

AMRE Safety Seminar 24 July 2008

**CYANIDE SAFETY IN METALLURGICAL
PLANTS**

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Incidents

• **May 2008 West Africa**

“It Will Never Happen To Me”

- 2 Project personnel and 9 contractors were sprayed with sodium cyanide on top of leach tanks.
- Dosing pipe dislodged – temporary repair/unchoke
- Visitor familiarisation with emergency drills
- Safety Showers and Emergency Response
- Cyanide Alarm
- Oxygen Availability
- Doctor familiarisation with treatment protocol
- 2 Patients IV, 1 Patient administered antidote
- All released within 12 hours.
- Sub-standard pipe installation rectified

CHANGE MANAGMENT



Incidents

- Nov 1999 ERGO 1 X FATAL, 2 X Severe Impediment
 - Jan 2000 ERGO Exposure , 9 X Hospitalisation
- CHANGE
MANAGEMENT
- 2000 Major Ecological Disaster in Romania, large volume of tailings & cyanide spilt into Danube – Black Sea. Extensive fish kills 1200 tons, Hungary 5km carpet of dead fish. Major drinking water interruptions. Green Peace call to stop using CN.



Fish killed from cyanide spill at Baia Mare

Cyanide Uses

- **History**

- Military and Civilian Targets (Blood Agents)
- French used 4000tons in WWI without notable success “all or nothing” biological activity. Small munitions.
- Allegedly by Japan against China pre WWII
- US maintained a small amount of CN munitions in WWII
- 1942 Zyklon-B used by Nazi Germany mass gassings in concentration camps.
- 1980s Iran Iraq chemical war against Kurds northern Iraq – CN possible.

- **Other**

- Cloth and paper manufacture
- Ingredient in plastic
- Developing photos
- Pest control, ships and buildings
- Cleaning metal – electroplating
- Cyanide is an ingredient in cigarette smoke



- **Gold Mining**

- Cyanide is the most suitable and economical Lixiviant (selectively extract the desired metal)
- Economical extraction of low concentration ores – leach requires dissolving of Au
- No viable alternatives
- ERGO operation alone consumed 1500tpm
- Largest Gold Producers and CN Manufacturers commit to International Cyanide Code

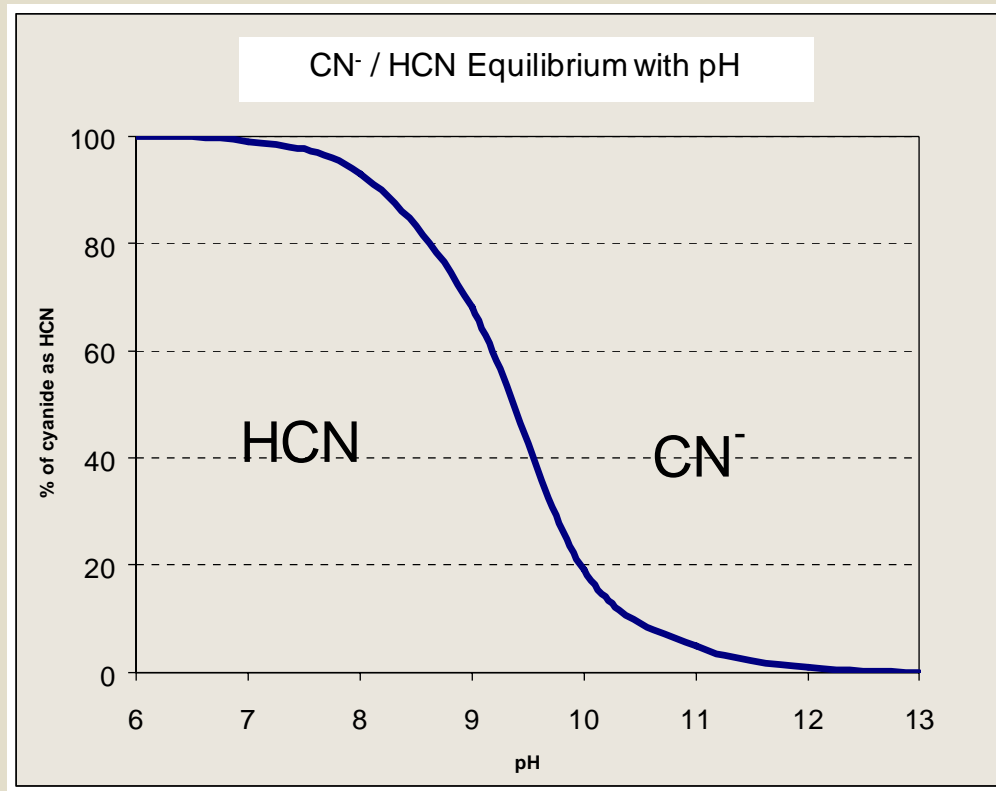
Cyanide Properties

- Cyanide is a rapidly acting, potentially deadly chemical that can exist in various forms.
- Unlike toxic metals, cyanide is not an element but a compound composed of only carbon and nitrogen.
- Free cyanide does not bio-accumulate up the food chain, or persist like toxic metals. Its toxicity is instant or acute and, once reacted, leaves little residual trace
- Sodium and Calcium cyanide are stable at ambient temperatures
- Cyanide can be a colorless gas, such as hydrogen cyanide (HCN) or cyanogen chloride (CNCl), or a crystal form such as sodium cyanide (NaCN) or calcium cyanide (CaCN).
- Cyanide sometimes is described as having a “bitter almond” smell, but it does not always give off an odor, and not everyone can detect this odor –genetic.
- Degradation through
 - pH
 - Tempertaure
 - UV Light
 - Aeration



Properties

- Specific gravity (liquid): 0.69
- Gas density: 0.94 (air = 1)
- Flammability: flammable limits 3.9% to 21.8% at room temperature
- Flammable range: 5.6% to 40% (concentration in air)
- pH sensitive



Biochemistry

Swallowing, inhalation and absorption through the skin

270ppm HCN immediately fatal

18ppm slight symptoms after several hours

Cyanide cuts off oxygen to cells

by stopping aerobic cell metabolism

binding to hemoglobin preventing oxygen exchange

Especially harmful to brain and heart

Light to mild poisoning

Irritation of the nose and throat

Headaches, nausea and vomiting

Breathlessness

Dizziness

General weakness

Severe poisoning

Unconsciousness

Respiratory failure

Convulsions

Cessation of breathing

Death



Cyanide Best Practice

- **Responsible Use of Cyanide and Increased Operator Awareness**
- **Guidelines & Codes**
 - AGA Cyanide Code 1999 – focused on delivery and off loading RA
 - AGA Guideline Rev 4 Feb 2005
 - AGA CN Code Rev 5 Feb 2008
 - International Cyanide Management Code Nov 05



Cyanide Best Practice

- AGA Africa Region Cyanide Code Rev 5 Feb 2008

60 Chapters 333 pages

- Section 1 : **Guideline management Systems**
- Section 2 : **People Awareness and Protection**
- Section 3 : **Chemical Stewardship**
- Section 4 : **Environmental Stewardship**
- Section 5: **Closure Management**
- Section 6 : **Emergency Preparedness/Response**
- Section 7 : **Information/Best Practice Development**
- Section 8 : **Photographic Library**



CHANGE CONTROL IS CRITICAL IN A CYANIDE MANAGEMENT SYSTEM

Maintenance of Equipment Chapter 25

- Risk Assess
- Protecting workers, environment and members of the public
- Decontamination steps
- Testing of environment and entry permits, continuous monitoring
- Lock outs
- Work practices, procedures and standards are essential. Any changes are subject to hazop study and risk assessment.
- Training, testing, competency (maintenance & cyanide)
- PPE, air line mask
- Ventilated area
- Buddy System
- Emergency Response
- Consider fatigue/dehydration



First Aid Chapter 42

- Sound the alarm + notify clinic
- Protect the rescuer
- Put on PPE and remove patient to cyanide free area
- Remove contaminated clothing
- Wash off contamination
- **Give Oxygen**
- If respiratory distress is evident then make patient inhale Amyl Nitrite
- Transport to hospital/clinic
- Use bag resuscitator if necessary – no mouth to mouth
- Vomitus is acidic – HCN
- Tripac Cyano Kit to accompany patient to clinic





Plant Design Chapter 46

- Location away from public, buildings other hazardous chemicals. Prevailing wind directions.
- Materials of construction – caustic solution therefore no aluminum, brass, magnesium, galvanising.
- Access Control, off loading + 12m turning circle radius min.
- Drain off loading bay into storage area.
- Demarcation, colour coding, mandatory, prohibitory and warning signs.
- Storage tanks to BS 2654,
- Two drain valves in series, second one with tell tale hole.
- Piping -no galvanised or PVC. HDPE widely used. Welding spec to be strictly adhered to. Flanged or welded, no screw or compression fittings. Secondary containment. Flange covers.
- Stainless steel valves on main solution lines.
- Minimum 150 lux illumination at off loading points, emergency equipment. 20 lux at tanks and stairways.
- Design is to take emergency equipment and PPE into account

The Way Forward

- **Preserve the licence to mine through Responsible Use of Cyanide ICMI**
- **Continuous Improvement**
 - **Audit + Action**
 - **Alternatives to Cyanide not presently feasible**
 - **Alternative Treatment – USA Fire Fighters**
 - **Drills – Practise**
- **Ensure Your Own Safety**

