



EXHIBIT B – STANDARD OPERATING PROCEDURES

This Exhibit contains two Standard Operating Procedures (SOPs) relating to the sodium cyanide mix tank. The SOPs appear in the following order:

- SOP for mixing sodium cyanide solution
- SOP for sodium cyanide clean-up (Levels 1, 2 and 3)

Lyndia Stacey of the University of Waterloo prepared this design case study for classroom use. The authors do not intend to illustrate either effective or ineffective handling of an engineering situation. The author may have disguised certain names and other identifying information to protect confidentiality.

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Standard Operating Procedure

Mixing Sodium Cyanide Solution

1. Purpose

The purpose of this procedure is to outline the process of mixing sodium cyanide solution. It is extremely toxic and must be handled carefully.

2. Scope

This procedure applies to activities related to the Mixing Sodium Cyanide Solution and it is applicable to all personnel that perform this task.

3. Procedure

General requirements:

1. The main risks associated with the task are:
 - a. The cyanide bag breaker spike mounted to the top of the mix tank is very sharp and care must be exercised to prevent personal injury.
 - b. The following list summarizes the risks associated to cyanide exposure:
 - i. Cyanide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. Sufficient cyanide to poison a worker may be absorbed through the skin, especially if exposed to cuts or open sores.
 - ii. Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the worker to rapidly lose consciousness, stop breathing and/or die. In some cases the worker may have convulsions.

Mixing Sodium Cyanide Solution Procedure

- iii. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea and vomiting. These symptoms may be followed by unconsciousness and death.
 - iv. Milder forms of intoxication may result only in weakness, dizziness, headache and nausea.
 - v. Avoid contact with strong oxidizers such as nitrates and chlorates as it may cause fire and explosions.
 - vi. Hazardous decomposition products include hydrogen cyanide and carbon monoxide.
 - vii. Cyanide solution must be maintained at a pH of 10.0 or higher to avoid the generation of highly toxic hydrogen cyanide gas.
2. Personal Protective Equipment (PPE): As per Sudbury Operations Minimum Personal Protective Equipment Standard.
- Half-mask respirator with dust/mist cartridges with face shield
 - Alternatively, full face respirator or RACAL helmet can be used for comfort
 - Chemical resistant suit
 - Rubber boots
 - Rubber or Viton gloves
 - Personal cyanide monitor
 - 2-way radio
3. Tools and Equipment:
- Sledge hammer
 - Side cutters
 - Hose with running water
 - Set of slings and shackles to secure cyanide bag hoops to forklift
 - Forklift

- Utility knife

Work Methods:

Precautions

1. Always have a hose with running water ready and within reach to wash cyanide off of you, tools and/or equipment.
2. Refer to Cyanide Cage Entry procedure before accessing the cyanide cage.
3. Mixing sodium cyanide solution requires two technicians.
4. Larox Room hoist-well floor hatch must be closed during Sodium Cyanide mixing.
5. While mixing cyanide, monitor HCN levels using the personal cyanide monitor. If an instantaneous HCN reading greater than 2.5 ppm is detected, go outside immediately and perform a fresh air calibration to purge and zero the meter. Then return to Reagent Room, if reading remains at zero, continue with mixing process. If a HCN reading greater than 2.5 ppm in the breathing zone is detected, proceed as per "Spill Response Sodium Cyanide" procedure, Level 3 Spill.

Preparation

1. Ensure mix tank level is below 14% and distribution tank is below 30% to allow mixing and transferring of one full batch of cyanide solution at 10% concentration (w/w).
2. Inform your Supervisor and CCR that you will be mixing cyanide solution.
3. Perform a ventilation fan test before entering the reagent room.
4. Evacuate the reagent room of all personnel not involved with mixing sodium cyanide and put up barricades in all entries to the Reagent Room to prevent unauthorized

entry to the room during the mixing process. Check bottom floor of reagent room at lime slaker area to ensure there is no personnel present.

5. Ensure that eye wash/shower stations inside the cage have been tested during the current week. If not, contact the Mill CCR Operator by radio before mixing to notify that you will be testing both emergency eyewash/shower stations inside the mixing cage. Verify that the alarm works and that the system is functioning properly. Reset alarms.
6. Perform pre-op on forklift. DO NOT OPERATE if any deficiencies are found and report this to your supervisor immediately to have issue resolved prior to using the forklift. If pre-op is positive, ensure that the boom lift test is performed in the open area in front of the xanthate tank.

Mixing

1. Put on prescribed protective equipment as listed in Section 3.2.
2. Visually inspect the enclosure area for solution leaks and tripping hazards. Eliminate any conditions that may cause slips and falls and do not proceed to mix if leaks are detected. Report the leak to your Supervisor and follow "Spill Response Sodium Cyanide" procedure.
3. Close the manual drain valve on the fresh water feed line at the top of the mix tank to direct fresh water addition into the mix tank and not to the floor. This valve is a safety measure where the valve is closed only during the water addition process. At the completion of the mixing cycle, the valve is opened such that if there is a failure of the automatic valve upstream, the water will be sent to the cyanide sump instead of the mix tank. Refer to "Cyanide Cage Entry" procedure.
4. Remove plywood cover on mix tank and dispense two 10-liter pails of sodium hydroxide powder into mix tank which buffers the cyanide solution to a pH of +12. Supplier is Reliable Industrial Supply.

Mixing Sodium Cyanide Solution Procedure

5. Add water to mix tank top 86% level. The worker outside the enclosure opens the fresh water valve by selecting it on the touch screen panel and starts the water addition to the mix tank.
6. Prepare the cyanide bag for hoisting with forklift. While the tank is filling with water, both workers open the storage platform gate and prepare the bulk bag of cyanide for hoisting with the reagent room forklift. Only workers trained on forklift operation are permitted to operate the reagent room forklift.
7. Loosen the sides of the box using a sledge hammer, then cut the plastic wrapping to expose the four loops. Run the forklift forks through the hoops and secure the hoops to the mast using the set of slings and shackles. Lift the bag, and position bag ovetop of mix tank spike. Lower bag and allow bag to empty into mix tank hopper.
8. Once the bag is empty, thoroughly rinse the bag and hopper with water, while ensuring not to over fill the mix tank which will trigger "Mix Tank Hi Level Alarm". Once the bag and hopper are rinsed, allow the bag and hopper to drain and then place the bag back inside the wooden box and place wooden lid on top of box. Once complete, lock the storage platform gate and replace the wooden cover on the bag breaker.
9. Start mix tank agitator by selecting it on the touch screen panel. It will time out after two hours.
10. The worker at the top of the mix tank opens the drain on the fresh water line.
11. Contact CCR to give the all clear. Remove all Reagent Room access doors' barricades.

SODIUM CYANIDE

CLEAN UP PROCEDURES

LEVEL 1 " CRYSTALS

RESPONSE TEAM MEMBER WILL USUALLY BE TECH MEMBER OR MILL LAB

P.P.E. REQUIRED:

- Rubber suit, rubber gloves, rubber boots, full face respirator with organic vapour cartridges and HEPA filter.
- Personal monitor for HCN gas / or Gastec if no monitor.

TOOLS REQUIRED: (All tools may not be required.)

- Square mouthed shovel, scraper/wire brush
- Hydrated lime, (bagged or liquid)
- High ph water (made with NaOH or lime)
- Empty barrels complete with lids for solids disposal
- WHIMIS labels

METHOD: FOR DEALING WITH -SOLIDS- i.e. CRYSTALS.

(MAINLY FOR CYANIDE CAGE AREA)

- 1- Air must be tested and/or monitored for HCN during the clean up.
- 2- CLEAN briquettes on the floor can be picked up and put into the mixing tank.
- 3- For crystals scraped off of piping or dirty briquettes on floor,
 - Cover the solids with hydrated lime and shovel it into a barrel for disposal.
 - Seal the barrel and label it with an appropriate WHIMIS label.
 - Contact the Mill environmental dept. for instructions on disposal.
- 4- Wash down the area afterwards with high ph water to ensure proper clean up. Domestic water can be used with some sodium hydroxide on the floor area first.
- 5- Ensure that sump No. 126 is directed to No.21 surge tank and that pumps are running.

SODIUM CYANIDE

CLEAN UP PROCEDURES

LEVEL "2 "

LESS THAN 1 GALLON OR COULD BE A LARGE AMOUNT SPILLED INTO CIRCUIT.

P.P.E. REQUIRED:

- Rubber suit, rubber gloves, rubber boots, full face respirator with organic vapour cartridges and HEPA filter.
- Personal monitor for HCN gas / or Gastec if no monitor.

TOOLS REQUIRED: (All tools may not be required.)

- Square mouthed shovel, scraper/wire brush
- Hydrated lime, (bagged or liquid)
- High ph water (made with NaOH or lime)
- Empty barrels complete with lids for solids disposal
- WHIMIS labels

METHOD:

NOTE : Ensure area is well ventilated before entering.

- If the reagent room is the area involved, ensure that the REAGENT ROOM ALARM is not activated and that ventilation systems are working properly.

Cyanide exhaust fan should read >0.35 " on the manometer.

Xanthate exhaust fan should read >0.35 " on the manometer. The breaker is No. 6 in utility "power panel"

Other fans include:

Xanthate mixing ROOM EXHAUST fan.

The breaker is No. 16 in utility panel "LP-B"

- Approach the spill area from a safe place while taking gas detector readings for HCN gas.
- If readings are less than 10 ppm, proceed to stop the leak. Shut down necessary pumps, valves, etc...

level 2 continued:

CLEAN UP PROCEDURES

LEVEL "2" (clean up continued)

LESS THAN 1 GALLON OR COULD BE A LARGE AMOUNT SPILLED INTO CIRCUIT.

METHOD FOR SOLID SPILLS:

Should never be any large amount of solid cyanide spilled but, if it occurs it will likely be near the reagent room.

- Continue to monitor for HCN gas with Gastec or HCN personal monitor during clean up.

- Any CLEAN briquettes can be put directly back into the mixing tank for re-use.

- Any DIRTY briquettes or powder should be covered with BAGGED hydrated lime and then shovelled into a waste barrel.

NOTE : ANY OTHER DISPOSAL ARRANGEMENTS MUST BE APPROVED BY THE MANAGEMENT TEAM MEMBER AND MONITORED WHEN DOING SO.
i.e. If the copper circuit is running the cyanide could be returned to the process VIA tank No. 1 or 18.

- The barrel should then be sealed and labelled with a WHIMIS label. Contact the mill environmental services dept. for instructions on disposal.

- Ensure the sump No. 126 is directed to No.21 surge tank and that pumps are running.

- Hose down the area with high ph water to ensure proper clean up.

level 2 continued:

SODIUM CYANIDE

CLEAN UP PROCEDURES

LEVEL "2" (clean up continued)

LESS THAN 1 GALLON OR COULD BE A LARGE AMOUNT SPILLED INTO CIRCUIT.

METHOD FOR LIQUID SPILLS:

- Continue to monitor for HCN gas with Gastec or HCN personal monitor during clean up.
- Cover the area with bagged hydrated lime (purpose is to keep the ph from 10 to 12).
- Let dry lime soak up the spill.
- Shovel the lime and cyanide into a barrel, seal it and label for disposal. Contact the mill environmental dept. for instructions on disposal.
- Hose down the area with high ph water if possible. Otherwise, proceed with regular water to hose up.
- Ensure that the sumps involved are directed to No. 21 surge tank
- NOTE: if HCN readings rise above 10 ppm during clean up, re-apply hydrated lime immediately to the area.
- If levels remain above 10 ppm, leave the area and increase ventilation. Take readings from a safe distance until levels are lower than 10 ppm.
- Keep monitoring for HCN and hosing until readings remain at 0 ppm.
- When clean up is completed, notify the OGF and the OGF can then authorize removal of the barricades.

SODIUM CYANIDE

CLEAN UP PROCEDURES

LEVEL "3"

MORE THAN 1 GALLON OR UNCONTROLLED

P.P.E. REQUIRED:

- Encapsulating suit, Scott air pak.
- Personal monitor for HCN gas / or Gastec if no monitor.

TOOLS REQUIRED: (All tools may not be required.)

- Square mouthed shovel, scraper/wire brush
- Hydrated lime, (bagged or liquid)
- High ph water (made from NaOH or lime)
- Empty barrels complete with lids for solids disposal
- WHIMIS labels

METHOD FOR DEALING WITH -LEVEL "3"

- The fire dept. is in charge.
- They check area for explosive gases.
- Fire dept. can shut off valves or pumps if needed.
- The fire dept. remains in charge of the scene until the immediate danger to people is controlled and fire hazards are eliminated.
- The management team takes charge and manages the situation and directs the containment and/or clean up. Also communicates with environmental services on handling of the situation.

METHOD : LIQUID CLEAN UP

- Operating and Tech team member work together to ventilate the area.
- The Tech team member will monitor for HCN during this time until the levels remain below 10 ppm.
- Bring up the ph in the spill area with bagged hydrate lime or with lime slurry if possible.

level "3" continued...

SODIUM CYANIDE

CLEAN UP PROCEDURES

LEVEL "3" MORE THAN 1 GALLON OR UNCONTROLLED

- Ensure that any accumulation of liquid is assessed first by the response team. It should be either neutralized if possible and then pumped to No. 21 surge tank with pumps running or vacuumed up by spill response contractor.
- Continue monitoring for HCN gas and continue to hose down the area until readings remain at 0 ppm HCN.
- Once area is cleaned up, have necessary repairs done to the system.
- The Tech team member will continue to take HCN readings during the repair if required.
- Management team member authorizes barricade removal upon satisfactory clean up.