APPENDIX B8 - HAZARDOUS MATERIAL MANAGEMENT PLAN, VERSION 3 (OCT. 2013)

MEADOWBANK GOLD PROJECT

Hazardous Materials Management
Meadowbank Mine Site
Baker Lake Facilities

In Accordance with Water License 2AM-MEA0815

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 3
October 2013

EXECUTIVE SUMMARY

General Information

The Hazardous Materials Management Plan (HMMP) will be executed within the scope of normal operations. The Meadowbank Gold Project is in the Operations Phase, and as such, requires that the transportation, storage, handling and use of hydrocarbon products, ammonium nitrate and associated explosive materials, and all other chemicals be conducted in a safe and efficient manner.

Annual Review

The HMMP will be reviewed annually and updated as required. Completion of the annual review of the HMMP will be documented through signatures of the personnel responsible for reviewing, updating and approving the HMMP.

Record of Changes

A record will document all significant changes that have been incorporated in the HMMP subsequent to the latest annual review.

Distribution List

Agnico Eagle Mines Limited (AEM) will maintain a distribution list for the HMMP providing information about all parties that receive the plan including mine personnel, departments, and outside agencies.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA0815, Part B, Item 16, the proposed implementation schedule for this plan is effective immediately (March 2012) subject to any modification proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

AEM - Environmental Superintendent

AEM – Environmental Coordinator

AEM – General Mine Manager

AEM – Health and Safety Superintendent

AEM – Mill Superintendent

AEM – Maintenance Superintendent

AEM – Mine Superintendent

AEM – Site Services Superintendent

AEM – General Services Superintendent

AEM – Procurement and Logistics Coordinator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	2007/08			Comprehensive plan for Meadowbank Mine Site and Baker Lake Facilities
2	2012/3/12			Comprehensive review and update.
3	2013/10			Add Baker Lake Jet-A Information and comprehensive review and update

Version 3:

Prepared By: _____

Jeffrey Pratt
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Approved By: _____

Kevin Buck
Environmental Superintendent

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1. INTRODUCTION

1.1 PURPOSE & SCOPE OF THE PLAN

The purpose of this plan is to provide a consolidated source of information on the safe and environmentally sound transportation, storage, and handling of the major hazardous products that are used at the Meadowbank Gold Project. A hazardous material is one that, as a result of its physical, chemical, or other properties, poses a hazard to human health or the environment when it is improperly handled, used, stored, disposed of, or otherwise managed. In combination with AEM's Emergency Response Plan (ERP) and Spill Contingency Plan (SCP), this Hazardous Materials Management Plan (HMMP) provides instruction on the prevention, detection, containment, response, and mitigation of accidents that could result from handling hazardous materials.

The plan is based on the following principles of best practice management for hazardous materials:

- Identify and prepare materials and waste inventories;
- Characterize potential environmental hazards posed by those materials;
- Allocate clear responsibility for managing hazardous materials;
- Describe methods for transport, storage, handling, and use;
- Identify means of long-term storage and disposal;
- Prepare contingency and emergency response plans;
- Ensure training for management, workers, and contractors whose responsibilities include handling hazardous materials; and
- Maintain and review records of hazardous material consumption and incidents in order to anticipate and avoid impacts on personal health and the environment.

All hazardous materials to be used at the Meadowbank operation will be manufactured, delivered, stored, and handled in compliance with all applicable federal and territorial regulations. AEM is committed to preventing, to the greatest extent possible, both inadvertent release of these substances to the environment and accidents resulting from mishandling or mishap. AEM has instituted programs for employee training, facility inspection, periodic drills to test systems, and procedural review to address deficiencies, accountability, and continuous improvement objectives.

AEM actively works towards minimizing the generation of hazardous wastes by investigating alternatives to the use of hazardous materials, by recycling products and containers wherever feasible, and by treating wastes using state-of-the-art technologies before any release to the environment.

As with all other aspects of health and safety policy at the Meadowbank mine, all employees will be expected to comply with all applicable precautions and handling procedures with regard to hazardous materials. Employees are also expected to report any concerns to their supervisors, the Occupational Health & Safety Committee (OH&SC), or senior site management. All staff is

encouraged to bring forward suggestions for improvements that can be incorporated into procedure revisions as appropriate.

1.2 APPLICABLE LEGISLATION

Both federal and territorial legislation regulate the management of hazardous materials in Nunavut. Copies of relevant legal documents are kept on file at the mine site. AEM will regularly update the HMMP with respect to applicable legislation, and ensure that current legislation documents are available at the mine site.

Management and safety personnel provide an overview of the applicable regulations to all employees as part of their initiation and ongoing training. The acts, regulations, and guidelines pertinent to the hazardous products that are used at the Meadowbank Gold Project are listed in Appendix A.

The *Transportation of Dangerous Goods Act* classifies hazardous materials into nine (9) main classes according to an internationally recognized system, as follows:

- Class 1 – Explosives;
- Class 2 – Gases;
- Class 3 – Flammable liquids;
- Class 4 – Flammable solids;
- Class 5 – Oxidizing substances and organic products;
- Class 6 – Poisonous (toxic) and infectious substances;
- Class 7 – Nuclear substances, within the meaning of the Nuclear Safety and Control Act, which are radioactive;
- Class 8 – Corrosives; and
- Class 9 – Miscellaneous products or substances.

Fuel products hazard classes and potential impacts are located in Table 1.

2. OVERVIEW OF HAZARDOUS MATERIALS

2.1 HAZARDOUS MATERIALS AND FUEL STORAGE LOCATIONS

The primary storage locations for hazardous materials, hazardous wastes and fuel are shown on Figures 1 to 5. Figure 1 and 2 are respectively a general layout of the Meadowbank mine site and Vault. Figure 3 identifies hazardous material storage areas at the mine site. Figure 4 shows the Diesel Fuel Tank Farm and Figure 5 show the Jet-A Fuel Tank Farm at the Baker Lake Marshalling Area. Comprehensive lists of all hazardous materials and the estimated quantities that are and will be stored at the mine site are provided in Appendix B.

Petroleum products, explosives, sodium cyanide and miscellaneous hazardous materials are stored in facilities that contain no open drains, utilize concrete berms, and incorporate lined areas or secure sea-cans. Storage tanks on site are regularly inspected and maintained.

The permanent storage facilities are clearly identified as storage facilities for hazardous materials with proper labelling. These are ventilated in order to prevent the build-up of toxic fumes or dust, which could harm both the personnel present and the environment. The facilities are secured and only authorized personnel have access to the area.

2.2 TYPES OF HAZARDOUS MATERIALS

The Meadowbank Gold Project requires the use of the following types of classified hazardous materials:

- Petroleum products and lubricants – diesel fuel, Jet-A, oils, greases, anti-freeze, and solvents used for equipment operation and maintenance;
- Process plant consumables – sodium cyanide, caustic soda(sodium hyroxide), sulphur prills, carbon sodium metabisulphite, nitric acid , calcine lime, flocculants, calcium chloride, borax, silica, lead nitrate, and anti-scalants used in mineral extraction;
- Water treatment chemicals - silica sand and flocculants polymers;
- Explosives – emulsion, caps, and high explosives used for blasting in the mine; and
- Laboratory chemicals and wastes – various by-products classified as hazardous waste and chemicals such as nitric acid used in the assay laboratory.

Sections 5 and 7 contain general information and safe handling procedures for the first four categories above. Laboratory wastes are generally very limited in quantity and will be handled only

by specialist laboratory technicians. These wastes will be pumped to the grinding circuit in the process plant for recycling and eventually become part of the tailings disposal stream. As such, they are not addressed separately in this document.

2.3 GENERAL HAZARDOUS MATERIAL STORAGE GUIDELINES

AEM is committed to the safe and appropriate storage of fuels, hazardous materials and hazardous wastes. The following sections outline AEM's general guidelines for storing fuels, hazardous materials and hazardous wastes.

2.3.1 General Guidelines for Storage Drums/Containers

Hazardous materials/waste shall be stored in super sacs/drums/sea containers according to the following guidelines:

- In the original containers, where possible, or in containers compatible with the material being stored to prevent corrosion or chemical interaction that could lead to leaks or fires;
- Storage containers shall be in good condition, sealable and not damaged or leaking;
- Drums containing hazardous materials/wastes expected to be in storage for more than six months shall be placed on pallets or on a well-drained storage area to prevent rusting;
- Each container shall be clearly labelled to identify the substance being stored according to the requirements of the *Workplace Hazardous Materials Information System* (WHMIS) and MSDS available;
- Containers shall be kept closed except when adding or removing product;
- Containers with product shall be kept in the upright position, empty drums can be placed horizontally;
- Containers shall be arranged to prevent damage from falling or dislodging; and
- Containers shall be arranged to allow for easy access and inspections.

2.3.2 General Guidelines for Storage Areas

To assist in the safe and secure storage of fuels, hazardous materials and hazardous wastes, the following general guidelines for storage areas/facilities are followed:

- Design of storage areas are in compliance with the *National Fire Code*, where appropriate;
- Compliance with the Canadian Council of Ministers of the Environment (CCME) publication, *"Environmental Code of Good Practice for Above Ground Storage Tank Systems Containing Petroleum Products"*. This CCME code deals with inventory control, inspections, corrosion protection, records and monitoring. Environment Canada's *Storage Tank Systems for*

Petroleum Products and Allied Petroleum Products Regulations outline registration and documentation requirements for storage tanks;

- Storage areas are adequately signed indicating that hazardous materials/wastes are stored therein;
- Storage locations are clearly defined and marked to prevent damage of storage drums and containers in the event they are covered by snow;
- Incompatible materials are segregated by chemical compatibility within the storage area to prevent contact between materials in the event of a release;
- Storage areas are located at least 30 metres from surface water and on a low-permeability area;
- Storage areas are readily accessible for firefighting and other emergency procedures;
- Storage areas are adequately ventilated to prevent the build-up of noxious or toxic vapours;
- Where necessary secondary containment is installed to allow for the containment of at least 110% of the largest container or tank volume within the contained area;
- Storage areas are constructed, or provided with barriers, to protect containers from physical damage;
- Adequate spill and emergency response equipment has been installed at large volume storage areas – ie bulk fuel tank facilities (i.e. spill control, fire protection, etc.). A list of spill control equipment is provided in the Spill Contingency Plan.

3. HAZARDOUS MATERIALS LIFE CYCLE MANAGEMENT

3.1 LIFE CYCLE MANAGEMENT

"Life cycle management" implies the assessment of a particular product over its entire life — from the time where a material need is identified to the time the product is fully consumed or disposed of as waste. It covers product supply, transportation, storage, handling, recycling, and waste disposal. AEM is committed to ensuring proper life cycle management of all products used at the Meadowbank site, including hazardous materials. AEM and its contractors will deal only with reputable, certified suppliers, transporters, and expediters.

3.1.1 Delivery

All hazardous materials are delivered to site by commercial carriers in accordance with the requirements of the *Canadian Transportation of Dangerous Goods Act* (TDGA). Carriers are licensed and inspected as required by the Department of Transportation. All required permits, licences, and certificates of compliance are the responsibility of the carrier. All shipments are properly identified and labelled. Shipping papers must be accessible and include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, firefighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

Each transportation company is required to develop a spill prevention, control, and countermeasures plan to address the materials they are importing. In the event of a release during transport, the commercial transportation company is responsible for first response and cleanup. AEM intends to periodically verify the qualifications of transport companies, their personnel and the existence of their spill prevention, control and countermeasures plan.

3.1.2 On-Site Handling

Once dangerous goods are received at the workplace, additional regulations apply. The federal *Workplace Hazardous Materials Information System* (WHMIS) calls for the proper labelling of products, the availability of product information in the form of MSDS, and employee education on how to identify and handle hazardous products. AEM has established procedures for obtaining MSDS with new product deliveries; maintaining MSDS current (i.e. no older than three years), and maintaining a system of hardcopy or electronic MSDS that are readily accessible by all employees. A chemical tracking system is also established and all news hazardous material used on site are reviewed by Health and Safety and Environmental Department before the first use.

All hazardous materials are stored in secured areas to prevent access by unauthorized personnel or any tampering. All tanks used for the storage of diesel and aviation fuel have been installed in secondary containment areas sized to hold at least 110% of the volume of the largest tank or in double walled storage tanks. Tanks and vessels in the process plant are installed on concrete

surfaces sloping to interior sumps that will route spilled solutions to lined collection areas. Additional guidelines for the storage of hazardous materials are provided in Section 2.3.2.

In support of pollution prevention, AEM has established procedures for the regular inspection of storage containers and facilities. If deficient conditions are identified, appropriate corrective actions are taken and documented. Additional details for inspection of storage areas are provided in Section 9.

Emergency response procedures for spilled chemical substances are provided in the Spill Contingency Plan (SCP) (see also the Emergency Response Plan (ERP). These procedures outline the response to accidental spills or releases of hazardous materials to minimize health risks and environmental effects. Included are procedures for evacuating personnel, maintaining safety, cleanup and neutralization activities, emergency contacts, internal and external notifications to regulatory authorities, and incident documentation.

3.1.3 Wastes

On becoming wastes, materials are stored and/or disposed of in accordance with specific government regulations and guidelines. AEM stores most waste materials on site in secure facilities until they can be transported to other provincial jurisdictions for recycling or disposal.

Process plant tailings pass through a treatment plant for cyanide destruction using the standard Inco SO_2/air process or through chemical destruction with Sodium Metabisulphite before being disposed of in the tailings pond. The cyanide content of the tailings material is reduced to 15 ppm (parts per million). Cyanide further degrades naturally with exposure to air and sunlight (UV) in the Tailings Storage Facility. The current regulatory requirement for cyanide content in liquids released to the environment is 1 mg/L for a single grab sample or no greater than 0.5 mg/L average for the month (Nunavut Water Board Water License).

The Nunavut Department of Environment and Environment Protection Service (EPS) monitor the movement of hazardous waste from the generator to final disposal, through use of a tracking document known as a Waste Manifest. Accordingly, a Waste Manifest accompanies movements of hazardous wastes for the Meadowbank Project. AEM is registered with the EPS as a waste generator, and employs only registered waste carriers to transport waste to registered/approved waste receivers. A copy of the completed manifest will be maintained for a period of two years after the hazardous waste is received by the authorized waste disposal facility.

3.1.4 Empty Product Containers

Many empty chemical containers are not safe to dispose of directly and require handling precautions identical to those for full containers. Chemical users must be familiar with safe waste handling and storage procedures supplied by manufacturers in MSDS. The containers are backhauled to the Baker Lake Marshalling Area for disposal at an approved facility. These containers are stored and hauled south via sealift.

4. SODIUM CYANIDE

4.1 INTRODUCTION

Large quantities of sodium cyanide are used at the Meadowbank Gold Project to optimize gold recovery from the ore. Due to transportation restrictions, normally a full year's supply of sodium cyanide will be transported and stored on site. This product will be transported, stored, handled, transferred and used in compliance with appropriate legislation and applicable Best Management Practices. AEM is a signatory to the International Cyanide Management Code.

4.1.1 Physical Properties

Cyanide is one of only a few chemical reagents that will dissolve in water. Gold mining operations use very dilute solutions of sodium cyanide, typically in the range of 0.01% to 0.05% cyanide (100 to 500 ppm). Unlike many synthetic chemicals, cyanide oxidizes and decomposes when exposed to air or other oxidants (UV sunlight rays), and does not persist in the environment. As such, it does not give rise to chronic health or environmental problems when present in low concentrations.

4.1.2 Cyanide Production

Cyanide production and handling are highly regulated. Both the manufacturer and AEM employ stringent risk management systems to prevent injury or damage from the use of cyanide.

Sodium cyanide for the Meadowbank project is in briquette form, and packaged in water-resistant super sac and 4mm bags inside an intermediate bulk container (IBC). The IBC holds 1,000 kg of cyanide, and have the following approximate dimensions: 44" x 44" x 44". For shipment, there are normally 20 IBCs in a sea can container.

4.1.3 Cyanide Transport

Cyanide producers audit purchasers and transportation systems. They design special packaging for the transport of cyanide and inventory all shipments against delivery records to ensure proper surveillance at all times. All shipments are accompanied by MSDS that provide the chemistry and toxicity of sodium cyanide, instructions in case of accidents, and emergency telephone numbers for assistance.

Truck, rail, and barge transporters screen their employees, carefully inventory shipments and, establish and maintain systems for loading and unloading cyanide products. Product handling and transportation are in accordance with protocols set by the industries and in compliance with national and international regulations.

For the Meadowbank Project, the IBCs are properly stacked in sea containers and transported by ship from Becancour, QC to Baker Lake, NU. At Baker Lake, the containers are transferred from

barge to truck for transport to the Meadowbank mine site. At no point during transport the sea container or IBCs will be opened. From the point of cyanide packaging and onwards, the bags will only be opened on site, when and at the location (mill) where the use of cyanide is required.

This method of cyanide transport provides three levels of containment. The cyanide is contained within plastic bags. In the event one of the bags ruptures, the cyanide is contained within the IBC. In the event the IBC container breaks, the cyanide is contained within the sea container, which provides a tertiary precautionary measure for minimizing the impact of the spilled material.

4.1.4 On-Site Storage & Handling

The cyanide is stored on site in a dark, cool, dry, location. Cyanide is stored within sealed sea cans until the time in which cyanide is needed for process. The cyanide storage area is located close to the processing plant. Only authorized personnel have access to the cyanide storage.

When cyanide is required, only the quantity required for immediate use will be removed from storage. The cyanide bag will be lifted by its straps (the straps are provided by the manufacturer as part of packaging; see Appendix C for an illustration) using a forklift, and then using an overhead crane to lower onto a specially designed knife slitter that cuts the bag. The contents of the bag will drop into a mixing tank. At no time does the cyanide need to be physically handled by Meadowbank personnel.

The IBC materials are properly decontaminated and disposed of according to all applicable regulations to prevent environmental impact. Before disposal, the bags are visually inspected to ensure they are empty, and triple rinsed and drained to dissolve any residual cyanide left in the bag. Rinse water from the flushing process is recovered and reused in the cyanide mix tank and used in the gold recovery plant.

All personnel potentially exposed to cyanide, including contractors and visitors, receive appropriate training (see Section 10).

4.1.5 Spills

In the event a spill occurs, the cyanide will be promptly cleaned up to minimize its exposure to humans and the environment. A dry spill will be swept up and disposed of in a drum or other suitable container. In the event of a wet spill, the spill procedures will be carried out to prevent environmental contamination and the appropriate authorities will be contacted. For more information on spills handling and containment, see the SCP and ERP.

After cleaning up as much cyanide as possible, the area will be decontaminated using a small amount of caustic solution (i.e., 1 oz. /5 gal hypochlorite solution). This will help keep the pH in the 10 to 11 range and suppress the formation of lethal HCN gas.

4.1.6 International Cyanide Management Code

AEM is a signatory to the International Cyanide Management Code (the Code) for the manufacture, transport and use of cyanide in the production of gold. The Code is administered by a non-profit

institute consisting of participants from the gold mining industry, governments, non-governmental organizations, labour, cyanide producers, and other interested parties.

The Code represents a voluntary commitment on the part of all signatories to identify and follow basic principles and guidelines for safe cyanide use at gold mining operations. This is the first such generic international code in the history of the mining industry. Under the Code, gold mines are required to manage their cyanide from source to site, thus assuming “cradle to grave” responsibility for all cyanide used at their operation.

5. PETROLEUM PRODUCTS

5.1 PRODUCT DESCRIPTION

The operation uses large amounts of fuel and lubricants (petroleum products). These products are transported, stored, handled, transferred and used in compliance with the appropriate legislation and Best Management Practices.

5.2 DELIVERY TO SITE

With the exception of diesel and aviation fuel, most petroleum fuel and lubricant products are delivered to site and stored in the original packing container from the manufacturer. These types of containers include a variety of sealed drums, pails, 1 ton super sac, bulk cubes, cans, and tubes.

Due to transportation restrictions, i.e. climate, a full year's supply of fuel and lubricants is transported and stored on-site, in order to meet the demand of the upcoming year. During the summer months, diesel and aviation fuel are shipped from Becancour, QC to Baker Lake, NU where it is transferred into storage tanks. From the Baker Lake storage tanks, fuel is transported daily on the AWPR to the Meadowbank site via contracted tanker trucks.

Diesel fuel coming from the Baker Lake Tank Farm is stored at the Meadowbank site into a single 5.6 million liter tank within secondary containment and the aviation fuel into two (2) – 50,000L double walled tanks at the airstrip. From there, the diesel is redistributed into different storage tanks by an on-site tanker. Table 2 provides the varieties and volumes of petroleum products stored on site and the storage locations. The Baker Lake fuel farm consists of six (6), ten (10) million liter tanks for diesel fuel and twenty (20), 100,000L double walled tanks, within secondary containment, for aviation fuel. The diesel fuel tanks are single-walled and constructed of welded steel. The aviation fuel tanks are double-walled and constructed of steel. Both Baker Lake Fuel Farm and storage locations have been designed and constructed to meet the CCME guidelines for *Aboveground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*. The fuel unloading facility in each area includes a sloped lined pad to prevent contamination of the receiving environment. A continuous 60 mm high-density, polyethylene liner sheet is installed under the tanks and the internal sides of the berm. The containment area is sized to hold 110% of the volume of the largest tank.

All fuel transfer and storage facilities have been designed in accordance with the Canadian Council of Ministers for the Environment (CCME, 1994) *Environmental Code of Practice for Above Ground Storage Tank Systems Containing Petroleum Products*, and the *National Fire Code*.

Appropriate measures are in place to minimize impacts to surface water, groundwater and soils from potential vehicle accidents when transporting petroleum products to the site. Details of petroleum

product safe handling procedures and proper PPE can be found in Tables 3 and 4. Details of spill response measures are presented in the SCP. The following general precautions will be taken:

- A maximum speed on the All-Weather Private Access Road for loaded and empty vehicles has been established based on the road design. This speed limit is 50 km/hr;
- All trucks will carry a spill kit;
- Trucks are equipped with a reliable radio and/or satellite phone; and
- AEM commits to being prepared to respond to spills resulting from vehicle accidents in a timely and efficient manner.

5.3 FUEL TRUCK TRANSFER PROCEDURES

A contract supplier fills the storage tanks in the main tank farms. General procedures to be followed are listed below. Similar procedures would be followed for fuelling remote station tanks.

Before fuel transfer, verify that:

- All fuel transfer hoses are connected properly and couplings are tight;
- Transfer hoses are not obviously damaged;
- Fuel transfer personnel are familiar with procedures;
- Personnel are located at both the fuel delivery truck and fuel transfer tank(s) and can manually shut off the flow of fuel;
- If a high liquid level shutoff device is installed at the delivery tank, verify that the shutoff is operating correctly each time it is used; and
- Fuel transfer will then proceed per the established procedures of the contract supplier.

Any accidents or spills must be reported immediately to the Environmental Coordinator. Notification and response procedures are detailed in the SCP.

5.4 CONTAMINATED SOILS AND SPILLS

All contaminated spill pads, and booms resulting from the storage and handling of fuels and lubricants will be salvaged at the time such impacts are identified, and put into Quatrex bags, labelled and shipped off-site to an approved disposal facility or incinerated (small quantities) on site. All the petroleum hydrocarbon contaminated soil is placed into the site landfarm for treatment. Refer to the *Landfarm Design and Management Plan* for more details.

5.5 USED PETROLEUM PRODUCTS

Used oil that is no longer suitable for its intended use is classified as a liquid waste. The discharge of used oil into the environment, including but not limited to landfills, sewers and water bodies, is prohibited.

Used oil is used as auxiliary fuel at the secondary chamber at the incinerator or in designated on site waste oil heaters. This used oil burner at the incinerator has the capacity to handle approximately 200,000 liters of used oil per year. You can refer to the *Incinerator Waste Management Plan* for more information. All used oil products that are not burned in the incinerator or on site waste oil heaters are collected in tanks or drums marked "Waste Oil" and disposed of at an approved facility in the south. Empty petroleum containers are stored on site in a designated area and returned to the supplier on backhauls or disposed at approved facilities in the south. Oil filters are punctured and/or crushed and drained of their contents for 24 hours prior to disposal.

A random sample of used oil incinerated is analysed each month to ensure that it does not contain unacceptable levels of impurities, including cadmium, chromium, lead, total organic halogens (such as chlorine compounds), polychlorinated biphenyls (PCB) and ash content. Samples will be sent to an accredited laboratory (Multi-lab) for analysis. Concentrations of parameters listed above will be compared to the criteria set out in Schedule A of the *Used Oil and Waste Fuel Management Regulations*. Alternate arrangements will be made for the off-site disposal, treatment or recycling of used oil that does not meet this criteria.

The following information is recorded in association with the incineration of used oil:

- Volume of used oil generated at the facility;
- Volume of used oil incinerated;
- Name and address of the person in charge, management or control of the used oil, and the place where the used oil was produced;
- Analysis of any representative sample of used oil;
- Summary of maintenance performed on the incinerator or processing equipment;
- Volume and nature of the products produced from the used oil; and
- Destination of the used oil products shipped from the facility.

Table 1 - Fuel Products – Hazardous Classes & Potential Impacts

Material	TDGA Class[a]	Potential Environmental Impact
Diesel	3	Water & soil contamination
Motor oil	Not regulated	Water & soil contamination
Aviation fuel	3	Water & soil contamination
Hydraulic fluid	Not regulated	Low risk to water & soil with proper handling
Varsol	3	Water & Soil contamination
Automotive grease	Not regulated	Low risk to water & soil with proper handling
Ethylene glycol	Not regulated	Toxic by ingestion, could potentially be consumed by wildlife.

Table 2- Fuel Products – Storage Locations

Product	Total Quantity On-Site	Storage Location	Container	Presently used
Diesel	6.1 ML (potentially 66.1 ML including Baker Lake)	Fuel farm	1 x 5.6 ML tank in bermed area	Yes
		Powerhouse	2 x 25,000 L tank	Yes
		Exploration camp	1 x 10,000 L tank	Not in use but contain diesel
			1 x 75,000 L tank	Not in use but contain diesel
		Emulsion Plan	1 x 25,000 L tank	Yes
		Camp Emergency Genset	2 x 55,000 L tank	Yes
		Incinerator	1 x 2,200 L tank	Yes
		Fueling station	1 x 50,000 L tank	No
		Vault	4 x 50,000 L tank	Yes
			1 x 25,000 L tank	Yes
			1 x 10,000 L tank	Yes
		AWPR	1 x 10,000 L tank at KM 73	Yes
			1 x 10,000 L tank at KM 23	Yes
		Baker Lake	6 x 10 ML tank in bermed area	Yes
Gasoline	60,000 L	Fueling Station	1 x 50,000 L tank	Yes
			1 x 10,000 L tank	Yes

Waste oil	50,000 L	Incinerator	1 x 50,000 L tank	Yes
Motor oils	*refer to Appendix B	Mechanical shop	Cubes or Barrels	Yes
		Powerhouse	Cubes or Barrels	Yes
		Exploration camp	Cubes or Barrels	No
Aviation fuel	100,000 L (potentially 2.1ML including Baker Lake)	Airstrip	2 x 50,000 L tank	Yes
		Exploration Camp	1 x 75,000 L tank	Not in use but contain aviation fuel
		Baker Lake	20 x 100,000 L tank in bermed area	Yes
Hydraulic fluid	*refer to Appendix B	Mechanical shop	Cubes or Barrels	Yes
		Powerhouse	Cubes or Barrels	Yes
		Plant	Cubes or Barrels	Yes
Ethylene glycol	*refer to Appendix B	Mechanical shop	Cubes	Yes

Note: L = litre; ML = Mega-litre ($1X10^6$ litres).

Table 3 - Fuel Products – Safe Handling Procedures

Product	Handling Procedures
Diesel	Do not get in eyes, on skin, or on clothing. Avoid breathing vapours, mist, fume, or dust. Do not swallow. May be aspirated into lungs. Wear PPE and/or garments if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Use with adequate ventilation. Keep away from heat, sparks, and flames. Store in a well-ventilated area. Store in a closed container. Bond and ground during transfer.
Motor oil	Wear protective clothing and impervious gloves when working with used motor oils. To be handled generally consistent with other petroleum hydrocarbons.
Aviation fuel	See diesel procedures above.
Hydraulic fluid	Keep container closed until ready for use.
Ethylene glycol	Ensure adequate ventilation. Wear protective gloves and chemical safety goggles. Keep in tightly closed container, stored in a cool, dry, ventilated area. Separate from acids and oxidizing materials. Empty containers of this product retain product residues and may be hazardous.

Table 4 - Fuel Products – Personal Protective Equipment

Product	Personal Protective Equipment		
	Eyes	**Skin**	**Respiration**
Diesel	Chemical goggles	Neoprene or nitrile gloves; protective garments	None usually required
Motor oil	Chemical goggles	Neoprene or nitrile gloves; protective garments	None usually required
Aviation fuel	Chemical goggles	Neoprene or nitrile gloves; protective garments	None usually required; ensure adequate ventilation
Hydraulic fluid	Chemical goggles	None usually required	None usually required
Ethylene glycol	Chemical goggles	Neoprene or nitrile gloves; protective garments	None usually required; ensure adequate ventilation

6. EXPLOSIVES

6.1 PRODUCT DESCRIPTION

Explosives are required for blasting waste rock and ore in the mine. Transportation, storage, use, and handling of blasting materials are strictly regulated by the Federal *Explosives Act* and *Transportation of Dangerous Goods Act* (Class 1 – Explosives), as well as the following territorial Acts:

- Explosives Use Act and Regulations; and
- Mine Health and Safety Act and Regulations.

6.2 EXPLOSIVES STORAGE

Manufacturing, handling, and storage of explosives are carried out by QAAQTUQ – Dyno Nobel Canada Inc.

The estimated annual explosives requirement for the Meadowbank mine vary between 6,000 to 11,000 tonnes per year. However, only a small amount of explosive materials are shipped to site in the form of blasting caps. These are handled by AEM. The bulk of the explosives used at site are Emulsion (XL-1000), which is a mixture of nitrites and emulsifier. Emulsion is mixed in an on-site plant (Emulsion Plant shown on Figure 1) by Dyno Nobel.

Sea cans of emulsion and nitrite prill are stored on the Emulsion Plant site. They are stored within sea cans in quantities of approximately 20,000 kg's per sea can. These items are stored in separate locations so as to prevent the mixing of the two products. These products are also stored away from any other products, >40m away from the emulsion plant, and >25m from the fuel tanks.

The high explosive detonators and blasting caps are stored in an enclosed magazine. It is estimated that twelve magazines will be required on site, each being approximately 4 m x 14 m (i.e., not much bigger than a sea can). AEM looks after the handling of these explosive detonators.

The explosive mixing plant, product storage, and magazines are safely located away from vulnerable facilities, as stipulated by the federal and territorial *Explosives Use Act* and Regulations. The mixing plant is also used for the washing and minor repair of trucks and equipment used to handle the explosives.

6.3 USE OF EXPLOSIVES

The primary blasthole drills are diesel-powered rigs capable of drilling 152.4 mm diameter holes. Drilling requirements were calculated for ore and waste. A pre-shear and buffer blasting followed by mechanical wall cleanup is used for the final wall. Blasting operations are affected by several factors, including wall control and weather. A number of modified operating procedures will be implemented during the winter season. These may include minimizing the sleep time for loaded holes; ensuring that cuttings are mounded around the hole collars after loading to prevent snow drifting into the holes, and utilizing blasthole covers.

The responsibility for blasting is split between appropriately trained mine personnel and the explosives supplier, Dyno Nobel. Dyno Nobel is responsible for supplying and delivering blasting agents to the site, manufacturing the blasting product on site, delivering blasting agents to the blastholes and filling the holes. AEM Blasters are responsible for charging the holes, placing the detonators and boosters, and tying-in the patterns. The AN and emulsion components are loaded on barges and transported to the Baker Lake Marshalling Area for temporary storage, if necessary, prior to transport to site. Dyno Nobel provide mixing and delivery trucks. AEM provides diesel fuel and accommodations.

Blasting will be approximately daily and will average, in size, the daily production requirement of 50-90,000 tonnes per blast. Blasting will likely be by electric initiation and will feature current technology with down-the-hole delays to minimize the energy per delay to single hole loads. This will minimize backbreak, fly rock, vibration levels and will optimize fragmentation and minimize digging problems.

Blasting is carried out by certified blasters following blasting regulations and safe practices. All pit activities are under the supervision of certified mine supervisors, knowledgeable in mine operating regulations and best practices.

The manufacture and distribution of explosives is carried out by suppliers under Federal license to conduct such work. They provide and operate the explosives manufacturing plant under such license and authority.

Details on explosives inventory and inspections are provided in Section 9.2. Information on Explosives Handlers is available in Section 10.3.

6.4 DISPOSAL

Disposal of regular waste will follow the *AEM Waste Management Plan*.

Wash water that is created at the Emulsion plant is sucked out via vacuum truck and taken to the tailings storage facility for disposal.

Any unusable Emulsion waste is taken to the mines blast pattern for disposal down the bore holes.

7. PROCESS PLANT & WATER TREATMENT REAGENTS & CONSUMABLES

7.1 PRODUCT DESCRIPTION

The Process Plant (mill) uses a number of chemicals and reagents to treat the ore, recover entrained gold and to destroy cyanide. The Water Treatment Plant also uses a number of chemicals and reagents to treat water for TSS removal. Water Treatment chemicals would be used over a 3 to 4 month period during frost-free months only for the discharge of the attenuation pond water to Third Portage Lake and to Wally Lake. The range in annual quantities used would reflect the different dosages that may be used during different mining stages (early operations, late operations, closure treatment of tailings water and polishing of pit lake water quality on a contingency basis). Material categories, site handling and storage requirements, and PPE recommended by manufacturers are summarized in Tables 5 to 8.

Table 5 - Process Plant & Water Treatment Reagents – Use, Consumption & Storage

Reagent	Use	Approximate Consumption		Phase	Normal Delivery Format	On-Site Storage
		Daily	Annual			
Acetylene	Welding	1-2	600	gas	gas cylinders	secured upright
Activated carbon (granular)	Gold recovery	340 kg	140 t	solid	500 kg bags	Pallet
Anti-scalant	Water treatment	25 kg	10 t	liquid	650 kg tote tank	Pallet drums
Borax	Refinery	60 kg	22 t	solid	40 kg bags	Pallet
Silica	Refinery	30 kg	11 t	solid	22.7 kg bags	Pallet
Calcium oxide (Quicklime) (CaO)	pH control	7,814 kg	3150 t	solid	1 t supersacs	Pallet
Calcium peroxide (alternative to hydrogen peroxide)	Potential use: Water treatment	minimal*	minimal*	solid	45 kg drum	Pallet drums
Copper sulphate ($CuSO_4$)	Cyanide destruction	1450 kg	585 t	solid	1 t supersacs	Pallet
Flocculant (Magnafloc 338 or Magnafloc 10)	Settling aid	300 kg	120 t	solid	25 kg bags	Pallet
Hydrochloric acid (HCl)	Refining/stripping	200 kg	75 t	liquid	20 gal drums	Pallet drums
Hydrofluoric acid	Laboratory	5 gallons	1 825 gallons	liquid	20 gal drums	Pallet drums
Hydrogen peroxide (alternative to calcium hydroxide)	Potential use: Water treatment	minimal*	minimal*	liquid	1 m^3 HDPE tote	Pallet
Lead acid batteries	Vehicles	-	24	liquid	-	Pallet
Nitric acid	Stripping	50 kg	18 t	liquid	34 kg bottle	Pallet

Paints	Maintenance	-	100 gallons	liquid	gallon	Pallet
Sodium cyanide (NaCN)	Leaching	3825 kg	1 540 t	solid	1 t box bags	Pallet
Sodium hydroxide (caustic soda) (NaOH)	Refining/stripping	20 kg	8 t	solid	25 kg bags	Pallet
	Refining/stripping	786 kg	320 t	solid	1000 kg	Pallet
Sodium metabisulphite ($Na_2S_2O_5$)	Cyanide destruction	7710 kg	3100 t	solid	1 t supersacs	Pallet
Sodium nitrate	Refinery	40 kg	15 t	solid	50 kg bags	Pallet
Sulphur	Cyanide destruction	745 kg	300 t	solid	1 t bags	Pallet

Note: kg = kilogram; t = ton; gal = gallon; m^3 = cubic metre.

Table 6 - Process Plant & Water Treatment Reagents – Hazard Classes & Potential Environmental Impacts

Material	Class	Potential Impact
Acetylene	2.1	Generally not hazardous for water.
Activated carbon	4.2	No information available.
Anti-scalant	Not regulated	Negligible with proper handling
Borax	Not regulated	Presents no health hazards.
Calcium oxide	Not regulated	No information available.
Calcium peroxide	5.1	Releases oxygen into environment when dissolved in water.
Copper sulphate	9	Harmful to aquatic life.
Flocculant	Not regulated	Acute fish, invertebrate, algae and bacteria toxicity.
Hydrochloric acid	8	Extremely toxic to aquatic life by lowering the pH below 5.5. When released into the soil, this material may leach into groundwater.
Hydrofluoric acid	8.6.1	No information available.
Hydrogen peroxide	5.1	Aquatic Toxicity 96-hour LC50.
Lead acid batteries	8	No information available.
Nitric acid	8	No information available.
Paints	Not regulated	No information available.
Silica	Not regulated	Generally not hazardous for water.
Sodium cyanide	6.1	Expected to be very toxic to aquatic life and to terrestrial life.
Sodium hydroxide	8	No information available.
Sodium metabisulphite	Not regulated	No information available.

Sodium nitrate	5.1	Possibly hazardous short-term degradation products are not likely. However, long term degradation products may arise. The products of degradation are less toxic than the product itself.
Sulphur	9	No info available (insoluble in water).

Table 7 - Process Plant & Water Treatment Reagents – Safe Handling Procedures

Product	Handling Procedure
Acetylene	Do not mix with air or oxygen above atmospheric pressure. Store away from oxidizing agents. Open and handle cylinder with care. Keep ignition sources away - Do not smoke. Protect from heat. Protect against electrostatic charges. Pressurized container: protect from sunlight, store in a cool location and do not expose to temperatures exceeding 50°C. Do not pierce or burn, even after use. Prevent impact and friction. Store in accordance with local fire code and/or building code or any pertaining regulations.
Activated carbon	Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Avoid ingestion and inhalation. Activated Carbon, especially when wet, can deplete oxygen from air in enclosed spaces, and dangerously low levels of oxygen may result. Store in a tightly closed container. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances.
Anti-scalant	Used in extremely small quantities. Can cause mild to moderate irritation of eyes, skin, and upper respiratory tract. Wash thoroughly after handling. Use sensible industrial hygiene and housekeeping products. Not flammable. Keep containers tightly closed
Borax	No special steps required.
Calcium oxide	Store in closed containers in a controlled drainage area under cover. Use in a well-ventilated area. Empty containers retain product residues and may be hazardous.
Calcium peroxide	Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure. Store in a cool, dry, well-ventilated place. Keep container tightly closed and away from

Product	Handling Procedure
	incompatible materials and sources of heat.
Copper sulphate	Avoid contact with skin and eyes. DO NOT breathe dust. Always wash hands thoroughly after contact. Store and use only in dry, well-ventilated areas. Keep container tightly closed.
Flocculant	Dust generated in handling of this product can be explosive if sufficient quantities are mixed in air, in which case ignition sources should be avoided. Employ grounding, venting and explosion relief provisions in accord with accepted engineering practices in process operations capable of generating dust/or static electricity. Handle in accordance with good industrial practice, handle with care and avoid unnecessary personal contact. Avoid contact with eyes and prolonged or repeated skin contact. Avoid continuous or repetitive breathing of dust. Use only with adequate ventilation. Remove contaminated clothing; launder or dry-clean before reuse. Wash thoroughly with soap and water after using. For industrial use only. Slip hazard when wet. Material is slippery when wet. Store in the original container, securely closed, in a cool and dry location. Avoid extremes of temperature and ignition sources.
Hydrochloric acid	Do not get in eyes, on skin, or on clothing. Wear protective clothing. Avoid breathing vapours or fumes. Store in cool, dry, ventilated area with acid-resistant floors. Keep container closed, out of direct sunlight, and away from heat, water, and incompatible materials. When diluting, add acid slowly to water and in small amounts. Never use hot water and never add water to acid. When opening metal drum, use non-sparking tools because hydrogen gas may be present. Do not wash out container and use for other purposes. Empty containers retain product residues and may be hazardous.
Hydrofluoric acid	Wash thoroughly after handling. Remove contaminated clothing and wash before re-use. Use with adequate ventilation. Do not get on skin, in eyes or on clothing. Do not ingest or inhale. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not store in metal or glass containers. Do not store in direct sunlight. Keep tightly closed. Empty container may contain hazardous residue. Do not add any other material to the container. Do not wash down the drain. Do not allow smoking or food consumption while handling. Store in approved containers only. Do not add water to acids.
Hydrogen peroxide	Use extreme care when attempting any reactions because of fire and explosion potential (immediate or delayed). Conduct all initial experiments on a small scale and protect personnel with adequate shielding as the reactions are unpredictable, and may be delayed, and may be affected by impurities, contaminants, temperature, etc. Do not get in eyes. Avoid contact with skin and clothing. Wash thoroughly after handling. Avoid contact with flammable or combustible materials. Avoid contamination from any

Product	Handling Procedure
	source including metals, dust, and organic materials. In the event of an accident where large volumes of hydrogen peroxide might come into contact with external fires or with incompatible chemicals, a one-half mile area from the incident should be evacuated. Store in a properly vented container or in approved bulk storage facilities. Do not block vent. Do not store on wooden pallets. Do not store where contact with incompatible materials could occur, even with a spill (see "Hazardous Reactivity" on MSDS). Have water source available for diluting. Do not add any other product to container. Never return used or unused peroxide to container, instead dilute with plenty of water and discard. Rinse empty containers thoroughly with clean water before discarding. (See "Waste Disposal" on MSDS).
Lead Acid Batteries	Store batteries in a well-ventilated cool area. Handle carefully to avoid damaging or turning batteries over.
Nitric acid	Class 8 products are not to be loaded with class 1, 4.3, 5, 6, 7 or foodstuffs or foodstuff empties. Store in a well-ventilated area and out of direct sunlight. Keep containers closed at all times. Store away from oxidisable, caustic and combustible materials. Vapours heavier than air; prevent concentration in sumps and hollows. DO NOT enter confined spaces where vapour may have collected. Strong oxidising agent; can lead to fire or explosion with organic and/or combustible materials.
Paints	No special steps required.
Silica	Prevent formation of dust. This product is not flammable. When pouring into a container of flammable liquid, ground both containers electrically to prevent static electric spark. Keep containers tightly sealed.
Sodium cyanide	Highly toxic, corrosive to eyes, skin, and respiratory tract. Can be fatal if swallowed, inhaled, or absorbed through skin. Keep cyanide antidote kit available in any cyanide work area. Wear personal protective clothing at all times. Keep in tightly closed container in cool, dry, ventilated area. Protect against physical damage to containers. Do not store under sprinkler systems. Do not wash out container and use for other purposes. Empty containers retain product residues and may be hazardous.
Sodium hydroxide (caustic soda)	Can cause severe injury to eyes, skin, and respiratory tract. Use PPE at all times and DO NOT contact product directly. Wash thoroughly after handling. Store in dry, well-ventilated area. Keep in original container, tightly closed. Empty containers retain product residues and may be hazardous.
Sodium	May cause irritation to eyes, skin, and respiratory tract with prolonged exposure.

Product	Handling Procedure
metabisulphite	Sulphite-sensitive individuals may experience severe allergic reaction to dust. Releases sulphur dioxide gas when mixed with water. Wear PPE and wash thoroughly after handling. Store in dry, well-ventilated area away from heat, acids, and oxidizers. Keep container tightly closed. Use vacuum to clean up dust.
Sodium nitrate	Keep away from heat. Keep away from sources of ignition. Keep away from combustible materials. Empty containers pose a fire risk; evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, acids. Keep container dry. Keep in a cool place. Keep container tightly closed. Keep in a cool and well-ventilated area. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.
Sulphur	Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. May form flammable dust-air mixtures. Avoid contact with skin, eyes and clothing. Empty containers contain product residue, (liquid and/or vapour), and can be dangerous. Keep containers tightly closed. Avoid contact with heat, sparks, and flame. Use with adequate ventilation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat spark, or open flames. Store away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances (oxidizing agents).

Table 8 - Process Plant & Water Treatment Reagents – Personal Protective Equipment

Product	Personal Eyes	Protective Skin	Equipment Respiration
Acetylene	Tightly sealed goggles	Protective gloves	Use atmosphere-supplying respirators (e.g. supplied-air: demand, pressure-demand, or continuous-flow or self-contained breathing apparatus:

Product	Personal Eyes	Protective Skin	Equipment Respiration
			demand or pressure-demand or combination supplied-air with auxiliary self-contained air supply atmosphere-supplying respirator in case of insufficient ventilation).
Activated carbon	None required	None required	None required
Anti-scalant	For splash protection use chemical goggles or full face shield	Rubber or neoprene gloves; impervious apron or coveralls and boots	Not normally needed
Borax	Avoid eye contact	None required	None required
Calcium oxide	For splash protection use chemical goggles or full face shield.	Rubber, neoprene, or nitrile gloves; impervious apron or coveralls and boots.	NIOSH/MSHA approved respirator, if required.
Calcium peroxide	Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.	Impervious gloves of chemically resistant material (rubber or neoprene) should be worn at all times. Wash contaminated gloves and dry thoroughly before reuse. Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse. Impervious boots of chemically resistant material should be worn.	NIOSH-approved respirator for dust should be worn if needed.
Copper sulphate	Chemical goggles or full face shield.	Rubber or neoprene gloves; impervious apron or coveralls and boots.	Dust mask; NIOSH/MSHA approved respirator, if required.

Product	Personal Eyes	Protective Skin	Equipment Respiration
Flocculant	For splash protection use chemical goggles or full face shield	Rubber or neoprene gloves; impervious apron or coveralls and boots	Dust mask
Hydrochloric acid	For splash protection use chemical goggles or full face shield	Rubber or neoprene gloves; impervious apron or coveralls and boots	NIOSH/MSHA approved respirator
Hydrofluoric acid	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133. Wear face shield.	Wear appropriate protective neoprene gloves to prevent skin exposure. Wear acid-resistant jacket, trousers and boots sufficient to protect skin.	Wear appropriate OSHA/MSHA approved chemical cartridge respirator regulations found in 29CFR 1910.134. If more than TLV, do not breathe vapour. Wear self-contained breathing apparatus. Always use an NIOSH-approved respirator when necessary.
Hydrogen peroxide	Wear coverall chemical splash goggles. In addition, where the possibility exists for eye or faces contact due to splashing or spraying of material, wear chemical splash goggles/full-length face shield combination.	Where there is potential for skin contact, have available and wear as appropriate: impervious gloves, apron, pants, jacket, hood, and boots; or totally encapsulating chemical suit with breathing air supply. Permeation data supplied by vendors indicate that impervious materials such as natural rubber, natural rubber plus neoprene, nitrile, or polyvinylchloride afford adequate protection. Do not wear leather gloves or leather shoes (uppers or soles) because they can ignite following contact with peroxide. Cotton clothing can also	Where there is potential for airborne exposure in excess of applicable limits, wear NIOSH approved respiratory protection.

Product	Personal Eyes	Protective Skin	Equipment Respiration
		ignite. This effect may be within minutes, or delayed. Clothing fires and skin damage occur less quickly with 50% or lower hydrogen peroxide than with 70% material, but adequate personal protection is essential for all industrial concentrations. Protective skin creams offer no protection from hydrogen peroxide and should not be used.	
Lead Acid Batteries	Safety glasses must be worn when moving, connecting, disconnecting or maintaining batteries, or cleaning up acid spills; as well as, when brushing battery posts or handling solids from inside a battery.	When moving, connecting, disconnecting or maintaining batteries, or cleaning up acid spills acid resistant gloves and full coverage acid resistant clothing must be worn. When brushing battery posts or handling solids from inside a battery gloves and apron must be worn.	When brushing battery posts or handling solids from inside a battery, dust masks must be worn.
Nitric acid	Chemical safety goggles. A face shield may also be necessary.	Impervious gloves, coveralls, boots, and/or other resistant protective clothing. An impervious full-body encapsulating suit and respiratory protection may be required in some operations.	NIOSH/MSHA approved respirator, if required
Paints	None required.	None required.	None required.
Silica	Safety goggles	Wear impervious gloves, shoes and protective clothing to prevent skin	NIOSH/MSHA approved respirator, if required

Product	Personal Eyes	Protective Skin	Equipment Respiration
		contact.	
Sodium cyanide	For dust and splash protection use chemical goggles or full face shield	Rubber or neoprene gloves; impervious lab coat, apron, or coveralls and boots	NIOSH/MSHA approved respirator, if required
Sodium hydroxide (caustic soda)	Tight-fitting goggles if dust is generated. For splash protection use chemical goggles or full face shield	Gauntlet type rubber or neoprene gloves; impervious apron or coveralls and boots	NIOSH/MSHA approved respirator
Sodium metabisulphite	Chemical safety goggles	Cotton gloves adequate for handling dry product. For solutions, use rubber or neoprene gloves; impervious apron or overalls and boots	NIOSH/MSHA approved respirator
Sodium nitrate	Contact lenses should not be worn; they may contribute to severe eye injury.	Impervious gloves of chemically resistant material (rubber or PVC), body suits, aprons, and/or coveralls of chemical resistant material and impervious boots of chemically resistant material should be worn at all times	For dusty or misty conditions, wear NIOSH-approved dust or mist respirator. In case of spill or leak resulting in unknown concentration, use NIOSH approved supplied air respirator.
Sulphur	Chemical safety goggles	Wear impervious gloves, shoes and protective clothing to prevent skin contact.	NIOSH/MSHA approved respirator, if required

8. MISCELLANEOUS HAZARDOUS/TOXIC MATERIALS

8.1 PRODUCT DESCRIPTION

Acids such as nitric acid, as well as emulsifiers and ammonium nitrate are used at the mine site. Gases such as propane, oxygen, acetylene; solvents; water/effluent treatment chemicals and various additives are also utilized.

The release or spillage of any of these substances would possibly result in environmental impacts and pose a potentially hazardous situation for those personnel exposed to some of these materials. It is essential that materials deemed to be potentially hazardous be dealt with in a cautious manner, in strict adherence to recommended regulations outlined in the legislation, whether the substance is provided in large or smaller quantities as this will prevent serious repercussions should an accidental release of material happen.

8.2 STORAGE FACILITIES OF HAZARDOUS/TOXIC CHEMICALS

All explosive related chemicals will be stored as discussed in Section 6 of this Plan.

All other chemicals and gases will be stored in appropriate locations.

These storage facilities ensure that chemicals that could interact and cause a serious incident will be kept segregated.

9. INVENTORY, INSPECTION & RECORDS

A contract expediting company, Arctic Fuels, arranges all deliveries from the Baker Lake Marshalling Area to the Meadowbank site. This includes the hazardous materials discussed in this plan. The General Mine Manager has ultimate responsibility for supervising the receipt, inspection, and recording of all material inventories at site. The division managers reconcile total amounts received against amounts ordered.

9.1 PETROLEUM PRODUCTS

9.1.1 Inventory Management

Diesel fuel use is metered automatically when it is pumped from the bulk tanks. The metered volumes are summarized weekly and reconciled against tank levels determined manually with a dipstick from the top of the tanks. Diesel fuel consumption for the power generators is recorded weekly.

Aviation fuel is dispensed as required under the supervision of aircraft personnel. Consumption and on-site volumes are reconciled monthly. Lubricants and other petroleum products are inventoried monthly.

9.1.2 Inspection

The Environmental Department performs regularly scheduled inspections of all fuel and lubricant storage areas. The inspection schedule and procedures to be followed are summarized in Table 9. All inspections are logged with the date and time of inspection, facility inspected, and name of the person making the inspection. See Appendix D for the inspection report of any hazardous material storage area.

The condition of hazardous materials storage areas, containers, tanks, connectors and associated plumbing will be checked on a regular basis. Observations on their condition will be logged, dated and kept near the corresponding storage area. Drums/containers will be inspected for the presence and legibility of symbols, words or other marks identifying the contents, signs of deterioration or damage such as corrosion, rust, leaks at seams or signs that the drum/container is under pressure such as bulging and swelling, spillage or discoloration on the top or sides of the drum/container. If leaks or deterioration is encountered it will be noted and addressed in a timely manner.

The hazardous materials area's secondary containment will be inspected and the condition of the secondary containment will be noted. Arrangements will be made for repairs if necessary.

Table 9 - Inspection of Petroleum Storage Sites

Fuel Tanks	*Schedule* – Daily by Site Services Supervisor, Weekly by Environmental Technician, Quarterly by Environmental Coordinator. *Procedure* – Repair leaks and report promptly. Inspections will be reported annually and filed with the General Mine Manager or Site Services Superintendent and Environmental Superintendent.
Electrical Generating Plant (diesel)	*Schedule* – Daily by powerhouse operator, weekly by Environmental Technician as part of internal environmental inspections. *Procedure* – Inspections will be reported annually and filed as above.
Other Fuelling Stations	*Schedule* – Daily by Site Services Supervisor, Weekly by Environmental Technician as part of regular inspections. *Procedure* – Inspections will be reported annually and filed as above.
Spill Kits	*Schedule* – Monthly by Environmental Technician, Quarterly by Environmental Coordinator. *Procedure* – Inspections will be reported annually and filed as above.
Other Hazardous Material Storage	*Schedule* – Daily by Site Services Supervisor, Mill Supervisor, Weekly by Environmental Technician when materials are on site. *Procedure* – Inspections will be reported annually and filed as above.

Any accidental damage to containment structures will be inspected immediately and appropriate repairs undertaken. The extent of damage will be reported in writing to the General Mine Manager and Environmental Superintendent. The report will note any remedial repairs that may be made, the date of any repairs, and the need for any follow-up inspection.

9.1.3 Records

Records pertaining to storage, use, and loss of fuels and lubricants are required by CCME and the Fire Marshal (under the *National Fire Code).* The following records are prepared by the Procurement and Logistics and Site Services departments:

- Reconciliation of bulk inventory from resupply logs;
- Weekly use summaries;
- Weekly reconciliation for each storage tank;
- Overfill alarm tests;
- Pressure tests (if applicable);

- Inspections and maintenance checks of the storage tank, piping, and delivery systems;
- Any alteration to the systems;
- Reports of leaks or losses;
- Reports of spill responses; and
- Records of training.

9.2 EXPLOSIVES

9.2.1 Inventory Management

See Figure 1 for location of the Explosives Mixing Plant or Emulsion Plant. The emulsion manufactured on-site is stored in a tank located at the Emulsion Plant. AEM's explosive contractor, Dyno Nobel Inc., performs daily and weekly inspections on the Emulsion Plant to ensure that Inventory used is documented. AEM conducts daily inspections of the seacan's storing the boosters, delays and detonator cords and provides an inventory to the Mine Manager.

9.2.2 Inspection

Access to and use of explosives will be under the exclusive control of AEM. AEM will be responsible for inspection of all explosives equipment and facilities, including the ammonium nitrate storage areas and the magazines for high explosive detonators and blasting caps. The explosives manufacturing plant is inspected by Dyno Nobel Inc. and reports this to AEM Management.

9.2.3 Records

The *Federal Explosives Act* requires that the following records be kept with regard to explosives products:

- Quantity and strength of each explosive manufactured; and
- Quantity of each explosive issued to the mine site from the factory, including the dates of shipments and quantity of each explosive on site.

AEM staff will provide weekly reports to the General Mine Manager that will include:

- Staffing;
- Safety concerns or incidents;
- Total explosives consumption;
- Amount of ammonium nitrate remaining on site; and
- Inventory of other explosives and accessories to be audited for fiscal month-end balances.

9.3 MISCELLANEOUS HAZARDOUS/TOXIC MATERIALS

9.3.1 Inventory Management

Adequate quantities of all hazardous chemicals are reconciled against orders on receipt. The appropriate department responsible for the miscellaneous chemicals is responsible for reconciling the resupply inventory.

9.3.2 Inspection

During operations, the appropriate department responsible for storage and handling of the miscellaneous chemicals are to regularly inspect all areas where such hazardous materials are used and stored. Any problems will be noted and reported to the Department Manager. The Department Manager is responsible for weekly or monthly inspections of miscellaneous hazardous materials and storage areas.

9.3.3 Records

The quantity of hazardous materials received, used, and in possession of personnel are recorded by appropriate Departments. The departments are to comply with the environmental regulations.

10. TRAINING

10.1 GENERAL

All staff and contractors at the Meadowbank Gold project will receive the following training:

- WHMIS;
- Emergency and spill response (see also the SCP and ERP);
- Operations overview; and
- Mine Standard Operating Procedures.

Mine employees will receive additional training in mine safety as specified by the *Mine Health and Safety Act* and regulations. AEM will ensure compliance with the training requirements specified in the Act and regulations.

Plant employees will receive additional training specific to their area of work and duties, including safe operating practices, safe handling and storage of chemicals, and use of PPE. Other training includes cyanide and chemical awareness, specific chemical training for specific tasks, and a mill induction training. This training will be the responsibility of AEM.

A record of training received will be maintained for each employee and also from contractors.

In Appendix E you will find a procedure poster that is placed at the applicable hazardous material storage location. This poster will also be used during toolbox meetings with all departments to ensure that hazardous material is being segregated and placed in the appropriate containers for storage.

10.2 PETROLEUM PRODUCTS HANDLERS

Personnel who handle petroleum products will be expected to be conversant with relevant MSDS information. As well, these personnel will be given training in the following:

- Transportation of dangerous goods (TDG);
- AEM's fuel handling procedures (outlined in Section 5);
- Spill response and cleanup procedures for petroleum (see the SCP); and
- Emergency response, especially firefighting procedures (see the ERP).

10.3 EXPLOSIVES HANDLERS

Only trained and certified persons will work with explosives. The explosives personnel will undertake formal training and on-the-job training to ensure compliance with legislation. The Mine Inspector will check the adequacy of training. Training requirements will include (but not necessarily be limited to):

- Specific fire procedures as per the *Federal Explosives Act*;
- First aid;
- Transportation of dangerous goods (TDG); and
- WCB Blasting Certificate.

10.4 PLANT EMPLOYEES

Plant operators may receive TDG training, if appropriate. All plant employees will be trained in spill and emergency response procedures. Emergency response procedures for spilled chemical substances are provided in the SCP.

10.5 THIRD PARTY CONTRACTORS

It is expected that third party contractors receive adequate and comprehensive training to conduct their work tasks from their employer. AEM intends to review the general qualifications of third party contractors prior to having them work at the site. In addition, the contractor companies may also be requested to confirm the qualifications of specific individuals that they may have working at the site.

Third party contractors working on the site are required to participate in, and complete a site specific health and safety training session. The training session is envisioned to be valid for a period of 3 years, after which time the contractor may be required to complete the training again, or attend a refresher. The training session will outline site specific hazardous and response procedures that they should be aware of in the course of conducting their work on site. The training session will cover hazardous materials management.

11. PLAN EVALUATION, AUDIT & IMPROVEMENT

As part of AEM's commitment to attain certification under the International Cyanide Management Code, it will sponsor regular (every three years) audits by Institute-approved, third-party professionals to verify its compliance with the Code's principles and standards of practice with regard to cyanide handling

12. FIGURE

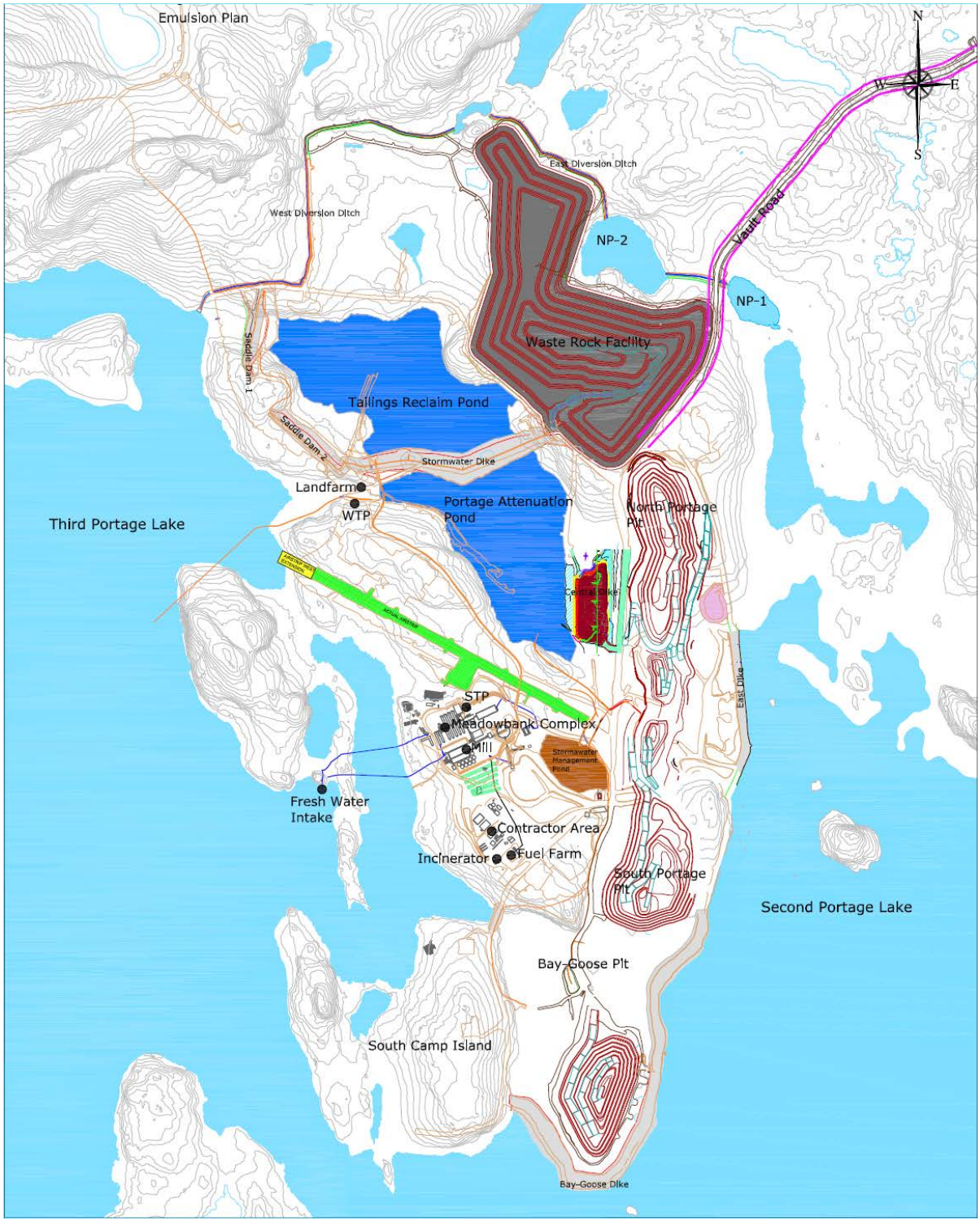


Figure 1 - Meadowbank Mine Site General Layout

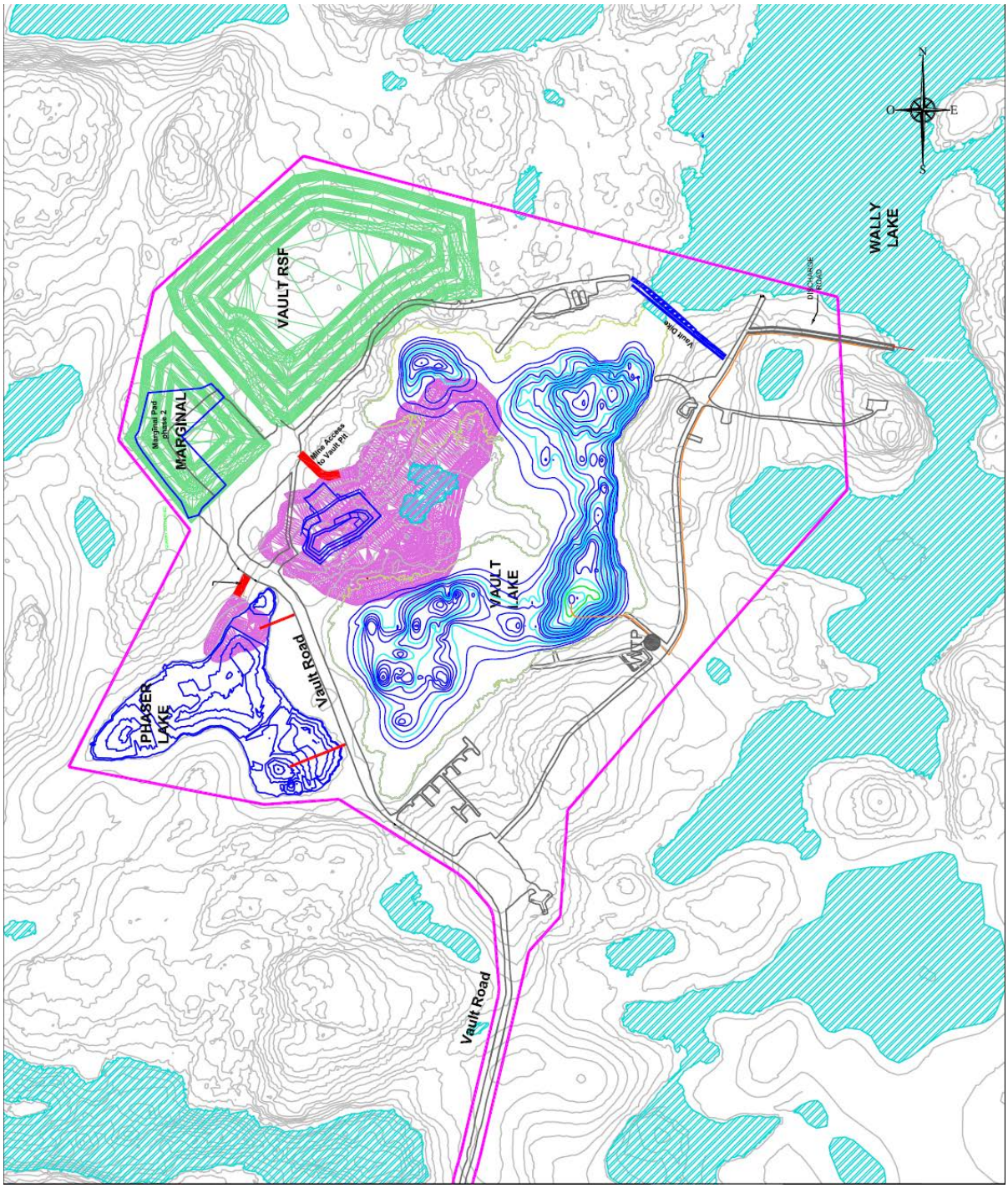


Figure 2 - Vault General Layout

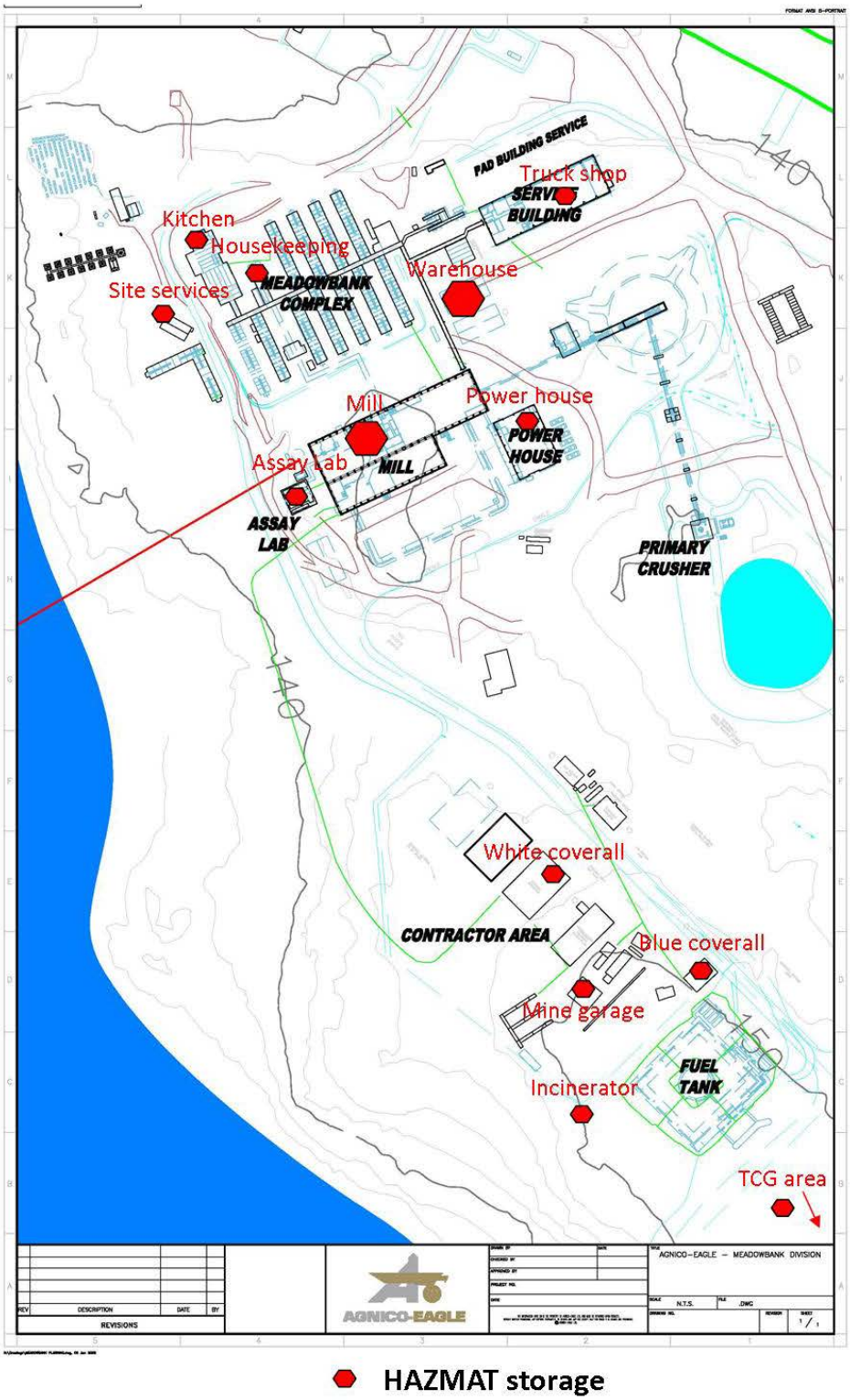


Figure 3 - Meadowbank Mine Site: Hazardous Material Storage Locations

Figure 4 - Baker Lake Marshalling Area Layout: Diesel Fuel Storage Facility

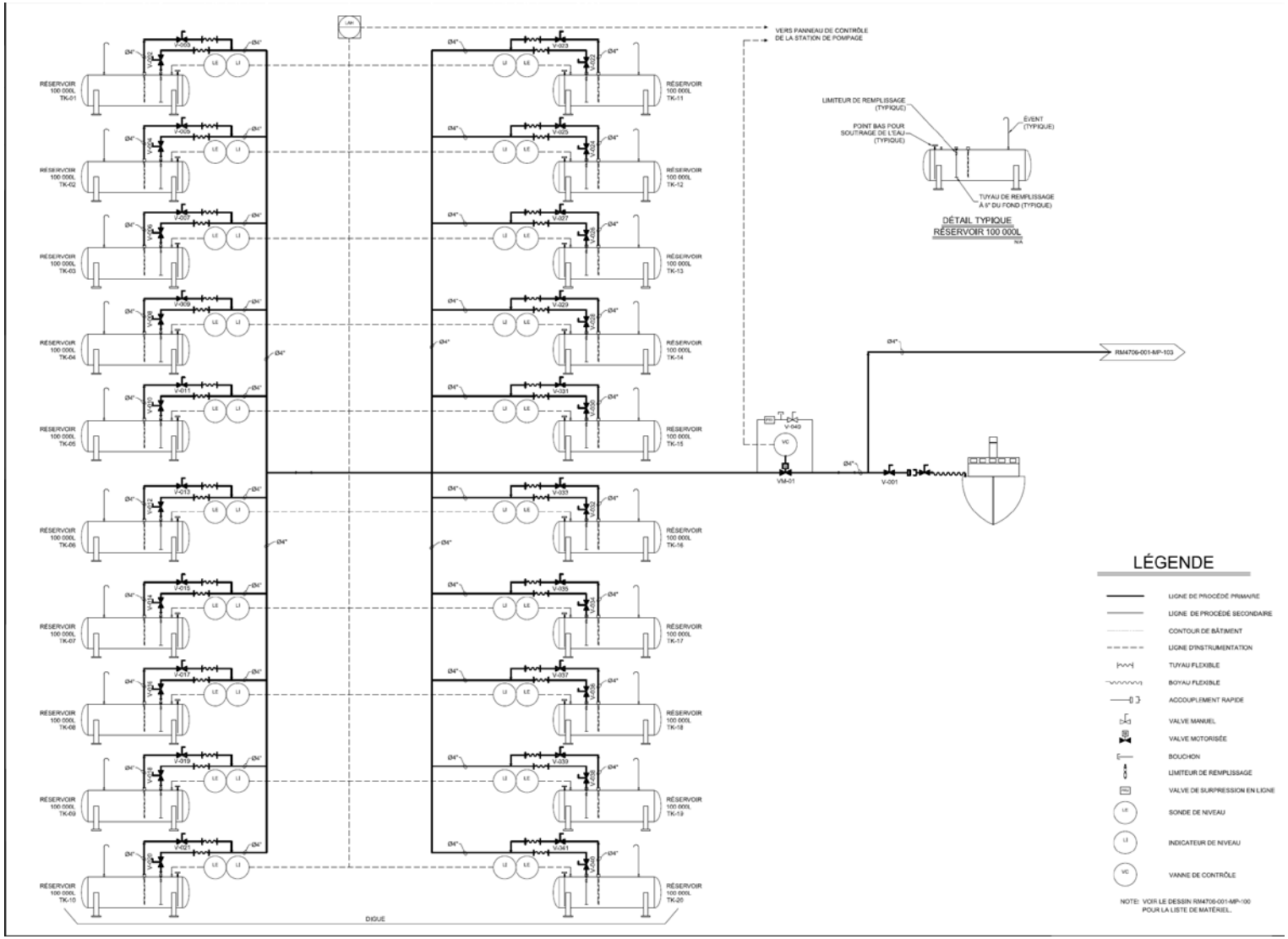


Figure 5 – Baker Lake Marshalling Area Layout: Jet-A Fuel Storage Facility

13. LIST OF ACRONYMS

AEM	Agnico-Eagle Mines Ltd.
AN	Ammonium Nitrate
ANSI	American National Standards Institute
ANFO	Ammonium Nitrate Fuel Oil
CCME	Canadian Council of Ministers of the Environment
EPS	Environmental Protection Service
ERD	Explosives Regulatory Division, Natural Resources Canada
ERP	Emergency Response Plan
ERT	Emergency Response Team
FS	Fuel Storage Area
HAZCOM	Hazard Communication
HCN	Hydrogen Cyanide
HM	Hazardous Materials Storage Area
HMMP	Hazardous Materials Management Plan
HR	Human Resources
HSC	Occupational Health & Safety Committee
HW	Hazardous Waste Storage Area
IBC	Intermediate Bulk Container
ISO	International Organization for Standardization
MSDS	Materials Safety Data Sheets
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
OHSA	Occupational Health and Safety Administration

OHSP	Occupational Health & Safety Plan
PCB	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
SCP	Spill Contingency Plan
TDG	Transportation of Dangerous Goods
TDGA	Transportation of Dangerous Goods Act
WCB	Workers' Compensation Board
WHMIS	Workplace Hazardous Materials Information System

Appendix A

List of Applicable Legislation

The following is a list of federal and territorial legislation and guidelines that regulate the management of hazardous materials in Nunavut, and which are considered potentially applicable to the Meadowbank Gold Mine. As part of Meadowbank Mining Corp's overall environmental management system for the mine site, this list is updated at least annually to ensure it represents current and relevant information.

Federal Legislation

- **CANADIAN ENVIRONMENTAL PROTECTION ACT, 1999 S.C. 1999, c. 33**

  Code of Practice for the Reduction of Chlorofluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

  Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

  Environmental Code of Practice on Halons Code of Practice EPS 1/RA/3E.

  Environmental Emergency Regulations SOR/2003-307.

  Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks, CCME-EPC-87-E, as amended.

  Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations SOR/2005-149.

  Federal Halocarbon Regulations, 2003 SOR/2003-289.

  Interprovincial Movement of Hazardous Waste Regulations SOR/2002-301.

  Ozone-Depleting Substances Regulations, 1998 SOR/99-7.

- **EXPLOSIVES ACT R.S.C 1985, c. E-17**

  Ammonium Nitrate and Fuel Oil Order C.R.C. 1978, c. 598.

  Explosives Regulations C.R.C. 1978, c. 599.

- **TRANSPORTATION OF DANGEROUS GOODS ACT, 1992 S.C. 1992, c. 34**

  Transportation of Dangerous Goods Regulations SOR/2001-286.

  Transportation of Dangerous Goods Regulations - Schedules SOR/2001-286.

Federal Codes and Other Guidance Documents

- National Fire Code.
- Indian and Northern Affairs Canada. 2005. DEW Line Cleanup Barrel Protocol.
- Canadian Council of Ministers for the Environment (CCME) - Environmental Code of Practice for Above-Ground and Underground Storage Tanks Systems containing Petroleum Products and Allied Petroleum Products (2003).
- CCME - Canadian Wide Standards for Petroleum Hydrocarbons in Soil.
- CCME - Canadian Environmental Quality Guidelines.
- Environment Canada (Tilden & Westerman). 1990. Guidelines for the Preparation of Hazardous Material Spill Contingency Plans.
- Department of Fisheries and Oceans. 1998. Guidelines for the Use of Explosives in or Near Canadian Fisheries Water.

Territorial Legislation

- **ENVIRONMENTAL PROTECTION ACT R.S.N.W.T. 1988, c. E-7**

  A Guide to the Spill Contingency Planning and Reporting Regulations January 2002.

  Environmental Guideline for Contaminated Site Remediation November 2003.

  Environmental Guideline for Waste Lead and Lead Paint.

  Guideline for Ozone Depleting Substances.

  Guideline for the General Management of Hazardous Waste in the NWT.

  Guideline for the Management of Waste Antifreeze.

  Guideline for the Management of Waste Batteries.

  Guideline for the Management of Waste Paint.

  Guideline for the Management of Waste Solvents.

  Guideline for Dust Suppression, February 1998.

  Spill Contingency Planning and Reporting Regulations R-068-93.

  Used Oil and Waste Fuel Management Regulations R-064-2003.

  Plain Language Guide to the Used Oil and Waste Fuel Management Regulations.

- **TRANSPORTATION OF DANGEROUS GOODS ACT, 1990 S.N.W.T. 1990, c. 36**

  Transportation of Dangerous Goods Regulations R-049-2002.

- **EXPLOSIVES USE ACT R.S.N.W.T. 1988, c. E-10**

  Explosives Regulations R.R.N.W.T. 1990, c. E-27.

Appendix B

Hazardous Materials Stored on the Meadowbank Site

Name	Description	Quantity
2,6 DIMETHYL 4 HEPTANONE 80 %	4LT	60
ABS GLUE CAN WITH BRUSH	500ML	3
ABS TO PVC TRANSITION GLUE	W/ BRUSH 500ML	11
ACETONE	4LT	4
ACETONE CLEANER		22
ACETYLENE	SIZE A390 CYLINDERS	506
ACETYLENE CGA510	SIZE MC CYLINDERS	20
ACETYLENE LABORATORY GRADE	SIZE K	42
ACTISAND 7E-3003	SILICE SAND 22.68KG	144
ACTIVATED CARBON	8 X 16 - 60% ACTIVE IN 500KG	504
ACTIVATED CARBON (GAC) FILTER	2 1/2" X 10" PHOSPHATE	12
ADDITIVE		16
ADHESIVE SILICONE	WITH RTV SUPERFLEX	40
ADHESIVE SILICONE	HIGH-TEMP RTV RED	93
ADHESIVE/SEALANT 277	BOT/250ML F/ LARGE BOLTS	41
ALIQUAT 336 AVERAGE MW 442	1LT	4
ALIQUOT 336	250ML	4
ALL SEASON SELECT OIL.	1L	16
ALL STEEL WELDING ELECTRODE	M4 5/32" 2.5KG/BX	2
ANHYDRE BORAX 12 MESH	25KG DEHYBOR	167
ANHYDRONE		7
ANIONIC FLOCCULANT 920 MC	750KG/BAG	181
ANIONIC FLOCCULANT 934 SH	750KG/BAG	151
ANTI SEIZE LOCTITE SILVER GR	CONTENANT 1LB	26
ANTI-STATIC/FOG BOTTLE CLEANER	MAGIC 225ML	36
ARC AIR TORCH	EXTREME K4000	4
ARC AIR TORCH 1000A	W/10' CABLE CSK4000W	9
ARCAIR SLICE ROD	1/4" X 22" LONG 100/PACK	2
ARCAIR SLICE ROD	3/8" X 18" LONG 50/PACK	2
ARCTIC GREEN LOW TEMP WET CHEM	FOR HVY EQUIP FIRE SUPPRESSION	15
ARDEE 100 ROCK DRILL OIL	20LT	201
ARDEE 32 ROCK DRILL OIL	20LT	1301
ARDEE 32 ROCK DRILL OIL	205LT DRUM	7
ARENA SILICA	MALLA 2030 INDUSTRIAL 25KG/BAG	0
ARGON	SIZE T CYLINDERS	118
ARSENIC EDL		2
ARSENIC STANDARD	1000PPM 500ML	4
ASSIST 1AL1 LIQUID ALKALI	18.9LT	107
ATF D3M	1040LT	1
AU LUMINA HCL		1
BACKING COMPOUND	MAGANESE	50
BATTERY	12V CM785	4
BATTERY	12 VOLTS	0
BATTERY	KAWASAKI MULE	12
BATTERY	12V 8DW ELECTROL F/ DM45 DRILL	2
BATTERY	CR2	6
BATTERY 12V	FOR HVY EQUIP FIRE SUPPRES	6
BATTERY ACID NEUTRALIZER		22
BATTERY ENERGIZER	6V	3
BATTERY ENERGIZER INDUSTRIAL	ALKALINE AAA 4/PK	2185
BATTERY ENERGIZER INDUSTRIAL	AA 4/PK	2554
BATTERY ENERGIZER INDUSTRIAL	C	39
BATTERY ENERGIZER INDUSTRIAL	ALKALINE D	572
BATTERY ENERGIZER INDUSTRIAL	9V	453

BATTERY INTERNATIONAL	LUBE AND SERVICE TRK	12
BATTERY LI-ION CP200	2250MA CAPACITY	13
BATTERY MOTORCRAFT	12V 850A	31
BLUESHIELD WIRE LA-S6.35	20KG ROLL	10
BODY PRIMER	F/ URATHANE WINDOW&WINDSHIELD	1
BONE ASH	20 MESH	27
BRAKE CLEANER	KLEEN-FLO 20LT	82
BRAKE CLEANER	12/CS	766
BRAKE FLUID DOT-3	1LT	32
BRP MINERAL OIL	946ML 2 STROKE	265
BUFFER SOLUTION PH 10	4L	3
BUFFER SOLUTION PH 4	4L	3
BUFFER SOLUTION PH12	R1300 (4 LITRES)	0
BUFFER SOLUTION PH7	4/CASE	2
BUG SPRAY DEEP WOOD OFF	100ML PUMP BTL	278
BURNING RODS LENCO	10' 6" 5/8ID 11/16OD	100
BUTANE FUEL	70ML	14
C25 ARGOSHIELD	SIZE T CYLINDERS	99
CALCIUM CHLORIDE LIQUID	29.6% 1000L/DM	1587
CALCIUM CHLORIDE LIQUID	29.6% 1200L/DM	303
CARBON DIOXIDE	SIZE T CYLINDERS	0
CAT DEO MONOGRADE 40 OIL	1200 LITERS/TOTE	93
CAT DEO MONOGRADE 40 OIL	205 LITERS DRUM	6
CATIONIC POLYMER	25KG HYDREX 3613	25
CAUSTIC SODA ANHYDRE	1000KG MICROPEARL	321
CAUSTIC SODA MICROPEARL	25KG/BG	1137
CAUSTIC ULTRATAK GREASE	CARTRIDGES	4
CELLULOSE		30
CHASSIS LUBRIFIANT	2KG CASTROL	2
CHIP CMS HYDROCYANIC ACID	2 - 50 PPM	10
CHOKE AND CARB CLEANER	KLEEN-FLO	37
CLEANER BATTERY MAINTENANCE	AERO 312GM	78
CLEANER CARBURATOR/CHOKE		9
COAGULANT ALUMINIUM HYDROXYDE	1000KG HYDREX 352 PASS-10S	123
COLORED FLEECE RAGS	20LB	314
COMPRESSOR OIL SYNTHETIC	COMPRO XL-S 32 205LT	23
COMPRO SYNTHETIC	205LT/DM	14
COOLANT CVC-7-A	1040LT TOTE YELLOW	1
COOLANT SAMPLE KIT		114
COOLANT TREATMENT		2
COPPER OXIDE		16
COPPER SULPHATE	PENTAHYDRATE MINE GRADE	447
COUPLER QUICK		34
CPVC GLUE	W/ BRUSH 500ML	7
CULTURE TUBE DISPOSABLE	BOROSILICATE16MMX150MM 1000/BX	196
CVC-7-A YELLOW COOLANT	3.78LT	50
DEB DEBBA PROTECTIVE CREAM	# 233 8 X 800ML	31
DEB NATURELL HAIR/BODY	# 266 4 X 4LT	166
DEB NATURELL SUNFLOWER	# 256	145
DEFLECT PRO SUN SCREEN	140ML	1174
DE-ICER LOCK POCKET SIZE	35ML	47
DIELECTRIC GREASE		7
DIESEL ADDITIVE	9.8L	145
DIESEL MELT	ANTI-GELLING TREATMENT	34
DIFERENCIEL LOCK ADDITIVE SEAL		6

DISSOLVED OXYGEN SERVICE KIT	HACH PORTABLE OXYGEN METER	6
DIXON LUBRICATOR	3/4"	3
DOW CORNING GREASE # 111 TUBE	HVY EQUIP FIRE SUPPRES	7
DPD FREE CHLORINE HACH	10ML SAMPLE REAGENT 100/PK	7
DRILL CARE MOTOR OIL	QT FOR DM45 DRILL	7
DRILL STEEL GREASE	KOPPER KOTE 10LT	76
DURADRIVE MV SYNTHETIC ATF	20LT PAIL	10
DURATRAN SYNTHETIC	205 LITERS DRUM	5
DURON E 15W40	1040LT IBC	80
DURON E SYN 0W40	1040LT IBC	27
DURON E SYNTHETIC 5W-40	4L	32
DURON SYNTHETIC 15W40	205LT	1
DURON XL 0W30	1040LT IBC	88
DUST BAN	20KG	95
DUST CONTROL NALCO	8882.61 1183KG TOTE	92
DYNALENE EG 60 A-RED	ETHYLENE GLYCOL (1078KG/TOTE)	15
ECOTRACTION	1 TON BULK TOTE IBC	15
EDGE DETERGENT	18.9LT	108
ELECTRODE	600-800-900	60
ELECTRODE CLEANING SOLUTION	HANNA INSTR.TESTER 230ML BTL	12
ENDURATEX EP150	205L/DM	86
ENDURATEX EP220	205LT/DRUM	30
ENDURATEX EP220	1040LB IBC	10
ENDURATEX EP320	205LT/DM	4
ENDURATEX EP460	205LT/DM	7
ENDURATEX EP68	205LT/DM	29
ENDURATEX SYN EP150	205LT/DM	3
ENDURATEX SYN EP220	205LT/DM	34
ENDURATEX SYN EP320	205L/DM	10
ENDURATEX XL SYN BLEND 68/220	205LT	7
ESAB WELDING WIRE	0.045 (15 Kg/ROLL)	50
ESAB WELDING WIRE	0.062 (15 Kg/ROLL)	82
ESSO XDO 60	1100L/TOTE	0
EXTENDED LIFE COOLANT -52	1040LT	123
EXTERIOR SEALANT MULCO	300ML BLUE SCOTIA	47
EXTERIOR SEALANT MULCO	300ML CLEAR	48
FLOCULANT	25KG/BG 85016	1
FUNNEL	DYNALINE	9
GASKET ELIMINATOR 515	50ML SMALL TUBE	16
GASKET MAKER HI-TEMP	80ML RED	5
GASKET SEALANT IN TUBE		94
GEAR CHAIN & CABLE LUBRICANT	LOCTITE 12 OZ. AEROSOL	26
GEARGUARD	180KG/DRUM	4
GENERAL PURPOSE THINNER	GALLON	59
GLUE STICK	20G	23
GLUE STICK ENIUM	40G	7
GLYCEROL (VERLUBE)	4LT/CONTAINER	1
GOLD SOLUTION STD	1000PPM	5
GREASE EP.	NLGI CHEVRON 6134 300GR	12
GREASE EP-1	IN TUBE ULTRA DUTY	58
GREASE FOR COUPLING	PEERLESS XCG FLEX GREASE	90
GREASE TUBE	TRAMAC	0
GREASE TUBE KIT	GRACO FIREBALL 425 50:1	8
HAND CLEANER GRIME EATER	3.5LT	7
HARD FACING ELECTRODE	3/16" 20KG/CS	0

HELISTAR CS GAS		30
HELIUM	SIZE T CYLINDERS	28
HIGH PRESSURE NITROGEN	SIZE T CYLINDERS	25
HIGH TEMPERATURE CONTROLLER		1
HIGH VACUUM GREASE		4
HYD ARCTIC OIL	FOR DM45	2
HYDRAULIC COOLER	THERMAL TRANSFER	1
HYDREX AW 46	HYDRAULIC OIL 20LT/PAIL	6
HYDREX EXTREME HYDRAULIC OIL	205LT	10
HYDREX MV ARCTIC 15	205LT	24
HYDREX MV22	20LT/PAIL	40
HYDREX MV36	20LT/PAIL	40
HYDREX MV60	20LT/PAIL	32
HYDREX XV ALL SEASON	1040LT IBC	0
HYDROCHLORIC ACID	240KG 20BE 32%	396
HYDROCHLORIC ACID REAGENT GRAD	2.5LT 4/CS	52
ICE FREE AIR TOOL OIL	1LT WHEEL & ACCESSORIES	0
INO FOAM SOAP	6 X 1LT	160
INT/EXT BLUE PAINT	AGNICO DEVOE	17
IRON ACCELERATOR		89
J-512 FINAL STEP/SANITIZER	4 X 1.89LB BY CS	15
JAVELISANT DIBAC	20LT	12
JERRYCAN GAS	20LT	30
KEEN-FLO	BRAKE & PARTS CLEANER 4LT	20
KIDDY APC WET CHEMICAL AGENT	MODEL # WHDR-125	2
KIDDY APC WET CHEMICAL AGENT	MODEL # : WHDR-600	2
KVS	20G/PKG	2
LAUNCH 6GL2 LIQUID SOUR	18.9LT	28
LEAD BULLION MOLD	1000 OZ	20
LEAD NITRATE	25KG 99% MIN	2730
LEAD NITRATE	1000 KG	138
LEPAGE BLUE CONTACT CEMENT	3.8L	0
LITHARGE GOLD FREE	25KG	2
LOCTITE 290	50ML GREEN	4
LOCTITE 510 GASKET ELIMINATOR	50ML	12
LOCTITE SUPER GLUE	SUPER GLUE 495	69
LOCTITE THREADLOCKER 242 BLUE	REMOVABLE BOT 250ML	7
LOW COOLANT SEN		2
LUBRICANT	5 GALLON	2
LUBRICANT OIL WD 40	AEROSOL	2
LUBRICANT OIL WD40	4LT	24
LUBRICANT SUPER PENETRATING	PL-100 350G 12/CS	20
LYSOL TOILET CLEANER	710ML	1
MAGIC BOND EPOXY STICK		6
MAGLITE RECHARGEABLE BATTERY		10
MERCON SP TRANSMISSION OIL	1 LITER CONTENANT	2070
METABISULFITE	97% W	1046
METABISULFITE	97% W 907.19KG	389
METABISULFITE	97% W 1200KG/BAG	51
METABISULFITE	97% W 1360KG/BAG	80
MILL PERSE 813	SCALE CONTROL 200LT	0
MILL PERSE 813	SCALE CONTROL 1000LT TOTE	34
MOBILE SHC 10/24	20LT COMPRESSOR OIL	4
MOBILITH	GREASE SHC100	10
MOBILTAC 325NC	205L/DM	1

MOBILTAC 375 NC	17.2KG PAILS	24
NEW FLUX	491KG BATCH (26 PAILS/18.8846)	34074.85
NICKEL ANTI-SEIZE	1LB. CAN	13
NITRIC ACID 67%	193LT/DM	467
NITRIC ACID REAGENT GRADE	2.5LT 4/CS	23
NITRO CARTRIDGE	FOR HVY EQUIP FIRE SUPPRESSION	14
NITROGEN PILOT CYLINDER KIT	FOR HVY EQUIP FIRE SUPPRESSION	4
NITROGEN PP4.8	SIZE T CYLINDERS	25
NU-ACTION-3	4LT	76
NU-BIO SCRUB	4LT	55
NU-KLEENSMELL	4LT	20
NU-TRAP	20LT	14
OIL ADDITIVE	301-A	20
OIL COOLER	COOLER	4
OIL COOLER		0
OIL COOLER		2
OIL F/ CHAIN LIGHT	WINTER -40°C RESISTANT	20
OIL MOTOR DRILL CARE	20 LITER	2
OIL RALUBE 40	1040 LITER TOTE IBC	40
OXYGEN	SIZE K CYLINDERS	286
OXYGEN CGA540	SIZE D CYLINDERS	10
OXYGEN LABORATORY GRADE	HYDROCARBON FREE SIZE K	67
PAINT	1GAL BRIGHT YELLOW	25
PAINT AERVOE INVERTED	ORANGE GLO 12CN/BX	158
PAINT AERVOE INVERTED	GREEN GLO 12 CAN/BX	78
PAINT BRUSH	2 1/2"	196
PAINT BRUSH ANGLE	2 1/2"	100
PAINT DEVOE	1GAL SAFETY BLUE H19	54
PAINT DEVOE	1GAL SAFETY YELLOW EPOXY	13
PAINT DEVOE RUST-OLEUM	1GAL SILVER GRAY	47
PAINT EXTERIOR LATEX	1GAL SAFETY BLUE	22
PAINT GREY	ATLAS-COPCO	15
PAINT PIZZAZZ ENAMEL ALKYD	1GAL SATURN YELLOW	2
PAINT RUST-OLEUM	14OZ FLUO GREEN	64
PAINT RUST-OLEUM	14OZ FLUO ORANGE	241
PAINT YELLOW	ATLAS-COPCO	12
PC ATF D3M	205LT/DM	5
PEERLESS LLG GREASE	TUBE	140
PEKOE THE VRAC	(1000/BX)	99
PERMATEX ORING&RUBBER ADHESIVE		11
PETROSOL 3139	205LT	1
PH 4.01 SOLUTION	HANNA INSTRUMENT PH TESTER	5
PH 7.01 SOLUTION	HANNA INSTRUMENT PH TESTER	6
PINE-SOL	443ML	0
POTASSIUM NITRATE	FA209A	0
PRECISION SYNTHETIC EMB	TUBE	90
PRECISION SYNTHETIC GREASE	TUBE	270
PRECISION XL EMB GREASE	TUBE	179
PRECISION XL EP2 GREASE	TUBE	782
PRECISION XL EP2 GREASE DRUM		15
PREMIX FLUX 66PB026SODA4.5	ORANGE 19KG/PAIL	0
PRIMARY OIL BURNER		1
PRODURO OIL FD-1 60	1100/TOTES	8
PRODURO TO -4+ SYNTH	ALL SEASON 205L	25
PRODURO TO-4 30 S	205LT/DRUM	9

PRODURO TO-4 SYN ALL SEASON	1040LT IBC	43
PRODURO TO-4 XL SYN LO-TEMP	1040LT	20
PROLEACH KG		10
PROLITE MOP STICK 54	#AG-1674	17
PROPANE FUEL TANK	16.9OZ	133
PVC GLUE W/ BRUSH	711 WELD*ON 946ML	16
PVC PRIMER WITH BRUSH	P70 500ML	2
QUICK LIME	1700KG 0-2 5MM 1152	2768
REAGENT TUBE	280 X 32MM F/ CHS500	2
REAGENT TUBE		1
REAGENT TUBE		1
RUBBER CLEANER RUB-O-MATIC	1 LITER	119
SAND FOR SANDBLAST JETMAG	GRIT 30-60 25KG OLIVINE	316
SILICA SAND	SILICA SAND 22.7KG	177
SILICON FOOD GRADE GREASE	4 OZ FOR AMP SERIES PUMPS	0
SILICONE LUBRICANT		11
SILVER ELECTRODE	M2.4 3/32" .5KG/TUBE	1
SILVER FOIL	1 ONCE 99.999% PURE	52
SILVER NITRATE	500GRAM	3
SODA ASH NA2CO3	25KG MR118	11
SODIUM CYANIDE	PELLETS 1000KG	1677
SODIUM HYDROXIDE	SCRUBBER FILL	8
SODIUM HYPOCHLORITE	20/LITERS	52
SODIUM NITRATE	22.27KG 98% INDUSTRIAL GRADE	226
SOLVENT VARSOL	PLASTIC BOTTLE 3.78LT	68
SPRAY SPATTER BLOCK	W/TRIGGER 500ML	10
STOKOLAN HAND CREAM		35
SULPHUR PRILLS	99.5% 1000KG	4497
SUPER 3000 MORTAR		4
SUPER 77 SPRAY ADHESIVE		0
SUPER 90 ABC DRY CHEMICAL	PAIL FOR HVY EQUIP FIRE SUPPRE	30
SUPER DUTY MOTOR OIL	4LT	18
SUPER FLUID KLAR PILOT		199
SWIVEL CASTERS WHEEL	8"	8
SYNDURO SHB150	205LT/DM	59
SYNDURO SHB32	20LT/BUCKET	262
SYNDURO SHB32 SYNT.	COMPRESSOR OIL 205L/DRUM	14
SYNDURO SHB460		2
SYNTETHIC SHB 68	205LT-45GAL	7
SYNTEX FAN MOP HEAD	20OZ 550G	70
SYNTHETIC 75W140	1040LT/TOTE	2
THREAD SEALANT	W/ PTFE	17
THREAD SEALANT W/TEFLON	PERMATEX 118ML	56
THREADLOCKER	36ML GREEN	4
THREADLOCKER 272 HIGH-TEMP	LOCTITE 250ML	2
TRANSFORMER OIL	VOLTESSO 205LT	1
TRAXON E SYN 80W140	1040LT/DRUM	3
TRAXON E SYN CD50	205LT/DRUM	8
TRAXON ENGRENAGE	20LT 85W140	1
TRAXON XL 75W90	205LT/DRUM	2
TRAXON XL SYNTH BLEND 75W90	60L	5
TUNGSTEN ACCELERATOR		15
TURBOFLO R&068	20LT PAIL	1
TURBOFLO R&O 100 OIL	20L PAIL	8
TWO CYCLE ENGINE OIL		12

ULTIMA EP150	205LT	2
ULTRA CLEAR PREMIUM OIL LAMP		3
URATHANE BRUSH	F/ URETHANE WINDOW&WINDSHIELD	33
URETHANE DUR-X-LINE MATERIEL	780001277 WRM-80T 1KG KIT	15
URETHANE DUR-X-LINE MATERIEL	780001276 WRM-80T 4KG KIT	5
URETHANE SEALANT IN TUBE		275
VALVE LUBRICANT AND SEALANT	400GR	40
VARSOL	PARTS CLEANER 45GAL/DM	8
VICTAULIC LUBRICANT	ONE QUART	0
VULTREX G-124 GREASE	TUBE	59
VULTREX GEARSHIELD NC	205 LITERS	120
VULTREX OGL SYNTHETIC	ALL SEASONS 54KG KEG	1
VULTREX OGL SYNTHETIC GREASE	ALL SEASON 680, 54KG	70
WELDING ELECTRODE BRONZE	3.2MM 1/8 SODEL 661 5KG/BX	5
WELDING ELECTRODE MG	1/8" 5KG/BX	2
WELDING ELECTRODE MG	3/32" 2.5KG/BX	2
WELDING ELECTRODE TRACTALOY	M2.4 3/32" 5KG/BX	2
WELDING FACE SHIELD		15
WELDING ROD	STUD-XTRACT SOUDOTEC 5KG/BX	2
WELDING ROD	0.156" NON FERROUS	12
WELDING ROD	3/32" 10.20KG/BOX 624P-3	5
WELDING ROD	1/8" 12.90KG/BX 624P-309	14
WELDING ROD	5/32" 12.90KG/BX 624P-309	7
WELDING ROD	3/32" 10KG/BX LA-11018	6
WELDING ROD	1/8" 20KG/BX LA-11018-M	5
WELDING ROD	5/32" 20KG/BOX LA-11018-M	5
WELDING ROD	3/32" 10KG/BX LA6010	14
WELDING ROD	1/8" 20KG/BX LA6010	14
WELDING ROD	3/32" 10KG/BX LA7018	8
WELDING ROD	1/8" 20KG/BX LA7018	25
WELDING ROD	5/32" 20KG/BX LA7018	24
WELDING ROD 1/4	6 X 450MM 19.5KG/CS	1
WELDING ROD 5/32	4 X 450MM 18.6KG/CS	1
WELDING ROD ALU LITE	3/32 2.5KG/BX	10
WELDING ROD ALU LITE	1/8 2.5 KG/BX	10
WELDING ROD CARBON ARC DCCC	1/8" X 12" 100/BX	15
WELDING ROD CARBON ARC DCCC	3/16" X 12" 50/BX	41
WELDING ROD CARBON ARC DCCC	1/4" X 12" 50/BX	22
WELDING ROD CARBON ARC DCCC	5/16" X 12" 50/BX	71
WELDING ROD CARBON ARC DCCC	3/8" X 12" 50/BX	98
WELDING ROD CARBON ARC DCCC	1/2" X 14" 50/BX	28
WELDING ROD FLAT DCCC	3/8" X 5/32" X 12" 50/BX	20
WELDING ROD FLAT DCCC	5/8" X 3/16" X 12" 50/BX	18
WELDING ROD HARD 58	1/8" 5KG/BX	6
WELDING ROD HARD 58	5/32" 5KG/BX	14
WELDING ROD STEEL ALLOY	1/8" (3.2mm) 5 KG/BOX	5
WELDING ROD TRI-CAST	3/32 5KG/BX	9
WELDING ROD TRI-CAST	1/8 5KG/BX	10
WELDING ROD XTREME	1/16 0.5KG/BX	11
WELDING ROD XTREME	3/32" 5KG/BX	7
WELDING ROD XTREME	1/8" 5KG/BX	7
WELDING WIRE LA 111 T1-K3M	1/16 FLUX CORE 15KG SPOOL	68
WELDING WIRE LA T-91	.045 CARBON STEEL 15KG SPOOL	155
WELDING WIRE LA T-91	1/16 CARBON STEEL 15KG SPOOL	215
WELDING WIRE OUTERSHIELD	0.045 33LBS	52

WELDING WIRE OUTERSHIELD	0.062 33LBS-	0
WET WASHING SIEVE 200 MESH		2
WHITE GREASE	KLEEN FLOW 225G/TUBE	51
WINDEX	765ML	437
WINDOW PRIMER	F/ URETHANE WINDOW&WINDSHIELD	6
WINDSHIELD GLUE TREMSHIELD		44
WINDSHIELD WASHER CONCENTRATE	SOLUTION 1000LT TOTE	54
WINDSOCK (ORANGE/WHITE)	AVIOATION STANDARD 36" x 12'	6
WIRE OPEN ARC	110-O 1/16 33LB WB	15
XL3 MOLY ARCTIC GREASE	54KG/KEG	636
ZEP LIQUID BOTTLE WASHER	X-2887 20LT/PAIL	4

Appendix C

Cyanide

C.1: Cyanide – Properties, Uses, Storage & Handling (Dupont)

C.2: Material Safety Data Sheets – Sodium Cyanide

C.1 Cyanide – Properties, Uses, Storage & Handling (Dupont)

Sodium Cyanide

PROPERTIES, USES, STORAGE, AND HANDLING

DUPONT CHEMICAL SOLUTIONS ENTERPRISE

DUPONT

The miracles of science™

Notice:

Sodium cyanide may be fatal if swallowed, inhaled, or with prolonged skin contact. Contact with acids, water, or weak alkalies liberates poisonous gas. Causes eye burns and may irritate skin. See "Personal Safety and First Aid." See DuPont's Sodium Cyanide Material Safety Data Sheet (MSDS) for more detailed safety and health information.

For Emergency Assistance, Call DuPont at

(901) 357-1546

(This is a transportation emergency Cyanide Hotline to our Memphis, TN plant.
Do not use for routine technical or commercial information.)

For Transportation Emergencies,

Call DuPont at (901) 357-1546, Then Call

CHEMTREC at (800) 424-9300

(See "Transportation Emergencies")

For commercial or technical information, call your DuPont marketing representative or a sales office listed on the back cover.

Sodium Cyanide: UN 1689

DO NOT USE AS A PESTICIDE.

See DuPont's MSDS for detailed instructions for treatment of cyanide poisoning.

Table of Contents

Product Information

Introduction

DuPont sodium cyanide (NaCN) is a white crystalline solid, available in a briquette or granular form. The briquettes are uniform in size, average 18 g (about ⅔ oz) in weight, and have overall dimensions of approximately 3.5 × 3.5 × 1.3 cm (1⅜ × 1⅜ × ½ in). They are resistant to breakage and dusting, easy to scoop up, and readily soluble in water. The granules are irregularly shaped particles, typically sized to generate a minimum of dust, and pass 90–100% through a ⅜-in screen and 3% maximum through a USS Sieve No. 50. Cyanobrik® and Cyanogran® are DuPont trade names (see **Figures 1** and **2**).

The Chemical Abstract Service Registry Number for NaCN is 143-33-9.

Table 1. Physical Properties of Sodium Cyanide

Formula Weight	49.007
Melting Point, °C (°F)	564 (1047)
Boiling Point, °C (°F)	1496 (2725)
Specific Gravity, Solid, 25°C (77°F)	1.60
Apparent Bulk Density, Solid, kg/m³ (lb/ft³)	880–960 (55–60)
Specific Gravity, Liquid, 850°C (1560°F)	1.19
Heat of Formation, ΔH° *f*	
25°C, cal/g	–438
25°C, kJ/kg	–1833
77°F, Btu/lb	–788
Specific Heat, 26–73°C (78–163°F)	
Btu/lb·°F or cal/g·°C	0.335
kJ/kg·K	1.402
Heat of Fusion, mp, Btu/lb	77
cal/g	43
kJ/kg	179
Heat of Vaporization, bp, Btu/lb	1309
cal/g	727
kJ/kg	3041
Vapor Pressure, mmHg	
800°C (1470°F)	0.76
1200°C (2190°F)	89.8
1360°C (2480°F)	314.0
Solubility in Water, g NaCN/100 g water	
(see **Figure 3**), –20°C (–4°F)	35.4
20°C (68°F)	58.3

Table 2. Specifications and Typical Analysis

	Cyanobrik®/Cyanogran® and Bulk Solution Specifications	Typical Analysis*
Product Code 1220 (Cyanobrik®)		
Product Code 1222 (Cyanogran®)		
Sodium Cyanide, %	98.0 minimum	99
Sodium Hydroxide, %	0.5 maximum 0.06 minimum	0.3**
Product Code 1254 (Mining Grade)		
Sodium Cyanide, %	96.0 minimum	98
Sodium Hydroxide, %	0.5 maximum 0.06 minimum	0.3**
Product Code 1249 (30% Solution)		
Sodium Cyanide, %	28 minimum	30
Sodium Hydroxide, %	0.5 minimum	1

* Typical analyses based on historical production performance. DuPont does not make any express or implied warranty that future production will demonstrate or continue to possess these analyses.

** **CAUTION:** Sodium hydroxide (NaOH) content can be below 0.1% versus 0.3%, typical. NaOH should be added as outlined on page 3 to suppress hydrogen cyanide formation when making a water solution.

Figure 1. Cyanobrik®

Figure 2. Cyanogran®

Uses and Applications

The mining, metal, and chemical industries are the principal consumers of sodium cyanide. Typical uses include:

Ore Extraction and Ore Flotation

The cyanide process for extracting gold and silver from low-grade ores uses aqueous solutions of sodium cyanide with oxygen (air) to convert the noble metal (M) to soluble $NaM(CN)_2$, from which M can be recovered either by precipitation with zinc dust or aluminum powder, carbon absorption, or electrowinning.

In the flotation of galena (lead sulfide) to separate it from mixed ores containing sphalerite (zinc sulfide) and pyrite (iron sulfide), sodium cyanide acts as a depressor; that is, it reduces the tendency of gangue materials to travel along on the froth and so impair the separation. Sodium cyanide finds similar use in the separation of pentlandite from pyrrhotite and molybdenite from copper concentrates by flotation. It is also used to purify the molybdenite by extraction of copper impurities.

Electroplating

Cyanide brass, cadmium, copper, gold, silver, and zinc baths deposit decorative and/or functional metal coatings on a variety of substrates. The good throwing power of the electrolyte causes relatively uniform deposition of the metal on intricately shaped parts. Small amounts of special additives in the baths give bright metal deposits, even on recessed surfaces of the work. Cyanide electroplating baths are versatile and capable of high production rates, whether plating large or small parts.

Case Hardening Steel

Molten salt baths containing 10–30% sodium cyanide find extensive use for case hardening steels at temperatures below 870°C (1600°F). The molten bath process is fast, easy to operate, and yields mixed carbon-nitrogen cases that have excellent wear resistance and uniformity. The addition of activators or accelerators to the bath results in deeper cases than those obtained with plain cyanide baths, but nitrogen pickup is usually less.

The life of keen-edged tools improves when the high-speed steel is cyanide-nitrided in molten cyanide baths at about 565°C (1050°F).

Metal Cleaning

Aqueous solutions of sodium cyanide are effective metal cleaners, especially for smut removal after acid pickling.

Chemical Manufacture

Sodium cyanide is used to make other chemicals that lead to such diverse products as pharmaceuticals, vitamins, animal food supplements, dyes and pigments, insecticides, sequestrants, polymers, and catalysts (see "Chemical Reactions" section).

In any synthesis or formulation involving sodium cyanide, no cyanide compound should survive in the final product as an impurity. This is especially important with regard to consumer products.

Chemical Reactions

The most hazardous reaction of sodium cyanide is with acids to form lethal hydrogen cyanide (HCN) gas, which is invisible and has a very weak odor. Smaller amounts of HCN gas can develop from contact with water and weak alkalies. When working with sodium cyanide, special provisions are needed to address HCN and cyanide toxicity.

Sodium cyanide deliquesces in moist air. Crystals of the dihydrate, $NaCN{\cdot}2H_2O$, form when saturated solutions of sodium cyanide cool at temperatures below 35°C (95°F) (see **Figure 3**). Sodium cyanide dissolves in methanol (6.05 g/100 mL saturated solution at 15°C [59°F]). It also dissolves in liquid ammonia (3.7 g/100 mL NH_3 at –33°C [–27°F]).

Sodium Cyanide Reactions in Water

Sodium cyanide dissolved in water forms an equilibrium between ionized sodium cyanide and highly volatile HCN. In sodium cyanide solutions, HCN concentrations must be kept low and/or contained to avoid toxic fumes. HCN formation varies with pH, cyanide concentration, and temperature. HCN in the air around a sodium cyanide solution will also be influenced by the amount of solution surface area and ventilation. At pH 8 or less, essentially all of the cyanide will be in the HCN form in dilute solutions (see **Figure 5**). To suppress HCN formation in typical concentrated sodium cyanide make-up solutions, a pH of 12 minimum (preferably 12.5–13) should normally be used. In operating tanks, HCN in the vapor space above a 23% solution at room temperature typically will be about 250 ppm (without pH adjustment). With the pH raised to 12–12.5, HCN levels drop to around 125 ppm and below 50 ppm, around pH 13. Higher temperatures and solution concentrations increase HCN fumes. The following recommendation is made to minimize HCN formation with a modest pH increase.

When making a concentrated (e.g., 10–30%) cyanide solution, the proper procedure is to add about 0.5% sodium hydroxide (caustic) (about 50 lb [22.7 kg] sodium hydroxide/1000 gal [3785 L] water) before adding the cyanide. More sodium hydroxide will not be chemically harmful to the cyanide and will further reduce HCN levels; however, increased alkalinity increases eye hazards from splashes. For most operations, pH 12.5–13.0 is a good compromise to reduce HCN without excessively high alkalinity. If process chemistry prevents adding caustic, adequate precautions in design and operation must be taken to protect against HCN fumes, HCN polymerization, and cyanide hydrolysis.

pH is a log scale measurement, which means it takes about ten times as much sodium hydroxide to raise the pH each subsequent unit than the previous. For example, if it took 1 lb (0.45 kg) of sodium hydroxide to go from pH 9 to 10, it would take 10 lb (4.5 kg) to raise the pH from 10 to 11 and 100 lb (45.4 kg) from 11 to 12, etc. Therefore, even pH 11 water will need

Figure 3. Solubility of Sodium Cyanide in Water

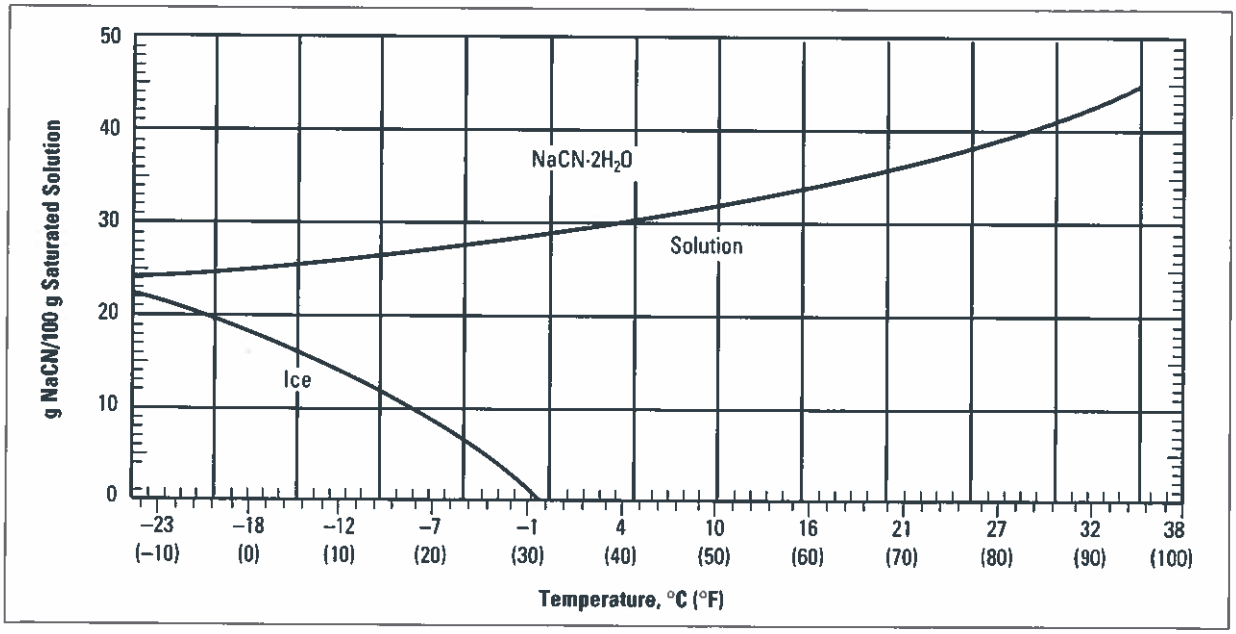


Figure 4. Densities of NaCN Solutions

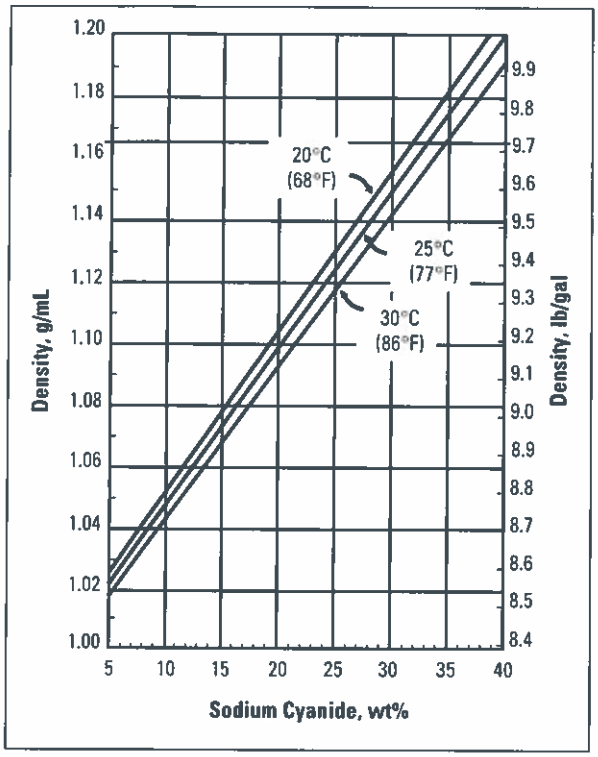
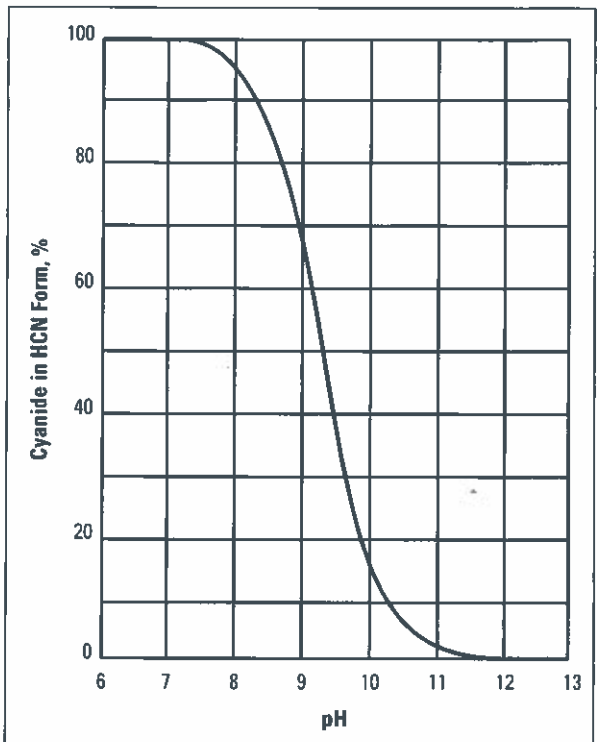


Figure 5. Effect of pH on Cyanide Ionization



Data based on work by D. Milne, 1950, for dilute sodium cyanide solutions at ambient temperature. Toxic HCN fumes increase as temperature and solution concentrations increase, requiring higher pH for safe operation.

nearly as much sodium hydroxide added to it as would the same amount of water with pH 6 to 11. Water at pH 10 or 11 does not eliminate the need to add sodium hydroxide to reduce HCN.

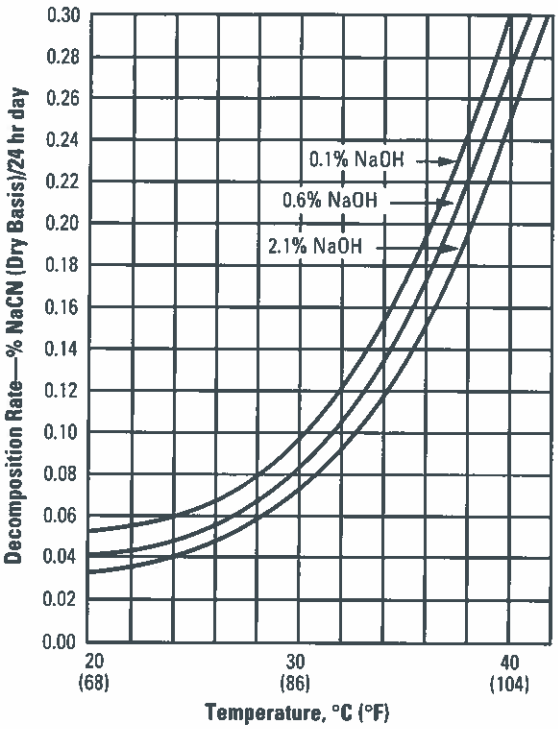
NOTE: Lime (calcium hydroxide) is not as effective as sodium hydroxide because of limited solubility, but it can be substituted to raise the pH to around 12.

Hydrogen cyanide molecules will polymerize to form the extremely inert HCN polymer. It is not unusual for HCN polymerization to occur in sodium cyanide solutions made without additional alkali, particularly if stored at elevated temperatures. In dilute solutions, HCN polymer will generate colors ranging from pale yellow to dark reddish brown. In stronger solutions, a dark brown precipitate resembling iron rust can form, which will interfere with heat transfer, plug pumps, orifices, etc., and may cause significant cyanide loss. HCN polymer will discolor chemical products. Again, high pH values give low HCN concentrations, which reduces the tendency for polymer formation.

Cyanide also reacts with water to form ammonia and formate ions. In the acid pH range, hydrolysis products are formic acid and ammonium salts. Alkaline solutions produce formate salts and volatile ammonia. With strong solutions, the volume of ammonia evolved can cause dangerous pressure buildup. One gallon of 30% sodium cyanide solution can produce more than 25 ft^3. For this reason, extra vent capacity is recommended for large, heated storage tanks.

Ordinarily, the reaction between cyanide and water proceeds slowly. However, the reaction rate increases exponentially with an increase in temperature. The critical range is around 60–70°C (140–158°F). At temperatures below this range, the reaction can be controlled by cooling and, where practical, by dilution. At higher temperatures, however, the reaction can be uncontrollable in large tanks for highly concentrated solutions and may proceed until substantially all the cyanide has been consumed, unless temperature control and adequate cooling and venting capacity exist (see **Figure 6**).

Figure 6. Decomposition Rate of NaCN Solutions



NOTE: The % NaOH shown above is the concentration in the final solution. The NaCN (as shipped–containing 0.1% NaOH), when diluted to a 30% solution, will have only 0.03% NaOH in the final solution, unless additional NaOH is added. (Decomposition rates based on DuPont experimental data using 35% NaCN solution.)

Heated sodium cyanide solution storage tanks should be equipped with facilities to measure and control solution temperature (see "Equipment" section). Heating may be needed to assist in dissolving the NaCN and to prevent freezing (see **Figures 3** and **7**). Cooling could be critically important, if the hydrolysis reaction begins to generate heat faster than it can be dissipated to the surroundings.

All the reactions discussed above consume a portion of the stored cyanide, and all are inhibited by maintaining low solution temperature and high pH.

If special precautions are taken, acidification of sodium cyanide to produce HCN gas for a chemical reaction is an acceptable procedure, but only when handled in special equipment by technically qualified people after detailed planning. HCN operations require much more stringent plans, procedures, and standards for safe operation.

CAUTION

Even in laboratory quantities, the accumulation and storage of liquid or gaseous HCN should not be considered until its properties and the required safety precautions for handling it have been studied carefully. In addition to toxicity considerations, violent exothermic polymerization reactions can occur with liquid HCN, even in the absence of air or oxygen.

Other Reactions

Oxidants, such as alkaline hypochlorite solutions, hydrogen peroxide solutions, and permanganate solutions can oxidize cyanide to sodium cyanate. These oxidation reactions find wide use in the control of cyanides in effluents. They must be done in dilute solutions at proper pH to avoid formation of highly toxic gases (see "Cyanide Destruction" section).

Strong oxidants, such as nitrites and chlorates, react violently when added to molten sodium cyanide (or vice versa).

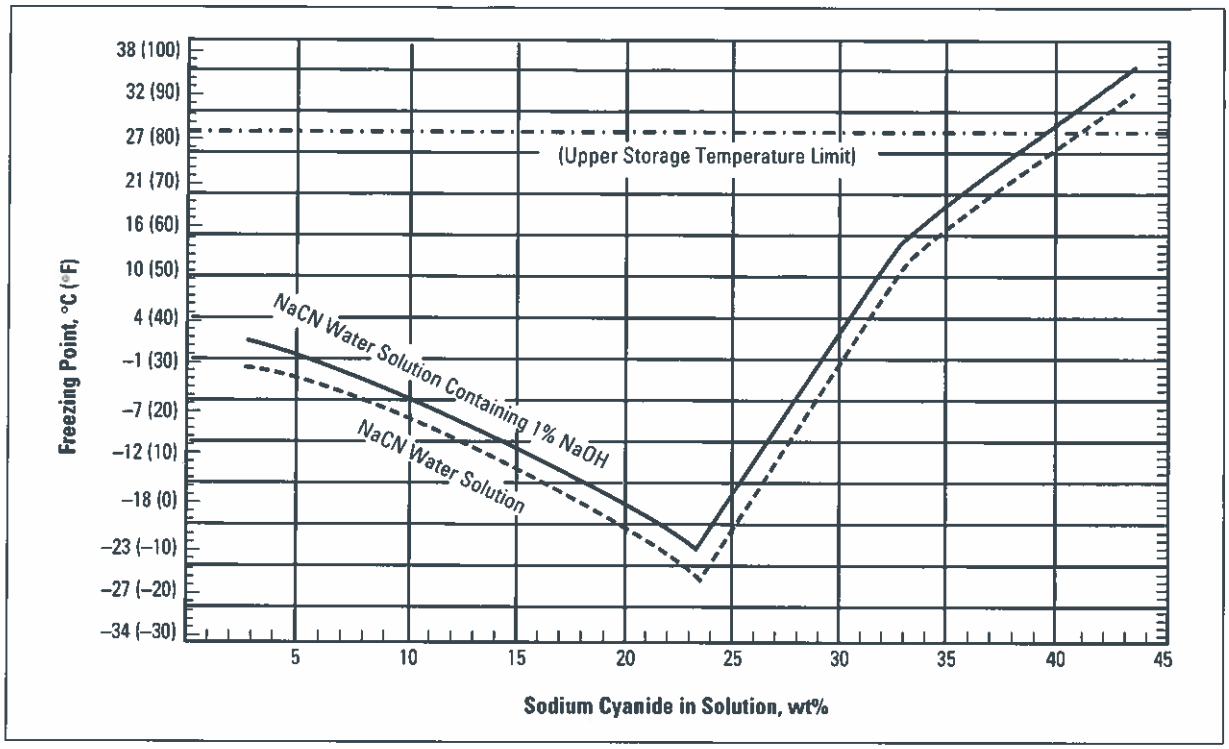
With the exception of lead and platinum, most metals (when finely divided) dissolve in aqueous sodium cyanide in the presence of oxygen.

Alkaline solutions of sodium cyanide dissolve water-insoluble cuprous and zinc cyanide with formation of sodium tricyanocuprate and tetracyanozincate, respectively.

Reacting an alkyl halide, sulfate, or toluene-sulfonate (p-$CH_3C_6H_4SO_2OR$) with sodium cyanide in aqueous alcohol, dimethylformamide (DMF), or similar aprotic solvent, leads to an alkyl cyanide (nitrile). Fusing a sodium aryl sulfonate with sodium cyanide yields the aryl nitrile; for example, sodium benzene-sulfonate (sodium phenyl sulfonate) gives benzonitrile (phenyl cyanide).

Hydrogen cyanide, generated by reacting an acid with sodium cyanide, is capable of adding to isolated double bonds and to the carbonyl group of an aldehyde or ketone. In the case of acetophenone, for example, the corresponding cyanohydrin forms, which hydrolyzes to atrolactic acid (a-phenylacetic acid, $C_6H_5[CH_3]C[OH]COOH$). Similarly, when preparing an alpha-amino acid from an aldehyde or ketone by Strecker synthesis, the hydrogen cyanide and ammonia needed can come from ammonium cyanide formed in the reaction of sodium cyanide with ammonium chloride.

Figure 7. Freezing Points of Sodium Cyanide Solutions



One method of synthesizing the sodium salt of ethylen ediaminetetraacetic acid (tetrasodium EDTA, a chelating agent) combines ethylenediamine with formaldehyde and sodium cyanide in hot (80°C [175°F]) alkaline solution.

Personal Safety and First Aid

Health and Safety Hazards

See DuPont's MSDS for detailed instructions for treatment of cyanide poisoning.

Because of the toxicity of sodium cyanide, all persons working with it should be completely familiar with and observe the established safety practices.

Sodium cyanide is a fast-acting poison that can cause death quickly at low levels of exposure. Its toxic effect results from the inhibition of specific processes in body cells by restricting oxygen use in cellular respiration, particularly cells in the brain and heart. Poisoning can result from breathing cyanide gas, dust, or solution; absorption through the skin, particularly the eyes and other membranes and feet; and from ingestion. Contact with the skin may cause irritation and poisoning, particularly with prolonged contact, or if open wounds, skin abrasions, or mucous membranes are involved. Sodium cyanide is alkaline and causes eye burns. Because of the possibility of skin absorption of hydrogen cyanide fumes, air monitoring for HCN is required, even for someone wearing an air mask.

Cyanide is not a cumulative poison, and it is not a carcinogen. It is believed that there are no chronic effects of cyanide poisoning, unless repeated, prolonged exposures, well above the established limits, were to occur. With prompt treatment, recovery from overexposure is normally quick and complete.

CAUTION

Sodium cyanide in contact with acids liberates highly toxic and flammable hydrocyanic acid gas. Also, toxic amounts of HCN can be liberated from water solutions of sodium cyanide or from contact with weak alkalies, if ventilation is inadequate (see "Sodium Cyanide Reactions in Water").

Safety Precautions

The basic safety precautions are:

- Do not breathe sodium cyanide dust, solution mist, or HCN gas. Wear an approved toxic dust and mist respirator when there is danger of inhaling cyanide dust or mist. Additional protection is required for HCN gas. The respirator should be one approved by the Mine Safety and Health Administration (MSHA) or by the National Institute for Occupational Safety and Health (NIOSH).
- Avoid skin contact with cyanides, particularly contact with open wounds or skin abrasions. Wash skin promptly and thoroughly if contact occurs. Wear protective gloves when handling solid cyanides. Wear rubber gloves when handling cyanide solutions (butyl rubber has very low permeability; neoprene is more rugged with low HCN permeability and is best for many jobs involving sodium cyanide).
- Do not get in eyes. Wear approved chemical splash goggles when handling cyanide solutions and when there is danger of splashing.
- Have available and wear other protective clothing as needed for job safety. Develop clothing change procedures to ensure cyanide is not scattered around the site or inadvertently carried home.
- Immediately sweep up any spilled cyanide and place in a suitable container. Wash area and/or treat contaminated area with dilute hypochlorite solution to destroy the cyanide. Comply with federal, state, or local regulations. If approved, drain to neutral chemical waste sewer.
- Take every precaution to keep acids from contacting sodium cyanide. Do not store with acids or weak alkalies.
- Do not eat, drink, or smoke in areas where cyanide is present. Do not handle or store food or beverages in cyanide areas.
- Store sodium cyanide in a ventilated, locked area. Containers should be kept closed and their contents dry. Do not store under sprinklers; sodium cyanide will not burn, but sprinkler activation could cause an environmental problem. Local fire regulations may require sprinklers. Always check and follow local regulations. If sprinkling is required, the area must be diked to contain the runoff.
- Have antidote, emergency plans, and training in place before using cyanide. See DuPont's Sodium Cyanide MSDS for detailed instructions.

Sodium Cyanide Exposure Limits

The U.S. Department of Labor (OSHA) has ruled that an employee's exposure to sodium cyanide in any 8-hr work shift of a 40-hr week shall not exceed a time-weighted average (TWA) of 5 mg of cyanide per cubic meter of air.[2,3] It also cautions that because cyanide may penetrate the skin, control of vapor or dust inhalation alone may not be sufficient to prevent absorption of an excessive dose.

HCN Exposure Limits

The current OSHA workplace exposure limit for HCN is 11 mg/m^3 (10 ppm), ***8-hr average***. A 1989 revision of the HCN limit (along with several hundred other chemicals) to 5 mg/m^3 (4.7 ppm), ***15-min average***, was vacated by court order, and the pre-1989 limit has been reinstated. OSHA (and others) also cautions that because hydrogen cyanide may penetrate the skin, control of vapor inhalation alone may not be sufficient to prevent absorption of an excessive dose.[2,3] During all of this, the U.S. Mine Safety and Health Administration (MSHA) limit stayed at 10 ppm for HCN. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a 4.7 ppm limit instantaneous ceiling value with a similar skin notation.[4] DuPont's experience supports the current OSHA and MSHA regulatory levels. However, as a matter of practice, DuPont does not have people working for prolonged periods under conditions approaching our upper limits, because we can design/operate to avoid prolonged exposure.

In summary, HCN air quality requirements will vary from jurisdiction to jurisdiction, and it is incumbent on each user to be aware of and comply with the rules regulating exposure to HCN in their regulatory jurisdiction. The specific OSHA and MSHA exposure limit for HCN is currently 11 mg/m^3 (10 ppm) for an 8-hr TWA. The ACGIH Threshold Limit Value (TLV) is 5 mg/m^3 (4.7 ppm), 15-min TWA. This is also a ceiling value. The DuPont Acceptable Exposure Limit (AEL) is 4.7 ppm, 15-min TWA with current regulatory ceiling limitations. All of these exposure limits carry a "skin" notation indicating that HCN may penetrate the skin; therefore, control of vapor inhalation alone may not be sufficient to prevent cyanide poisoning. Also, exposure limits are subject to change, and users should stay current with regulatory changes.

Symptoms of Cyanide Poisoning

Personnel should be constantly alert for symptoms of cyanide poisoning in themselves and others. The following poison symptoms can result from other causes, but should be investigated promptly when they occur around cyanide:

Reddening of the eyes*	Nausea*
Irritation of the throat	Headache*
Palpitation	Weakness of arms and legs
Difficulty in breathing	Giddiness
Salivation	Collapse
Numbness	Convulsions

Effects of Exposure to HCN Vapor

The following toxicity data show the "Reported Human Response to Various Concentrations of HCN Vapor"[5]:

2–5 ppm	Odor threshold
10 ppm	OSHA and MSHA exposure limit, 8-hr TWA[2]
20–40 ppm	Slight symptoms after several hours
45–54 ppm	Tolerated for ½ to 1 hr without significant immediate or delayed effects
100–200 ppm	Fatal within ½ to 1 hr
300 ppm	Rapidly fatal (if no treatment)

These numbers should be considered reasonable estimates only, because data are not exact and effects vary for different people. Also, *heavy breathing from physical work will increase cyanide intake and reduce the time for symptoms to show.* The "rapidly fatal" exposure level of 300 ppm assumes no first aid or medical treatment; either is very effective if used quickly.

* Reddening of the eyes (and skin) is one of the earliest symptoms, with nausea and/or headache common in low level exposure. These three are the most readily identifiable symptoms of low level cyanide overexposure.

Prompt administration of the recovery techniques has proven very effective, but emphasis must be placed on quick action. Seconds count, and treatment should be provided within about 200 sec (3–4 min). In case of overexposure to cyanide, quick action is required to sound the alarm, remove the patient from the contaminated area, and provide treatment. With prompt treatment as prescribed, recovery is normally quick and complete with no serious aftereffects. Treatment after 3–4 min can still be effective, but chances of recovery are reduced without prompt treatment. Unlike many poisons, cyanide is not cumulative. While cyanide poisoning can be rapidly fatal, no case should be considered hopeless. Treatment should be continued until a physician certifies death.

First Aid and Medical Treatment

See DuPont's MSDS for detailed instructions for treatment of cyanide poisoning.

Ordering Cyanide Poisoning Antidote Kits and Amyl Nitrite

To obtain cyanide poisoning antidote kits and/or amyl nitrite ampules:

1. Obtain a prescription from your local physician (required because amyl nitrite is a prescription product).
2. Purchase the cyanide antidote kit from your pharmacy. The pharmacy can obtain the kit from Akorn Pharmaceuticals at (800) 932-5676.
3. Amyl nitrite can also be purchased from your local pharmacy or from Save-A-Life Systems in Ft. Wayne, IN at (800) 933-5885.

Shipping

Containers

DuPont produces sodium cyanide in briquette and granular forms.

A variety of containers are used as follows:

Nonreturnable Drums

Net weight 50-kg (110.2-lb) steel drums stacked 9–27 to a pallet.

Net weight 100-kg (220.4-lb) steel drums stacked eight to a pallet (see **Figure 8**).

Note: Drums can be stored three pallets high in a warehouse.

Figure 8. Palletized 100-kg (220-lb) Drums Being Loaded into a Truck

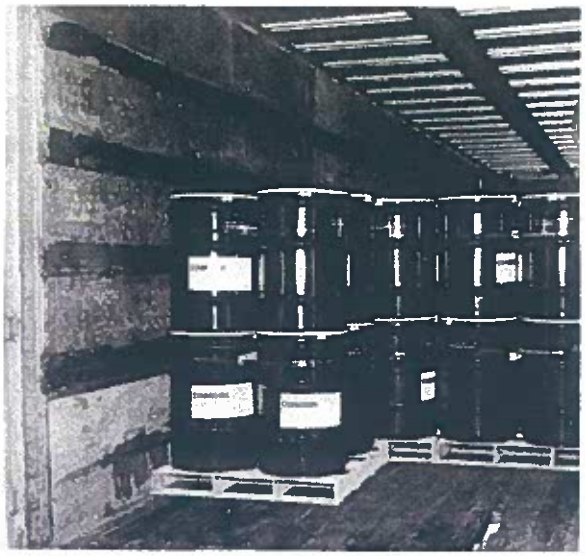


Figure 9. A Tuff-Pak Box Full of Bags

Tuff-Pak

- 48 20-kg (44-lb) pinch-bottom, multiwall composite bags that are hermetically sealed and water-resistant. The bags are packaged in a wooden box on a self-contained pallet. Net weight 960 kg (2116 lb). Individual bags are not to be sold separately (see **Figure 9**).

Figure 10. Partially Loaded Container of IBCs

Nonreturnable Intermediate Bulk Container (IBC)

- Water-resistant package holding 1000 kg (2205 lb). Box dimensions are 44¾ × 44¾ × 44⅜ in high (see **Figure 10**). For shipment, there are normally 20 IBCs in a container.

Returnable FLO-BIN® Containers (Briquettes Only)

- 1361- and 1497-kg (3000- and 3300-lb) net returnable FLO-BIN® containers, 12–14 bins per truck (see **Figures 11** and **14**).

Bulk Trucks

- 30% solution tank trailers (18,000 lb, 100% basis—8180 kg) are available from the Carlin, NV terminal. They can be unloaded using the customer's pump or by plant or truck air (see **Figure 13**).
- Excel I tank trucks (6804–9526 kg [15,000–21,000 lb]). These trucks are equipped with circulation pumps that will permit water addition, dissolving by circulation, and then pumping off into the customer's tank (see **Figure 15**).
- Excel II tank trucks (15,876–18,144 kg [35,000–40,000 lb]) are unloaded by circulating premeasured water from a storage tank by a driver/technician (see **Figures 12** and **16**).

Figure 11. Bins corded two abreast on a flatbed trailer. The bins are strapped to the trailer to prevent movement during transportation.

Transportation

Sodium cyanide must not be shipped by U.S. mail. The U.S. Department of Transportation (DOT)[3,6] hazard classification is Class 6.1 (Toxic) with an ID number of UN1689. A DOT toxic label is required. Transportation equipment must also be placarded with toxic placards in accordance with DOT requirements.

Sodium cyanide drums, Tuff-Paks, and IBCs should be shipped in vehicles that have secondary containment, such as vans. Pickup trucks, etc., should not be used. In case of an accident, secondary containment will minimize the impact of spilled material. Also, the driver must be in a separate compartment isolated from the cyanide.

Sodium cyanide must not be shipped with any acids (dry or liquid), food (human or animal), or ingredients for products used for human or animal consumption, including food, pharmaceuticals, food supplements, etc. Shipment with flammables and strong oxidizers should be avoided, as these mixed shipments can cause fire fighting complications, including cyanide runoff, in case of an accident and subsequent fire.

Storage and Handling

Storage and use areas should be designed so that accidental spillage can be contained and disposed of safely.

Storage Security

When sodium cyanide is stored, security should be maintained so only authorized people have access to it. Locked rooms or locked fenced areas can be used. Only the quantity required for immediate use should be removed from storage.

Figure 12. Excel II Truck

Drums

Drums of sodium cyanide should be stored inside and segregated from acids, weak alkalies, and strong oxidizing materials such as nitrates. It is also recommended that sodium cyanide be stored away from flammables and combustibles to minimize the chance of cyanide-water runoff as a result of fire fighting. Where local regulations permit, sodium cyanide drums should not be stored under sprinklers, because sodium cyanide will not burn in ordinary fires and cyanide runoff must be avoided. Storage with food or intermediates for human or animal products must be avoided. Observe all the precautions given under "Safety Precautions."

Figure 13. NaCN Solution Truck

If possible, open cyanide containers in the areas in which the cyanide is to be used. Remove the cover from the container, and remove the cyanide with a metal scoop or dump the cyanide from the container as required. Replace the cover on the container if the drum still contains cyanide. Store appropriately. Immediately pick up any spillage.

Drum Disposal

Sodium cyanide drums are nonreturnable, and it is against U.S. DOT regulations to reship or recoup the drum, except when approved for disposal of waste materials. Empty drums should be visually inspected for cyanide removal, flushed with large volumes of water, and then drained. This flush and drain cycle should be repeated three times to comply with federal regulations. Rinse water should be collected, treated, and disposed of according to local regulations (see "Cyanide Destruction" section). After cleaning, drum labels should be removed or obliterated to confirm cleaning, and the drum destroyed to prevent reuse. After the above, recycling as scrap metal is appropriate.

FLO-BIN®

A typical FLO-BIN® unloading and storage system is shown in **Figure 14**. A special design manual is available from DuPont. Contact DuPont's sales representative to discuss package and delivery options to meet specific needs.

Sodium cyanide is shipped in returnable FLO-BIN® containers (600 lb tare weight) to customers by truck or rail. In trailers, bins are shipped two abreast. Road weight limitations restrict the truck load to 12–14 bins. The advantages of FLO-BIN® deliveries are:

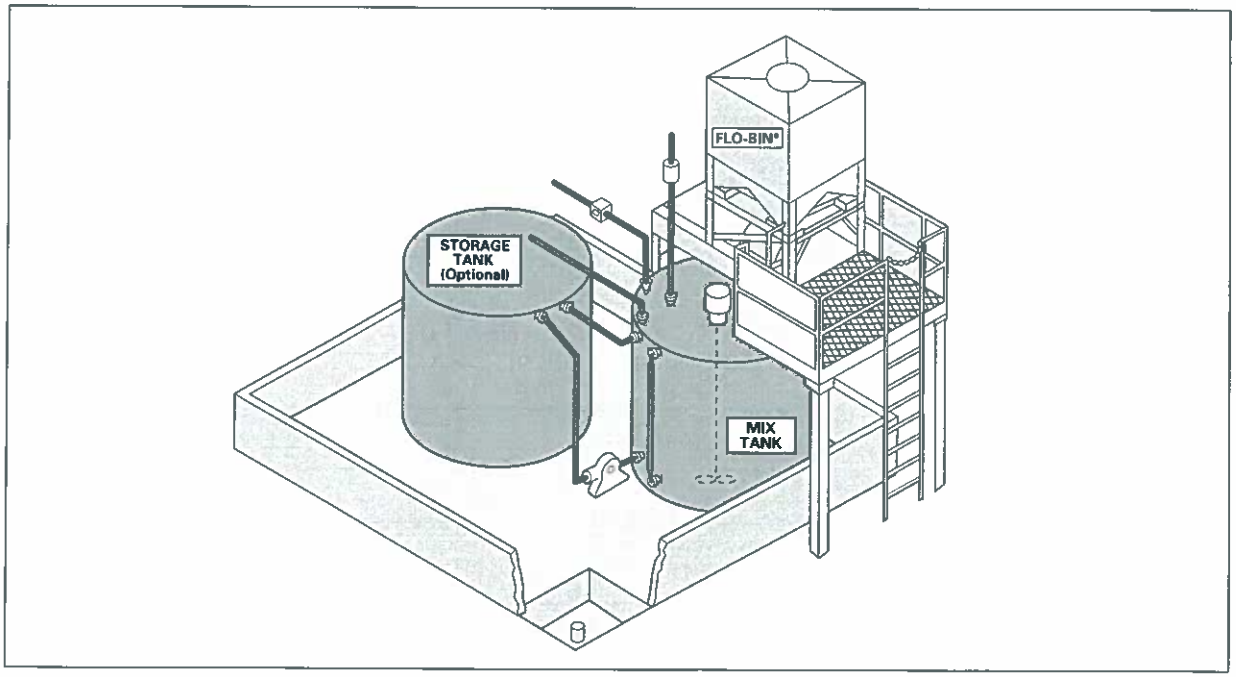
Economics—Customers using about 100,000 kg (200,000 lb) or more per year of sodium cya-nide can effect direct cost savings versus other smaller packages.

FLO-BIN® Customer Shipping Responsibility

When returning bins, the customer becomes the shipper and bears the responsibility for seeing that all safety precautions are carried out. DOT regulation 49 CFR 173.29 requires that a returnable container offered for transportation must meet the same standards as when the container previously held a greater quantity of a hazardous material. Returning bins do not have to be cleaned internally. Internal water washing is discouraged, because cyanide solution rundown is likely to create spillage, unless the bins are dried. External cleaning and inspection of each bin is required to ensure no cyanide is left on the outside and that the camlocks are locked closed with locking pins or wires.

When returning bins, secure bins with equipment provided. DO NOT reverse the poison placards (four) on car or truck. DO NOT remove or deface product label on bin.

Figure 14. Typical FLO-BIN® Unloading System



Intermediate Bulk Container (IBC)

IBCs are the ideal package for most large consumers of NaCN who are not near a manufacturing facility. IBCs are readily handled with forklift trucks. DuPont recommends stacking IBCs two high for storage. The DuPont IBC holds 1000 kg (2205 lb) of NaCN. When diluted to 23% (the minimum freezing point of a NaCN/water solution) with pH at 12 or above, the IBC will make about 3900 L (1030 gal).

The IBC is emptied by lifting the bag by the straps using a forklift or hoist and then positioning and lowering the bag onto the specially designed knife slitter that cuts the bag, allowing the contents to drop into the dissolving tank.

IBC Decontamination and Disposal

Decontamination and disposal of used IBC materials must be properly handled to prevent environmental contamination and meet regulations. The bags should be empty—this should be confirmed visually or by weight before they are sent to a disposal facility. Then, a flush and drain cycle, repeated three times, will dissolve any residual cyanide left in the bag. Care must be taken to ensure the bag material does not overlap and prevent water contact—interfering with the dissolving process. Rinse water should be collected and recycled or treated and disposed of according to local regulations. As part of the cleaning process, labels should be removed or obliterated. If burning is the method of disposal, keep in mind that all of the NaCN will probably not be destroyed during the burning process, and the ashes must be properly contained.

30% NaCN Solution

The DuPont terminal in Carlin, NV ships 30% NaCN solution as far away as 300 miles. The specially designed trailers hold 6300 gal—equivalent to 18,000 lb of dry NaCN. DuPont 30% NaCN solution is often the most convenient way to receive NaCN. The drivers are specially trained to make these deliveries and have a safety record envied in the trucking industry. DuPont offers technical assistance and support to assist with the design or modification of an existing system.

Excel Trucks

Excel trucks combine transportation and unloading safety by permitting shipment of solid sodium cyanide and unloading by dissolving the cyanide in place and then pumping the solution into appropriate storage. Excel I (see **Figure 15**) is ideal for customers with annual usage of ½ to 1 million lb, where 30% solution may not be desirable, but Excel I is only available in limited geographical areas. Excel II delivery systems (see **Figure 16**) are ideal for many large sodium cyanide users and usually require an annual NaCN usage of about 1 million lb per year to justify the larger investment compared to handling FLO-BIN® containers. Cost factors such as location (transportation), expected operating life, available space, inventory requirements, etc., should be evaluated with DuPont to determine the best system for each specific situation. Design manuals are available for Excel systems.

When dissolving the sodium cyanide in Excel systems, position the tank truck so that the hose connection can be made between the truck pipe headers and the storage tank and pump piping.

For Excel II, meter into the storage tank the amount of water and sodium hydroxide (NaOH) needed to make the desired concentration of sodium cyanide solution (about 363 kg [800 lb] NaOH for 18,144 kg [40,000 lb] NaCN). The water temperature needed for dissolving the NaCN depends on the solution concentration needed, the circulation rate, and weather conditions. The water can be preheated up to about 38°C (100°F) to speed the dissolving, but heated water is frequently not needed, unless cold weather and cold water are involved (see "Chemical Reactions" section).

Cyanide decomposition rates increase with higher temperatures, with sodium formate and ammonia being formed. Because the decomposition reaction is exothermic, provision must be made for temperature monitoring and emergency cooling, if heating is used (see "Temperature Indicators, Insulation, Heating, and Cooling").

Excel II Unloading Procedures

Position valves. Start the pump. Check the system for leaks. Circulate the water continuously from the storage tank through the tank truck from the bottom to top to flood the truck and overflow back to the storage tank. Listen to the rattling briquettes by placing your ear near the bottom of the tank trailer. Dissolving should be complete about 30 min after the rattling stops, but system experience will provide the best guide. Then, pump the sodium cyanide solution from the tank truck into the storage tank. The dissolving time varies with circulation rate, water temperature, and final concentration, but dissolving can be complete in about 1½ hr under best conditions. Typically, 3–4 hr are needed in winter, without heat, for a 20–25% concentration.

Figure 15. Typical Excel I Unloading System

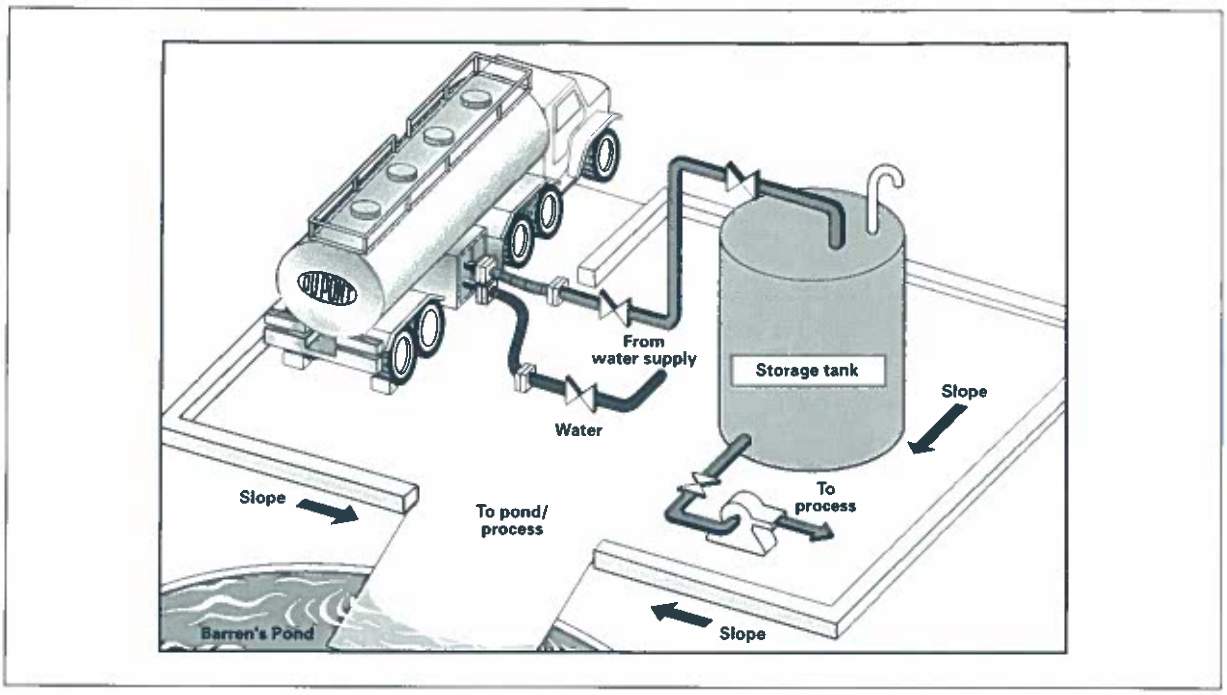
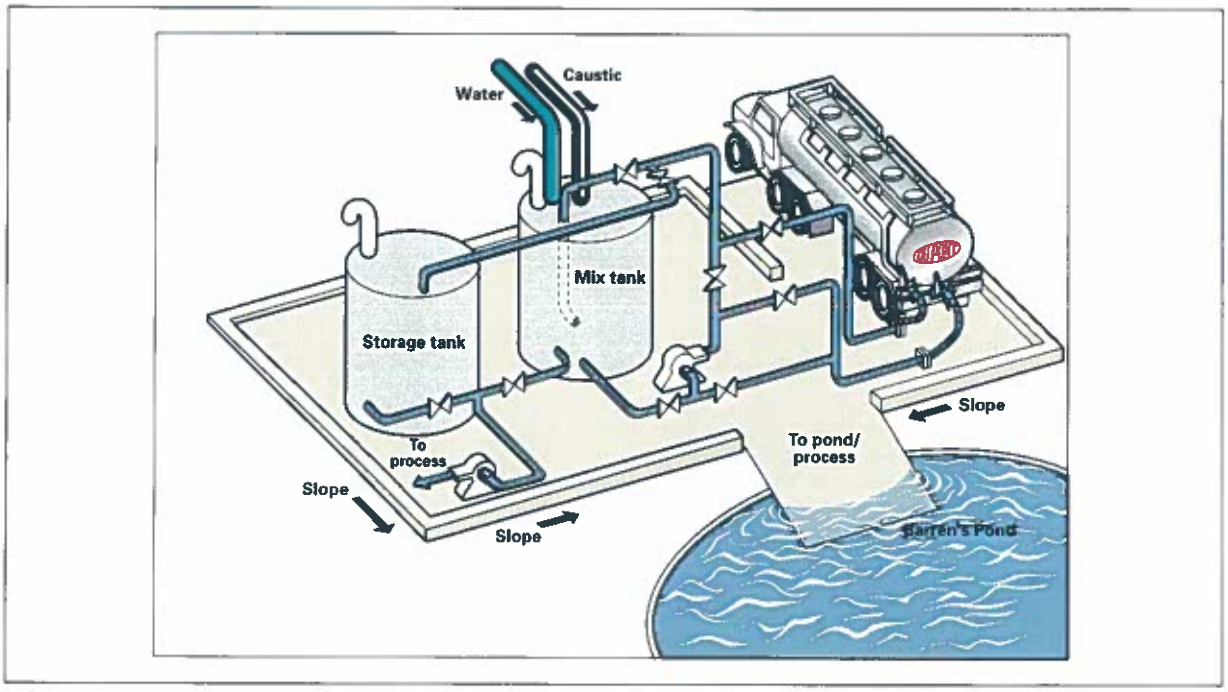


Figure 16. Typical Excel II Unloading/Storage System



Equipment

Materials of Construction

Carbon steel equipment is usually satisfactory for sodium cyanide solutions where velocities are not over 1.2–1.5 m/sec (4–5 ft/sec). At higher velocity, 304 or 316 stainless steel is sometimes recommended, because an erosion-corrosion effect occurs on steel. Carbon steel with a corrosion allowance may be acceptable instead of stainless to reduce cost, particularly if flow is frequently shut off so no erosion-corrosion is occurring. Even at very low velocities, welded, not threaded, piping should be used for all pipe materials to avoid leaks. To avoid leaks, no threaded connections should be used for piping instruments, drains, or any other connection. For pumps and instruments, 316 stainless is recommended. Valve operating conditions will determine whether carbon steel versus stainless can be used. Gaskets of Teflon® or nitrile-butadiene rubber (NBR), with Kevlar® filler, are recommended for sodium cyanide solutions.

Solution Storage Tank

Sodium cyanide solution is stored in a tank typically fabricated from ¼-in carbon steel plate. For bulk installations, top nozzles are recommended for a 15.2- to 20.3-cm (6- to 8-in) pipe vent, a 10-cm (4-in) fill and circulating line, level indicator, high-level alarm, provision for water, and caustic additions and manway. A top 4-in nozzle with a physical break in the water line will prevent backflow. Bottom openings must also be provided for a 15-cm (6-in) pump suction line, temperature control-alarm, and (optional) heating/cooling coils. The size of the storage tank depends upon the sodium cyanide shipment size and concentration of solution required. For example, 18,150 kg (40,000 lb) of sodium cyanide makes 71,000 L (18,750 gal) of 23% solution. A vertical tank 4.9 m (16 ft) in diameter by 5.0 m (16½ ft) high has a nominal 95,000-L (25,000-gal) capacity, which is sufficient to allow some outage and/or solution inventory (see **Figure 17**). The tank may be lined with neoprene to prevent buildup of iron content, if this is critical to the process. All pipe nozzles should be schedule 40 pipe minimum.

To provide mixing, a properly aligned dip tube/mixer with a siphon vent must be installed.

If the storage tank is located inside a building, all tank openings must be sealed and the tank vent routed outside the building to a safe location. This will prevent the discharge of hydrogen cyanide inside the building when the tank is being filled (see "Caustic Addition" on page 15).

Pump

For Excel II, a 316 stainless steel pump with a 10.2-cm (4-in) suction and a 7.6-cm (3-in) discharge is needed. It should be capable of delivering 2271–2650 L (600–700 gal) per minute at 18.3–21.3 m (60–70 ft) head. Small pumps will not provide sufficient agitation for tank car cyanide dissolving. Totally enclosed, fan-cooled, 25-HP motors are recommended.

Water Meter and Supply

A 7.6-cm (3-in) water meter with a preset totalizer and an automatic cutoff is recommended in the storage tank water addition line. There should be a physical disconnection in the water supply line to prevent cyanide from backing up into the water system.

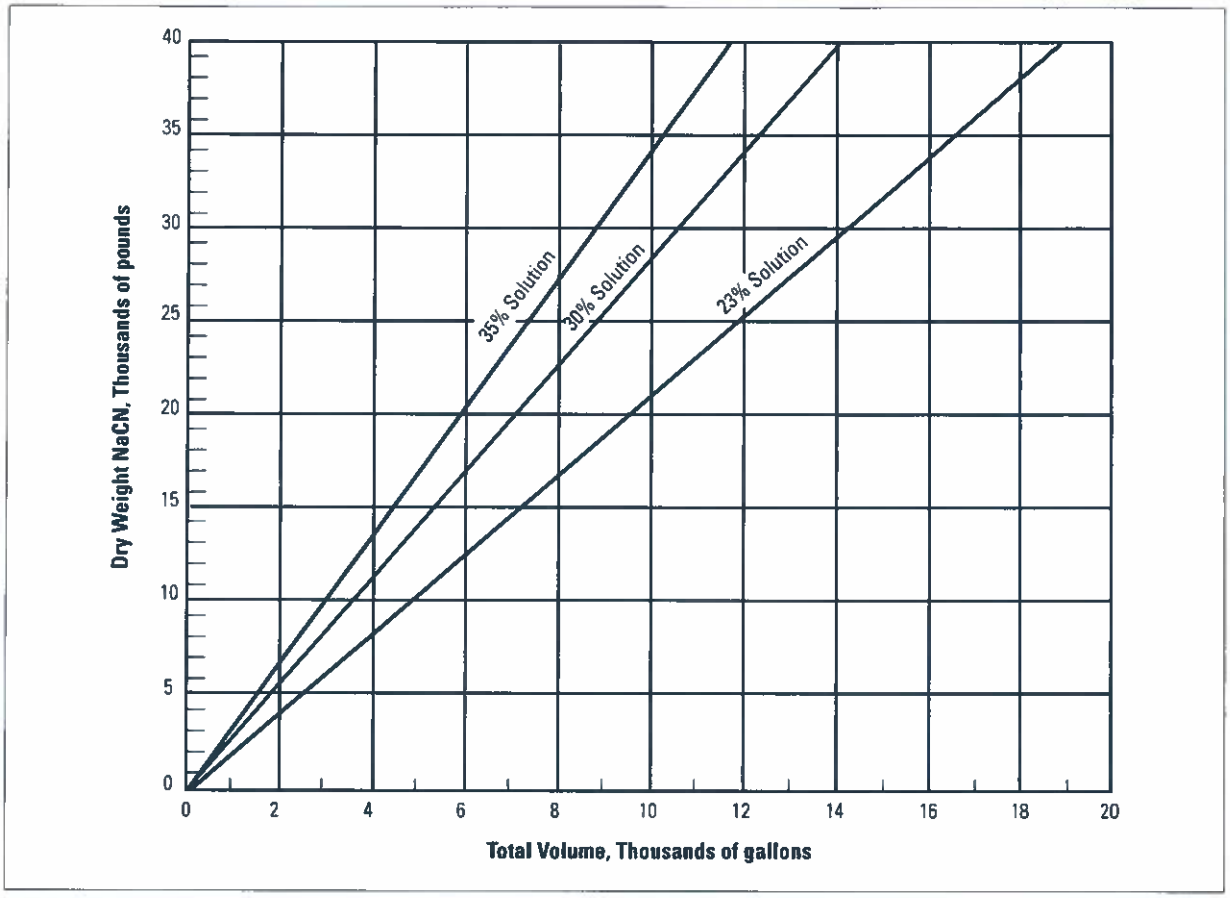
Pipe and Hoses

Welded, not threaded, carbon steel (or 304 or 316 stainless steel) pipe with minimum flanges can be used (see "Materials of Construction" for piping and gaskets). Excel II circulation piping of 10.2-cm (4-in) is recommended (except for the line from the tank to the pump inlet, which should be 6 in, to minimize NPSH losses) with all valves, pumps, etc., located inside the dike and minimum flanges outside the dike. Tank car and truck hoses should be overdesigned to ensure against failure. Hose pressure rating should be 225 psi minimum with burst pressure (including end connections) at least twice the rated pressure. Contact DuPont for hose design and vendor recommendations. Circulation piping system, including hoses, should be inspected before each use to protect against failure and a major spill. Hoses should be long enough to permit hookup, regardless of the direction the vehicle comes into the facility. Sodium cyanide solution trailer connections are located at the rear (bumper level) and middle (on top) of the trailer; Excel II trailer connections are located at the rear (bumper level); and Excel I connections are in the box located in the middle of the trailer (ground level). All connections are quick connects, except for the top solution connection, which may be either bolted or quick connect.

Drainage Control

The storage tank should be diked and have a sealed concrete bottom. No dike drain should be installed, because it might leak or be left open. The unloading area should be curbed and drainage control provided that will prevent spilled cyanide solution from draining into public water courses (see "Pipe and Hoses"). Specific spill control requirements depend on surroundings and local regulations. Impounded sodium cyanide can be reclaimed or chemically destroyed.

Figure 17. Solution Volume Curves—Gallons of Solution from Dry Weight at 35°C (95°F)



Filter

To obtain a clear solution, a filter can be used. It should be located so that it filters the solution between the tank car and the storage tank and, also, between the storage tank and process. Filters are not needed if a clear solution is not required.

Level Indicator and Alarm

A sonic liquid level indicator is preferred over a float-type instrument, as it is more reliable, easier to read, and can be installed at a convenient location. It is recommended that a high-level alarm system, equipped to shut off the pump, be installed to prevent overflowing the storage tank.

Temperature Indicators, Insulation, Heating, and Cooling

Sodium cyanide solution should be stored above the crystallization point (see **Figure 3**), but normally below 38°C (100°F), when possible, to reduce decomposition (see **Figure 6**). A temperature control system may be needed for high concentrations. Tank insulation can be fiberglass with a sheet aluminum cover, if climate and solution concentration warrant. Low pressure steam can be used to reduce localized overheating. The same coils can be used for circulating cold water when necessary. Alternately, live steam can be injected, if small concentration changes from condensation are acceptable.

CAUTION

Read the "Chemical Reactions" section carefully and note the dangers at high temperatures.

Caustic Addition

To minimize highly toxic HCN formation and prevent color formation from HCN polymerization in the stored sodium cyanide solution, sufficient caustic (sodium hydroxide) is added to give a pH 12, preferably 12.5–13. Caustic addition to provide a 0.3–0.5% solution (about 50 lb NaOH per 1000 gal water) is usually sufficient. A 50% caustic solution can be used during the summer, but 25% solution is recommended for winter to avoid freezing. Use of 22.7-kg (50-lb) bags of bead caustic may be convenient. Additions can be made directly to the tank. Caustic should be added before sodium cyanide is added. Where process chemistry prevents caustic addition, HCN formation will increase, which must be controlled by ventilation and/or other means.

Transportation Emergencies

How to Get Help

DuPont wants to be called about any transportation incident involving DuPont cyanide, regardless of whether a spill occurred. In the event of a transportation incident or other problem involving DuPont cyanide that requires immediate help, call the DuPont Cyanide Hotline at our Memphis, Tennessee plant:

Call Collect, Day or Night

(901) 357-1546

NOTE: Do not use this number for non-emergencies. Contact the sales office listed on the back cover for routine commercial or technical information.

Calling the DuPont Cyanide Hotline is the fastest way DuPont can provide guidance to assist in handling an emergency. DuPont will evaluate whether a team of specialists should be sent to the scene.

In the United States and Canada, CHEMTREC can also be called at:

(800) 424-9300

In the rest of the world, call CHEMTREC at:

001-703-527-3887

CHEMTREC uses Language Services for non-English speakers.

The DuPont or CHEMTREC information specialist on duty will ask the name and location of the caller, the name of the shipper, the product, the shipping point and destination as well as what happened, nature of any injuries, weather conditions, proximity to populated areas, etc. If you call CHEMTREC, the information specialist will then contact the manufacturer (DuPont) for further assistance.

In Canada, CANUTEC can also be called in Ottawa, Ontario, at:

(613) 996-6666

Action at the Scene

The following is intended to provide guidance to first responders to a DuPont sodium cyanide transportation emergency incident.

1. For any transportation incident involving DuPont sodium cyanide, call DuPont for assistance as soon as possible, regardless of whether there is a spill.
2. Avoid overreaction that can occur because "cyanide" is involved. Remember, in most cases, you are dealing with a dry, solid, nonvolatile material that is normally easy to clean up, unless the cyanide has contacted acid or some other incompatible chemical or is spilled into a water system. If sodium cyanide solution is spilled, the amount of HCN gas evolved will probably be greater than if dry sodium cyanide was spilled, but because of the amount of caustic contained in sodium cyanide solution, the amount of HCN will probably still be well below lethal limits (see "Effects of Exposure to HCN Vapor" on page 8)—unless the HCN vapors are somehow contained or the solution is in contact with an acid. Gasoline, diesel, or other motor oils do not generally cause large amounts of cyanide gas.
   a. The need for evacuation is highly unlikely. Unless acid and cyanide are mixed, hydrogen cyanide gas formation is limited.
   b. While rain or any water contact with sodium cyanide can produce hydrogen cyanide gas, the amount of gas is small and would not require evacuation. While dangerous levels of gas can develop in enclosed spaces, wet sodium cyanide in the open can be shoveled up by standing upwind during cleanup.
3. Shovel the cyanide into drums, plastic bags, or any suitable container.
4. If sodium cyanide solution is spilled, contain the spill as soon and as much as possible. Keep sodium cyanide out of lakes, streams, or any other water. Block off sewer system, drainage, or any other water access. Even small concentrations of cyanide can be fatal to aquatic life. As soon as is practical, place the spilled material into a container suitable for movement to a proper disposal area.
5. As with all chemical spills, approach the scene from upwind to determine what chemicals are involved. With sodium cyanide spillage, check for battery acid spillage.
6. Keep people (nonresponders) away.
7. Halt or divert traffic to prevent spreading the cyanide.
8. If raining, cover any spilled sodium cyanide with a tarp, plastic, or anything available to minimize water contact and subsequent cyanide-water runoff. Divert any water streams around the cyanide.
9. To repeat, call the DuPont Cyanide Hotline at:

(901) 357-1546

Cyanide Destruction

The entire process in which by-products are generated should be reviewed for possible recycle of sodium cyanide, instead of disposal. If recycle is not feasible, ion exchange and reverse osmosis may be useful for concentrating cyanides, but destruction is usually easier and more economical.

The most effective and widely used chemical methods to destroy cyanide are oxidizing it to cyanate (CNO^-) with hypochlorite or hydrogen peroxide. Both methods are effective for oxidizing free and weak acid-dissociable cyanide.

For concentrated cyanide solutions, long-term high-temperature heating will destroy much of the cyanide with associated ammonia release.

Chlorination

CAUTION

Concentrated hypochlorite should not be mixed with concentrated cyanide solutions or solid cyanide, because highly toxic cyanogen chloride gas will be released. Very dilute solutions, in the correct pH range, should be used.

Chlorination of dilute sodium cyanide solutions can be accomplished by treatment with diluted solutions of sodium hypochlorite, calcium hypochlorite, or by generating hypochlorite from NaOH and Cl_2 gas. The choice of hypochlorite is an economic and safety decision. Solution concentrations of 1% sodium cyanide and 1% hypochlorite can be reacted if mixed slowly (over, say, 10 min) and with proper pH control.

Hypochlorite reacts with cyanide ions (CN^-) to produce highly toxic cyanogen chloride, which, at pH 10–11, hydrolyzes promptly to form cyanate ions (CNO^-). Because cyanogen chloride is a poisonous gas with little water solubility, the treatment process must be designed and operated to prevent cyanogen chloride fumes. Fumes are best controlled by limiting the cyanide concentration to a few thousand parts per million and controlling pH. Below pH 10, cyanogen chloride release increases; above pH 11, cyanide destruction slows, particularly above pH 11.5.

Further chlorination to destroy cyanate, sometimes referred to as "complete" chlorination, can be accomplished with additional chlorine. After reaction at pH 10.5 for 10 min or more, the pH must be reduced to 7.5–9, preferably 8–8.5, and maintained at that pH until the reaction is complete. Completion of both reactions typically requires at least 2 hr and can use eight or more parts of Cl_2 per part of CN^- (versus about three parts of Cl_2 for oxidation to CNO^-), while producing CO_2 and N_2 as reaction products. Chlorination is effective for cyanide destruction and can be automated for continuous systems. However, other waste stream components are often chlorinated, which increases chlorine consumption and may produce undesirable by-products in the effluent.

pH 10–11

Normally fastest reaction rate. Reduced HCN release and pH drop during treatment favor starting around pH 11. Higher pH will slow reaction, particularly above 11.5.

CAUTION

Adequate ventilation and HCN monitoring are important and more so as cyanide concentrations increase and pH decreases, particularly below pH 11.

pH Below 10

Causes slower reaction and release of HCN and/or cyanogen chloride gas (highly toxic, like HCN, and a powerful lachrymator, causing tearing of the eyes). Also, there is greatly increased concern about HCN release.

Acid pH

CAUTION

In addition to toxic gas release, acidic conditions can result in nitrogen trichloride formation that can separate as an insoluble oil-like material and explode violently, even in small amounts.

Hydrogen Peroxide Oxidation

CAUTION

Concentrated hydrogen peroxide should not be mixed with concentrated cyanide solutions or solid sodium cyanide, because highly toxic HCN or ammonia gas could be released. Also, high heat and oxygen gas release may cause foaming or eruption and splash workers. Dilution minimizes these problems.

Depending on the composition of the waste, additions of copper or formaldehyde may be required to destroy cyanide. The waste liquor is adjusted to pH 11 (10.5–11.5), formaldehyde or copper ions (typically with copper sulfate) added if needed, and hydrogen peroxide mixed with the solution. The solution must be agitated mechanically or with air. The reaction rate is dependent on temperature. Dilute wastes can be warmed to 38–54°C (100–130°F), but temperature elevation is usually less economical than adding 10–20% excess peroxide to shorten reaction time (which is normally about ½–1 hr at ambient temperature). Dilution and/or controlled addition rate may be needed when treating more concentrated wastes.

Chlorination is faster than peroxide oxidation and is frequently more adaptable to continuous destruction systems. Where speed is not critical, such as in batch tanks, hydrogen peroxide has several advantages including:

- Cyanogen chloride and chlorinated by-products are not produced.
- More concentrated cyanide wastes can be treated safely.
- The hazards of handling chlorine are avoided.
- Chlorine/chloride in water discharges are prohibited in some locations and can be avoided with peroxide.
- Sulfur compounds will react with hypochlorite, but not peroxide, and can increase hypochlorite costs substantially.
- Peroxide may destroy other objectionable organics.

By-products from peroxide treatment are cyanate, ammonia, and glycolic acid amide. Cyanate does not revert to cyanide in surface waters or sewage treatment systems, according to a U.S. Public Health Service study. Both the cyanate and glycolic acid amide are biodegradable. The cyanate can be readily hydrolyzed in acid solutions to ammonia.

Hydrolysis

Hydrolysis is sometimes a practical treatment for strong sodium cyanide solutions. Simply heating a 10% sodium cyanide solution for about 36 hr to 95–100°C (about 210°F) should reduce the cyanide content well below 1%, where chemical oxidation can be used more effectively. Provisions should be made to accommodate the ammonia that will be generated (see "Sodium Cyanide Reactions in Water").

Metal Complexes

Strongly bonded metal cyanides, especially iron cyanides (ferrocyanide and ferricyanide), are apt to be found in cyanide waste streams. These will not be detected by simple analytical procedures, such as titration with silver nitrate, which are normally used for measuring "free" or "weak acid-dissociable" cyanides. However, they will be included in the "total cyanide" analyses using acid distillation procedures. These complexes are not effectively destroyed by the commonly used waste treatment processes. If regulations require removal of these generally stable complexes of low toxicity, other treatment methods such as precipitation to produce a solid waste may be required.

Handling Spills

Sodium cyanide spills should be cleaned up promptly to minimize exposure of people and the environment. Shovel and sweep dry spilled material into a drum or suitable container. Keep dry spilled material dry. If solutions are spilled, immediately contain them to prevent contaminating nearby water. Contact DuPont for additional actions at a spill scene. If raining, covering the spill will reduce sodium cyanide dissolving and runoff. Decontamination of an area, after cleaning up as much cyanide as possible, can be accomplished with hypochlorite solution. A small amount of caustic (1 oz/5 gal hypochlorite solution) will help keep the pH in the 10–11 range.

References and Notes

1. Elial, E. L., and Freeman, J. P., "Organic Syntheses," Wiley, New York, Coll. Vol. 4, 58–62.
2. OSHA, 29 CFR 1910.1000, Air Contaminants.
3. Due to changing governmental regulations, such as those of the Department of Transportation, Department of Labor, U.S. Environmental Protection Agency, and the Food and Drug Administration, references to governmental requirements may be superseded. Consult and follow the current governmental regulations, such as Hazard Classification, Labeling, Worker Exposure Limitations, and Waste Disposal procedures, for up-to-date requirements for sodium cyanide.
4. "HYDROGEN CYANIDE and CYANIDE SALTS" published in 2001 by American Conference of Governmental Industrial Hygienists (ACGIH) 1330 Kemper Meadow Drive, Cincinnati, OH 45240; telephone (513) 742-2020. The ACGIH recommends a 4.7 ppm ceiling for HCN. Both OSHA and ACGIH advise avoiding skin contact.
5. "Occupational Exposure to Hydrogen Cyanide and Cyanide Salts," NIOSH Criteria Document, U.S. Department of Health, Education, and Welfare, 1976.
6. DOT, 49 CFR 712.101, Hazardous Material Table.

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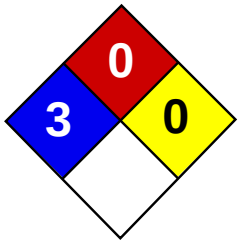
C.2 Material Safety Data Sheets – Sodium Cyanide



Material Safety Data Sheet
Sodium Cyanide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Cyanide

Catalog Codes: SLS2314, SLS3736

CAS#: 143-33-9

RTECS: VZ7525000

TSCA: TSCA 8(b) inventory: Sodium Cyanide

CI#: Not available.

Synonym:

Chemical Name: Sodium Cyanide

Chemical Formula: NaCN

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium Cyanide	143-33-9	100

Toxicological Data on Ingredients: Sodium Cyanide: ORAL (LD50): Acute: 6.44 mg/kg [Rat]. DERMAL (LD50): Acute: 10.4 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator). Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to skin, eyes, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of acids, of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Dangerous on contact with acids, acid fumes, water or stream. It will produce toxic and flammable vapors of CN-H and sodium oxide. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas. When heated to decomposition it emits toxic fumes hydgrogen cyanide and oxides of nitrogen

Special Remarks on Explosion Hazards: Fusion mixtures of metal cyanides with metal chlorates, perchlorated or nitrates causes a violent explosion

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Poisonous solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
STEL: 5 (mg/m3) from ACGIH (TLV) [United States] SKIN CEIL: 4.7 from NIOSH CEIL: 5 (mg/m3) from NIOSHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Granular solid. Flakes solid.)

Odor:
Faint almond-like odor. Odorless when perfectly dry. Emits odor of hydrogen cyanide when damp.

Taste: Not available.

Molecular Weight: 49.01 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 1496°C (2724.8°F)

Melting Point: 563°C (1045.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.595 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Vapor Density of Hydrogen Cyanide gas: 0.941

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Soluble in cold water. Slightly soluble in Ethanol

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, moisture, incompatibles.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity:
Corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent reaction with fluorine gas, magnesium, nitrates, nitric acid. Dangerous on contact with acids, acid fumes, water or stream. It wil produce toxic and flammable vapors of CN-H and sodium oxide. Cyanide may react with CO2 in ordinary air to form toxic hydrogen cyanide gas. Strong oxidizers such as acids, acid salts, chlorates, and nitrates. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

Special Remarks on Corrosivity: Corrosive to aluminum

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 6.44 mg/kg [Rat]. Acute dermal toxicity (LD50): 10.4 mg/kg [Rabbit].

Chronic Effects on Humans: May cause damage to the following organs: skin, eyes, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects (maternal and paternal fertility) based on animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health effects: Skin: May cause itching and irritation. May be fatal if absorbed through injured skin with symtpoms similar to those noted for inhalation and ingestion. Eyes: May cause eye irritation and eye damage. Inhalation: May cause respiratory tract irritation. May be fatal if inhaled. The substance inhibits cellular respiration causing metabolic asphyxiation. May cause headache, weakness, dizziness, labored breathing, nausea, vomiting. May be followed by cardiovascular effects, unconciousness, convulsions, coma, and death Ingestion: May be fatal if swallowed. May cause

gastrointestinal tract irritation with nausea, vomiting. May affect behavior and nervous systems(seizures, convulsions, change in motor activity, headache, dizziness, confusion, weakness stupor, aniexity, agitation, tremors), cardiovascular system, respiration (hyperventilation, pulmonary edema, breathing difficulty, respiratory failure), cardiovascular system (palpitations, rapid heart beat, hypertension, hypotension). Massive doses by produce sudden loss of conciousness and prompt death from respiratory arrest. Smaller but still lethal doses on the breath or vomitus. Chronic Potential Health Effects: Central Nervous system effects (headaches, vertigo, insomnia, memory loss, tremors, fatigue), fatigue, metabolic effects (poor appetite), cardiovascular effects (chest discomfort, palpitations), nerve damage to the eyes, or dermatitis, respiratory tract irritation, eye irritation, or death can occur. may prolong the illness for 1 or more hours. A bitter almond odor may be noted

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Sodium cyanide UNNA: 1689 PG: I

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut carcinogen reporting list.: Sodium Cyanide Illinois chemical safety act: Sodium Cyanide New York release reporting list: Sodium Cyanide Rhode Island RTK hazardous substances: Sodium Cyanide Pennsylvania RTK: Sodium Cyanide Minnesota: Sodium Cyanide Massachusetts RTK: Sodium Cyanide Massachusetts spill list: Sodium Cyanide New Jersey: Sodium Cyanide New Jersey spill list: Sodium Cyanide Louisiana RTK reporting list: Sodium Cyanide Louisiana spill reporting: Sodium Cyanide California Director's List of Hazardous Substances: Sodium Cyanide TSCA 8(b) inventory: Sodium Cyanide TSCA 4(a) final test rules: Sodium Cyanide TSCA 8(a) PAIR: Sodium Cyanide TSCA 8(d) H and S data reporting: Sodium Cyanide TSCA 12(b) one time export: Sodium Cyanide SARA 302/304/311/312 extremely hazardous substances: Sodium Cyanide CERCLA: Hazardous substances.: Sodium Cyanide: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-6: Reactive and very flammable material. CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS E: Corrosive solid.

DSCL (EEC):
R27/28- Very toxic in contact with skin and if swallowed. R41- Risk of serious damage to eyes. S1/2- Keep locked up and out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S28- After contact with skin, wash immediately with plenty of water S36/37- Wear suitable protective clothing and gloves. S39- Wear eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 11/01/2010 12:00 PM

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Appendix D

Hazardous Material Storage Area Inspection Report

HAZMAT Storage Area: Environmental Inspection report

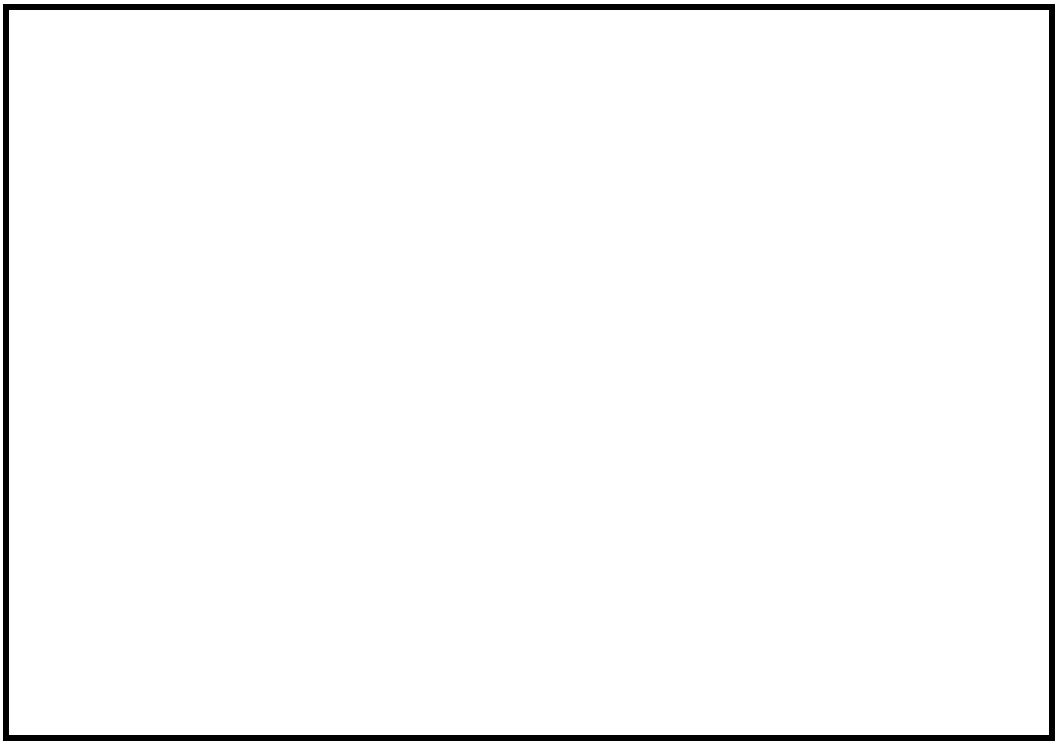
Date: _____ **Inspected By: _____**

Location: _____ **Responsible department: _____**

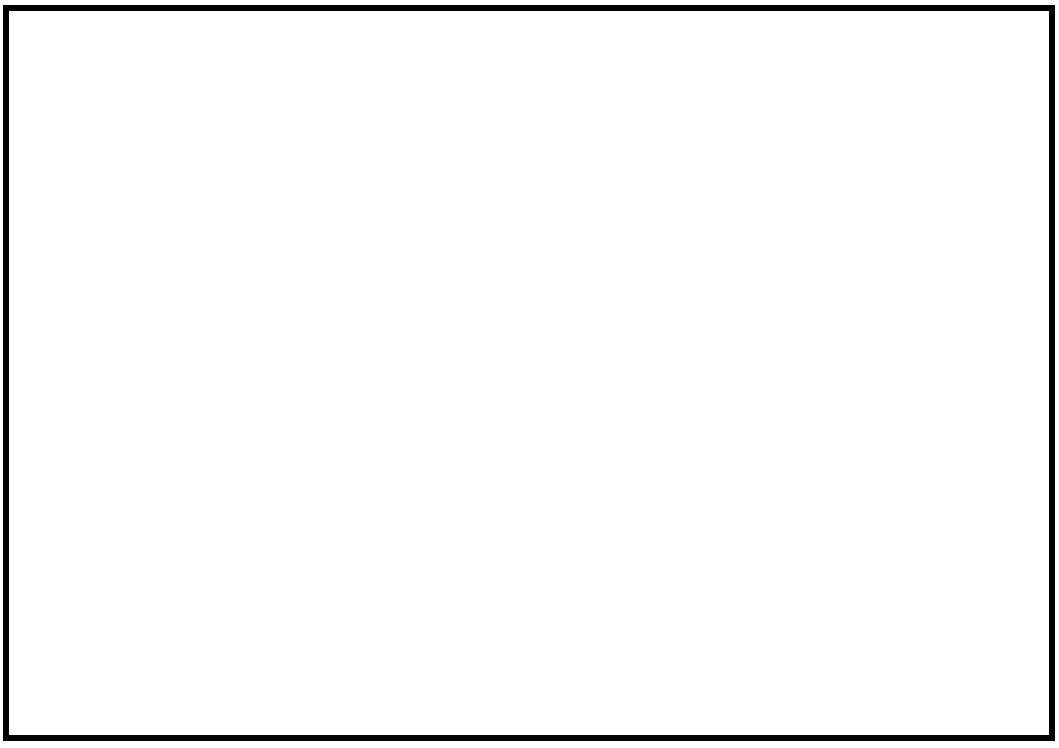
Subject	Conform	Non-conform	N/A	Picture(s) #
Are storage containers clearly labelled to identify Hazmat substance?				
Are storage containers in good condition? Is there any visible damage or leaks? Can the doors be sealed shut?				
Is HAZMAT in containers properly segregated?				
Is HAZMAT arrangement to prevent from falling or dislodging?				
Where necessary – Is HAZMAT placed on pallets i.e. Drums?				
Where necessary – Are containers with product stored in an upright position?				
Where necessary – Are Quatrex bags closed properly?				
Do you see any potential environmental hazards posed by these HAZMAT containers/materials?				

Comments:_____
_____
_____
_____
_____

Recommendations:_____
_____
_____
_____
_____



Picture 1: Description



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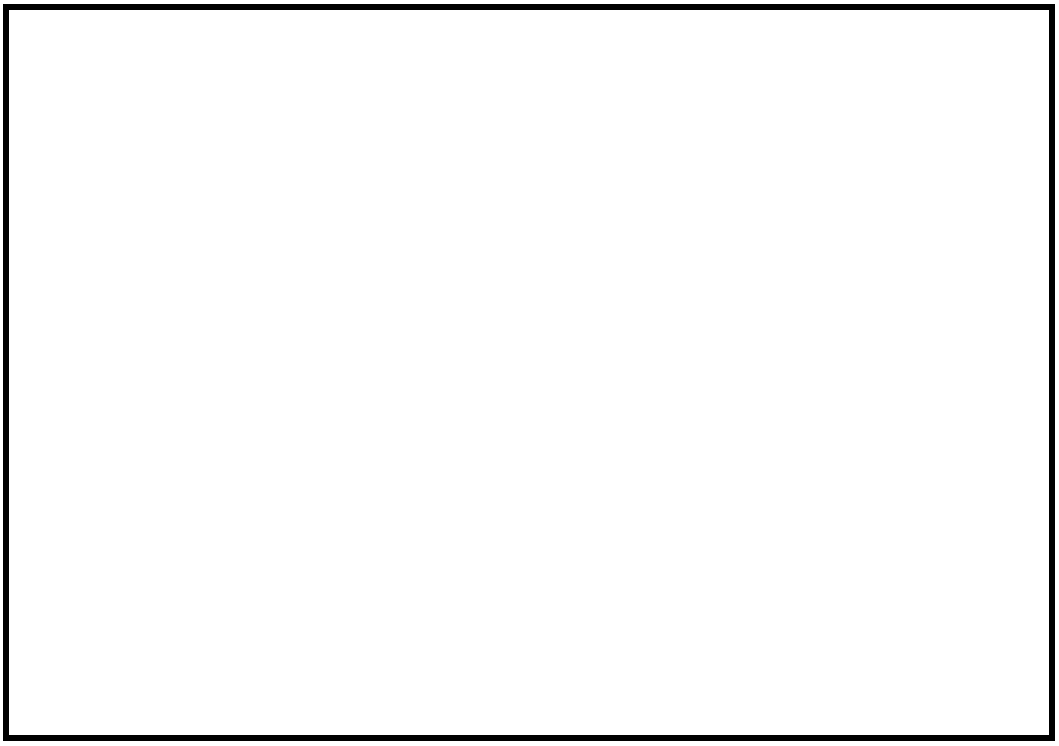
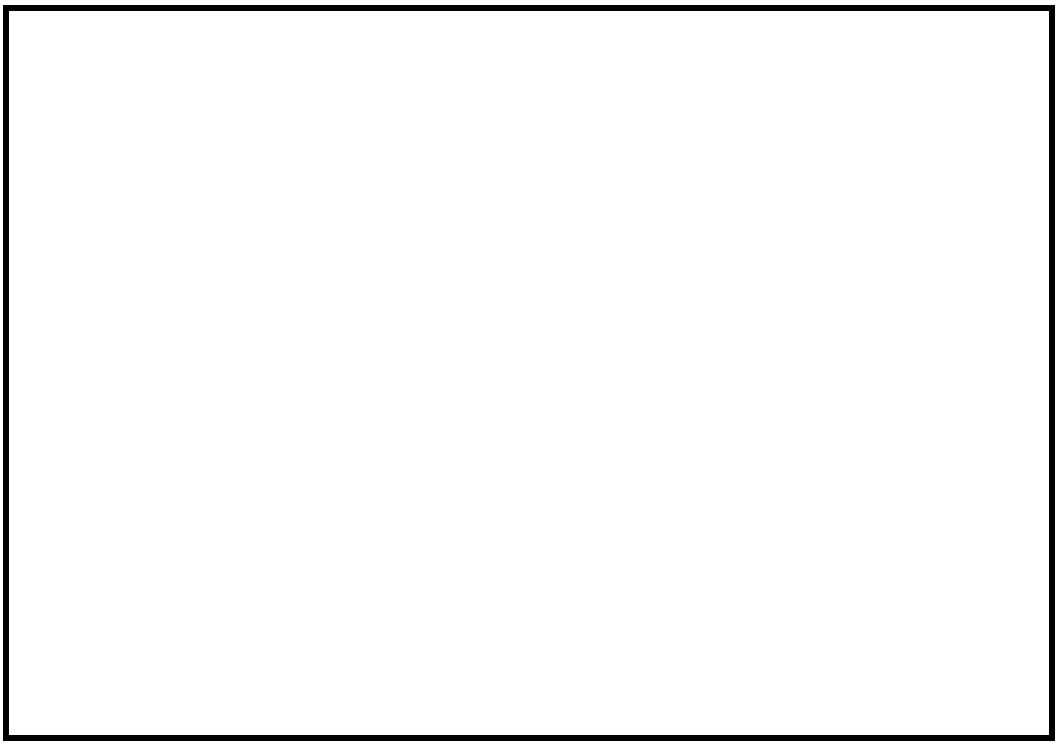


Picture 3: Description



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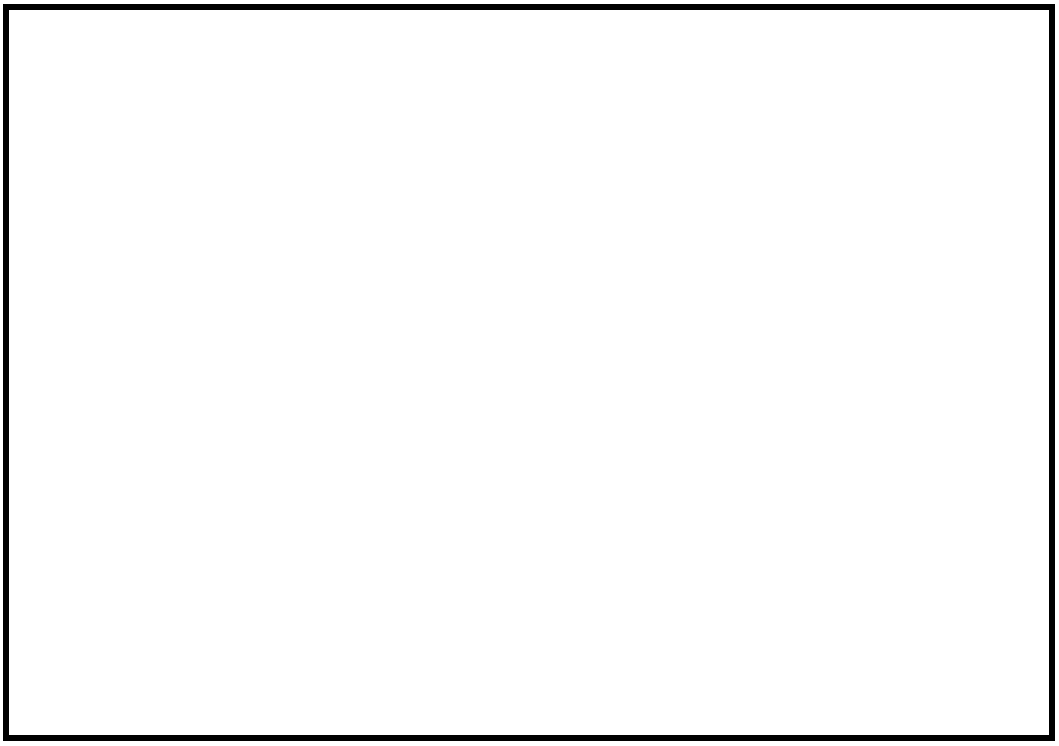

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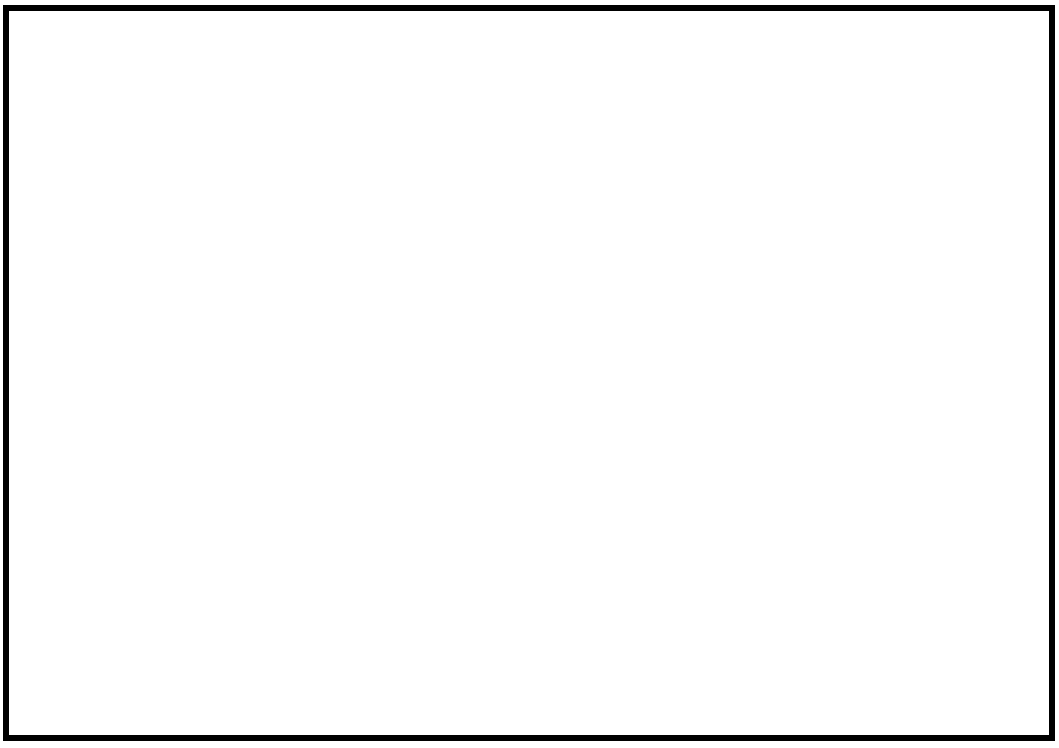


Picture 6: Description

Appendix E

Procedure Poster Hazardous Material Storage

Agnico-Eagle Mines: Meadowbank Division Environment Department

AGNICO EAGLE
MEADOWBANK

HAZARDOUS Materials/Waste Management and Storage Procedures

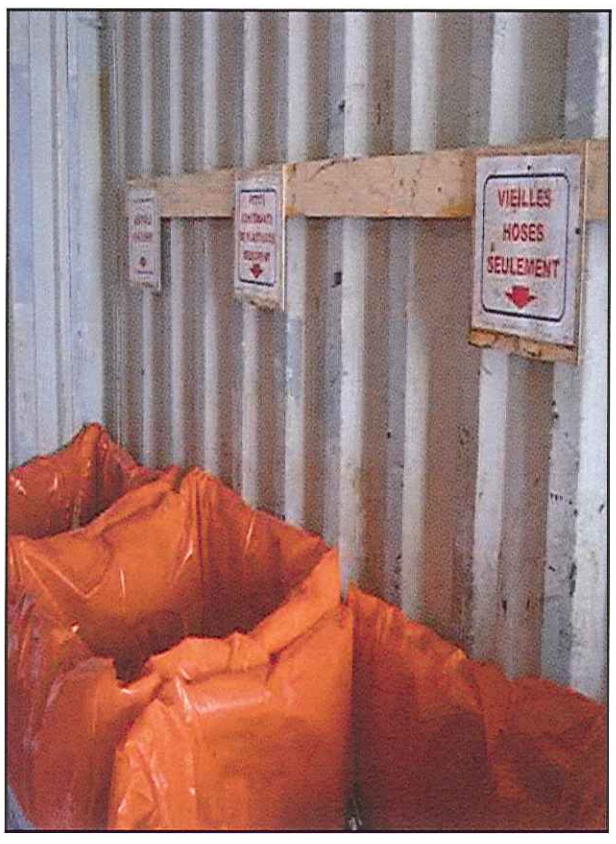
- AEM is committed to the safe and appropriate storage of fuels, hazardous materials, and hazardous wastes.
- AEM Environmental Department will be conducting routine inspections on each departments HAZMAT area to ensure proper procedures and storage are being met. This not only meets the requirements of our license, but is also a cost-savings initiative.
- When Hazardous Materials are not properly segregated, additional handling costs are added to the total cost of shipping our Hazardous Material down south.
- AEM's general guidelines for storing fuels, hazardous materials and hazardous wastes are listed below.

Hazardous Materials/Waste includes:

Waste Oil, Grease, Filters & Hoses, Spray Cans, Rags with Oil, Grease or Chemical Product, Paints, Batteries, Fluorescent Lights




HAZARDOUS MATERIALS/WASTE MUST BE SEPARATED (See Example Below)

The Hazardous Materials/Waste Storage Area is located near the Fuel Farm and Incinerator

When your HAZMAT is ready to transport to the Hazardous Materials/Waste Storage area, we ask that you follow these steps:

- HAZARDOUS MATERIALS MUST BE SEGREGATED AND STORED IN PROPER DRUMS, QUATREX, OR CONTAINER TO ALLOW ACCESS FOR INSPECTION AND EMERGENCY RESPONSE IN THE EVENT OF A SPILL OR RELEASE
- ALL OF THE CONTAINERS IN THE HAZMAT STORAGE AREA ARE CLEARLY LABELED. IDENTIFY THE STORAGE CONTAINER THAT MATCHES THE HAZMAT THAT YOUR TRANSPORTING (FOR EXAMPLE—SEE BELOW)

AEROSOL CANS **INTO** **AEROSOL CONTAINER**

- WHEN PLACING HAZMAT PRODUCT INTO THE STORAGE AREA CONTAINERS, GENERAL HOUSE KEEPING RULES APPLY. CONTAINERS WITH PRODUCT SHALL BE KEPT IN AN UPRIGHT POSITION AND MATERIAL SHALL BE ARRANGED TO PREVENT DAMAGE FROM FALLING OR DISLODGING

Hazardous Materials/Waste Management requires the commitment and participation of all site personal. If you have questions or are unsure of where to dispose of your Hazardous Material/Waste please call:

Site Services at extension 6902, Environment Department at extension 6747

THANK YOU FOR YOUR CO-OPERATION