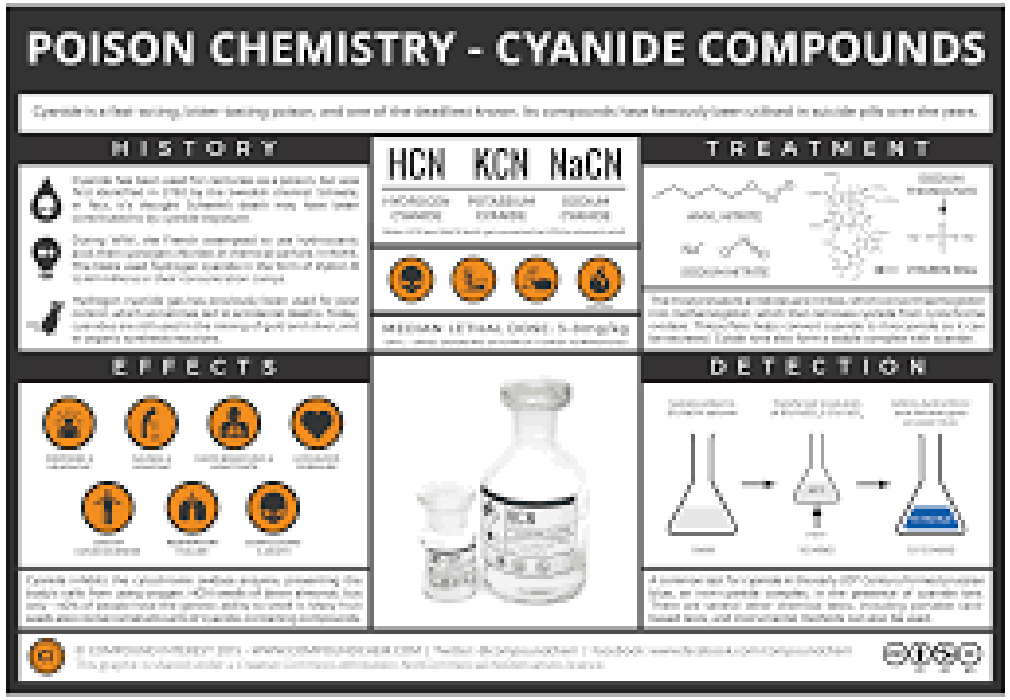
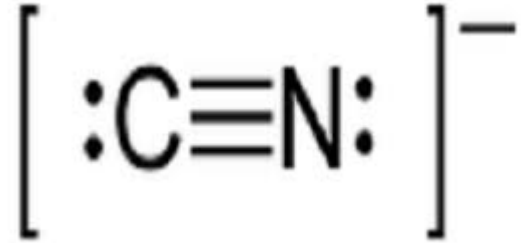
How About Cyanide?

- Cyanide = singularly charged anion consisting of a C-atom and N-atom joined with a triple bond, CN-.
- Most toxic form is “free cyanide” = cyanide anion & hydrogen cyanide (HCN), gaseous or aqueous state.
- pH = 9.3 - 9.5 CN- and HCN are in equilibrium, with equal amounts of each present.
- pH = 11, >99% remains in solution as CN-.
- pH = 7, > 99% cyanide exists as HCN.
- HCN is highly soluble in water;
- Solubility decreases with temp increase & highly saline conditions.
- Both HCN gas and liquid are colorless; odor of bitter almonds, although not all can detect odor.





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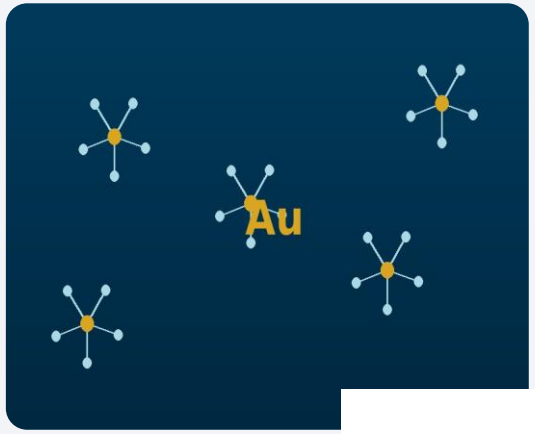
Cyanidation

- Process of extracting gold from ore with CN.
- Reaction, known as Elsner's Equation:

$$4\ Au + 8\ CN^- + O_2 + 2\ H_2O = 4\ Au(CN)_2^- + 4\ OH^-$$

- Affinity of CN for gold: extracts it preferentially
- CN also forms complexes with other metals from ore, including Cu, Fe and Zn. Will tie up CN otherwise available to dissolve gold.
- Cyanide chemistry is complex.



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Physical Forms of Cyanide Used in Gold Mining

- Variety of physical and chemical forms:
  - solid briquettes,
  - flake cyanide
  - liquid cyanide
- Strength of bulk CN reagents vary:
  - 98% NaCN briquettes,
  - 44-50% for flake CaCN,
  - 28-33% for liquid NaCN,
  - 5-18% for liquid CaCN

Areas & Tasks for potential CN exposures in Gold Mining Ops

- Reagent unloading & storage
- Mixing facilities
- Carbon stripping, washing & regeneration
- Tops of process tanks indoors
- CIL screen-cleaning
- CN treatment, destruction & recovery
    - (tailings)

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ICMI = International Cyanide Management Institute

The Institute is governed by Board of Directors responsible for establishing policies, standard operating procedures, and approving Cyanide Code revisions

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ICMC = International Cyanide Management Code

- “Code” for the Manufacture, Transport, and Use of Cyanide In the Production of Gold and Silver.
- “The Code” is an industry voluntary performance-driven global program for gold and silver mining companies.
    - Supply chain management of CN in gold mining ops
- Based on Principles and Standards of Practice, the Cyanide Code provides a management system for the safe management of cyanide throughout its use cycle, including production, transport, handling, use, recycling and disposal of the chemical at the mine site.

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As of January 1, 2025

48

countries are home to participating operations

>230

signatory companies

>270

Certified Operations

58 gold mining companies

33 CN producers

143 CN transporters

142 gold mines

40 CN production facilities

134 CN transporters

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Partial List from ICMC Website

Mining Operations

Agnico Eagle Mines Limited, Canada

AK Altynalmas JSC, Republic of Kazakhstan

AMG, French Guiana

AngloGold Ashanti, South Africa

Asanko Gold Ghana Limited, Ghana

Asante Gold Corporation, Ghana

Aura Minerals Inc., Canada

Barberton Mines (Pty) Ltd., South Africa

Barrick Mining Corporation, Canada

Production Operations

AfriChem Ghana Limited, Ghana

Almacenera Pacifico S.A.C., Peru

Anhui Anqing Shuguang Chemical Co., Ltd., China

Australian Gold Reagents Pty Ltd., Australia

Centroquimica S.A.C., Peru

Cesari Logística Ltda., Brazil

ChemQuest Ghana Ltd., Ghana

CyPlus Idesa S.A.P.I. de C.V., Mexico

CyPlus, Germany

Transportation Operations

Action Resources Inc., United States

Africa Global Logistics, France (formerly Bolloré Transport & Logistics)

Africa Transport, Republic of Guinea

Agnico Eagle Mines Limited, Canada

Alaska West Express Inc., United States

Alistair Group, Tanzania

Allship Logistics Limited, Ghana

Alpha Services Limited, Mauritania

AMA Guinée, Republic of Guinea

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ICMC = International Cyanide Management Code, continued

- Focuses exclusively on safe management of cyanide and cyanidation mill tailings and leach solutions.
- Companies become ‘signatory’ to adopt “the Code” & must have mining operations audited by an independent 3rd party to determine the status of Code implementation.
- Operations that meet the Code requirements can be “certified”.
- Unique trademark symbol utilized by the certified operation.
- Audit results made public to inform stakeholders of status of cyanide management practices at certified operation.

The Cyanide Code is amongst the most established certification programs in the mining sector. This voluntary industry program is focused on the safe management of cyanide by companies producing gold and/or silver and by companies producing and transporting cyanide.

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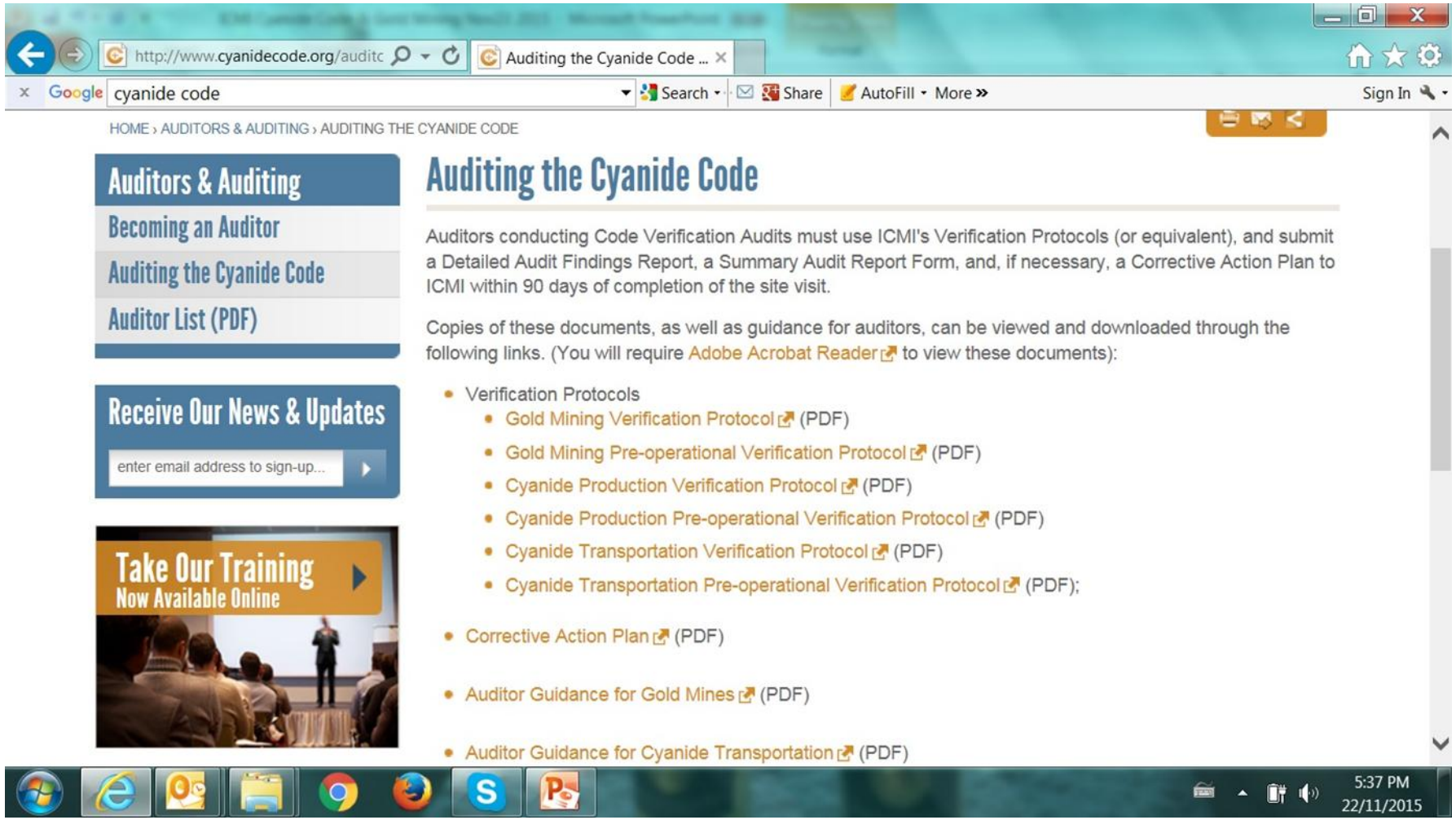
Auditing the Cyanide Code



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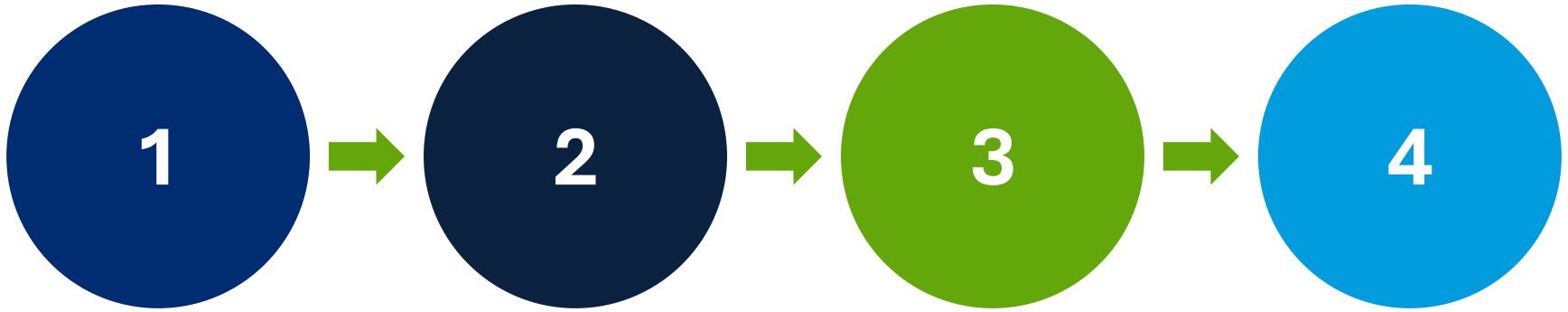
Usual Steps


1
2
3
4
Gap Analysis
Become a "Signatory" to Cyanide Code
Audit within 3 years of becoming Signatory
Re-certification every 3 years

9 Principles for ICMI Gold Mining Operations Audit

1. Production and Purchasing
2. Transportation
3. Handling and Storage
4. Operations
5. Decommissioning
6. Worker Safety
7. Emergency Response
8. Training
9. Dialogue and Disclosure

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5 Principles for ICMI CN Production Audit

1. Production Operations
2. Production Worker Safety
3. Monitoring
4. Production Training
5. Production Emergency Response

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3 Principles for ICMI CN Transportation Audit

1

Transport

2

Interim Storage

3

Emergency Response

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3 Principles of Transportation Audit with detailed Standards of Practice

1. **Transport** (Transport CN to minimize accidents & releases):
   - Cyanide transport routes
   - Personnel CN handling & transport equipment
   - Suitability of transport equipment for CN
   - Safety program for CN transport
   - Track CN shipments
2. **Interim Storage** (Design, construct & operate CN shipping depots & interim storage sites to prevent releases & exposures):
   - Store CN to prevent accidental releases
3. **Emergency Response** (Protect communities & environment through emergency response strategies & capabilities):
   - Detailed ERP for potential CN releases
   - Designate response personnel & resources
   - Procedures: internal & external emergency notification & reporting
   - Procedures for releases remediation; add'l hazards of CN treatment
   - Periodically evaluate response procedures & capabilities & revise

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Chronology of a Transport & Convoy of NaCN

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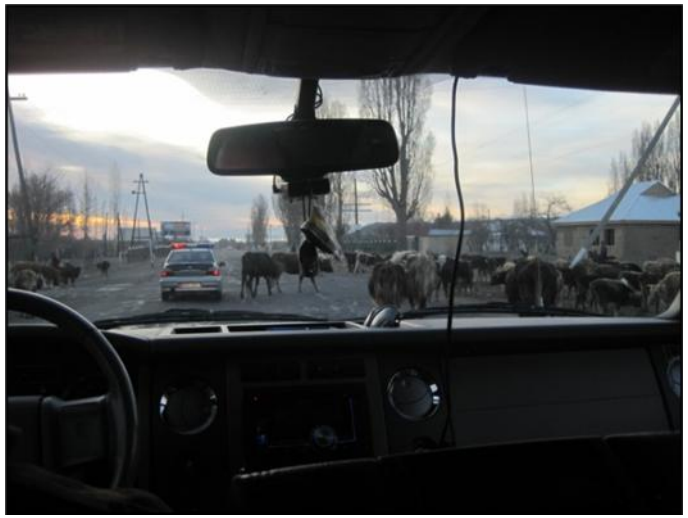

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Audit Findings

- Full Compliance
- Substantial Compliance
- Non-compliance

- Good faith effort to comply
- Deficiency readily correctable
- No immediate or substantial risk to health, safety or environment

- Specific scope specified for each Principle and each Standard of Practice
- Verification Protocols
- Auditor Guidance
- Risk and Management System based

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Next Steps after Feet-on-Ground Audit

- Draft DAFR (Detailed Audit Findings Report) & SAR (Summary Audit Report) & Auditor Qualifications must be submitted to ICMI within 90 days of audit.
- A typical audit schedule:
  - 5 days on site, with 2 accredited auditors
  - Draft DAFR sent to mine for review <60 days
  - Close potential CARs within 50 days for full compliance
  - Comments from mine <70 days
  - Draft SAR sent to mine for review <80 days
  - Auditors send draft DAFR & SAR to ICMI within 90 days
  - ICMI performs “completeness review” in 30-60 days
  - Certification posted to ICMI website ~ 1 month later.

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ACGIH TLV Documentation for Hydrogen Cyanide and Cyanide Salts

Recommended TLV's intended to minimize potential for headache, nausea, nasal, throat, & pulmonary irritation, & enlargement of thyroid gland, which can result from prolonged low concentration exposure.

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Aspects of an Audit – Neato!

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How to Become a CN Code Auditor

Auditor Criteria & Auditor Credentials

- 7 years experience (in the operation) for at least 1 auditor; > 3 years experience for others
- In 7 years: > 3 EHS audits
- Need Lead & Technical EHS auditors
- “Certified” lead auditor by self-regulating professional organization
- Recognized Auditor: Lead, Mining, Production, Transportation
- No conflict of interest
- No auditor or company derives >30% revenue avg 5 years

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ICMI Requirements

- Independent 3rd party auditor(s)
- Auditor rotation fosters independence
- Integral to Cyanide Code Program
- Individual not more than 2 consecutive audits for a particular gold mine, CN production or CN transport
- Audit firms can do 3 consecutive audits

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Thank You

QUESTIONS? COMMENTS?

Find out more on ICMI Cyanide Code: The Cyanide Code

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