



## ***MINTO MINE***

### ***PHASE I WATER TREATMENT CONTINGENCY PLAN***

WATER USE LICENSE QZ06-006

MARCH 14, 2006

Prepared by:



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## APPENDICES

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- Appendix B** MSDS Sheets for Water Treatment and Sediment Control System  
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- Appendix C** Water Quality Surveillance Program from QZ06-006

## 1.0 INTRODUCTION

This plan has been prepared in accordance with Section 43 of Water License QZ96-006:

*“Prior to the commencement of pit development, the Licensee shall provide the Board with detailed written assurance that all necessary resources and equipment are on site to comply with contingency treatment plans that are outlined in the water use application.”*

Minto’s water use license application was supported by technical advice from Hallam Knight Piesold, Ltd. (HKP) whose letter, dated February 3, 1997 (See Appendix A), outlines contingency treatment measures for the removal of copper in mine runoff water, and is based on Best Practicable Treatment Technology from the federal Metal Mining Effluent Regulations. HKP advises that, based on the available information, the tailings supernatant from the Minto operations is expected to have a diluting effect on the naturally high baseline copper concentrations in Minto Creek, but prescribes a treatment system for copper as a contingency measure, recommending a phased, portable system that can be deployed and moved easily in response to site development activities and changes in runoff patterns and metal concentrations.

Although HKP specifically addresses copper as the target metal for treatment, continued water quality monitoring of Minto Creek and its tributaries since 1994 have identified other metals that have naturally elevated concentrations in Minto Creek, these being aluminum, iron, lead, zinc, and manganese. Historic sampling (since 1994) has frequently returned background concentrations of the previously mentioned metals that are higher – sometimes significantly higher – than the water license effluent discharge standards (see section 3.0.) Access Consulting Group’s (ACG) experience with pH adjustment and metal hydroxide precipitation (proposed for Minto, see section 2.1) at the Keno Hill site lends confidence that the metal treatment system proposed by HKP for total copper will also be effective at removing these other metals as metal hydroxide precipitates.

In addition to metals concentrations, historic background total suspended solids concentrations have frequently been reported above the QZ06-006 discharge standard

(15 mg/L.) The Minto Property and much of the surrounding area, including the entire headwaters of the Minto Creek drainage upstream of the mine site and the site W-3 compliance point have historically been impacted by forest fires, the most recent of which was in 1997. This fact may be contributing to the increased levels of suspended solids seen in historic water quality results. These elevated concentrations also require 'treatment' contingency planning, although not of the same design as the metals treatment system. The design particulars of the water treatment and sediment control systems are discussed further in section 2.0.

The full range of activities scheduled for the Minto site in the near future can be partitioned into two distinct phases:

- **Phase I – Site Development:** encompasses the development of both the minesite and camp infrastructure, including pit development, road, campsite and dam construction; and
- **Phase II – Mining Operations:** includes ore removal and mill processing and tailings production and disposal in the tailings facility.

Although this plan will ultimately address the contingency planning for the operational mining activities included in Phase II, this plan is being submitted initially to cover water treatment contingency planning for the initial Phase I site development activities. Once the site development has progressed and there is more information available concerning the particulars and timing of mining operations, this plan will be amended to include Phase II water treatment contingency planning and the updated plan will be re-submitted prior to the commencement of Phase II activities.

MSDS sheets for all materials proposed for use in the water treatment and sediment control systems are included in Appendix B.

## **2.0 WATER TREATMENT PLANT AND SEDIMENT CONTROL SYSTEM DESIGN**

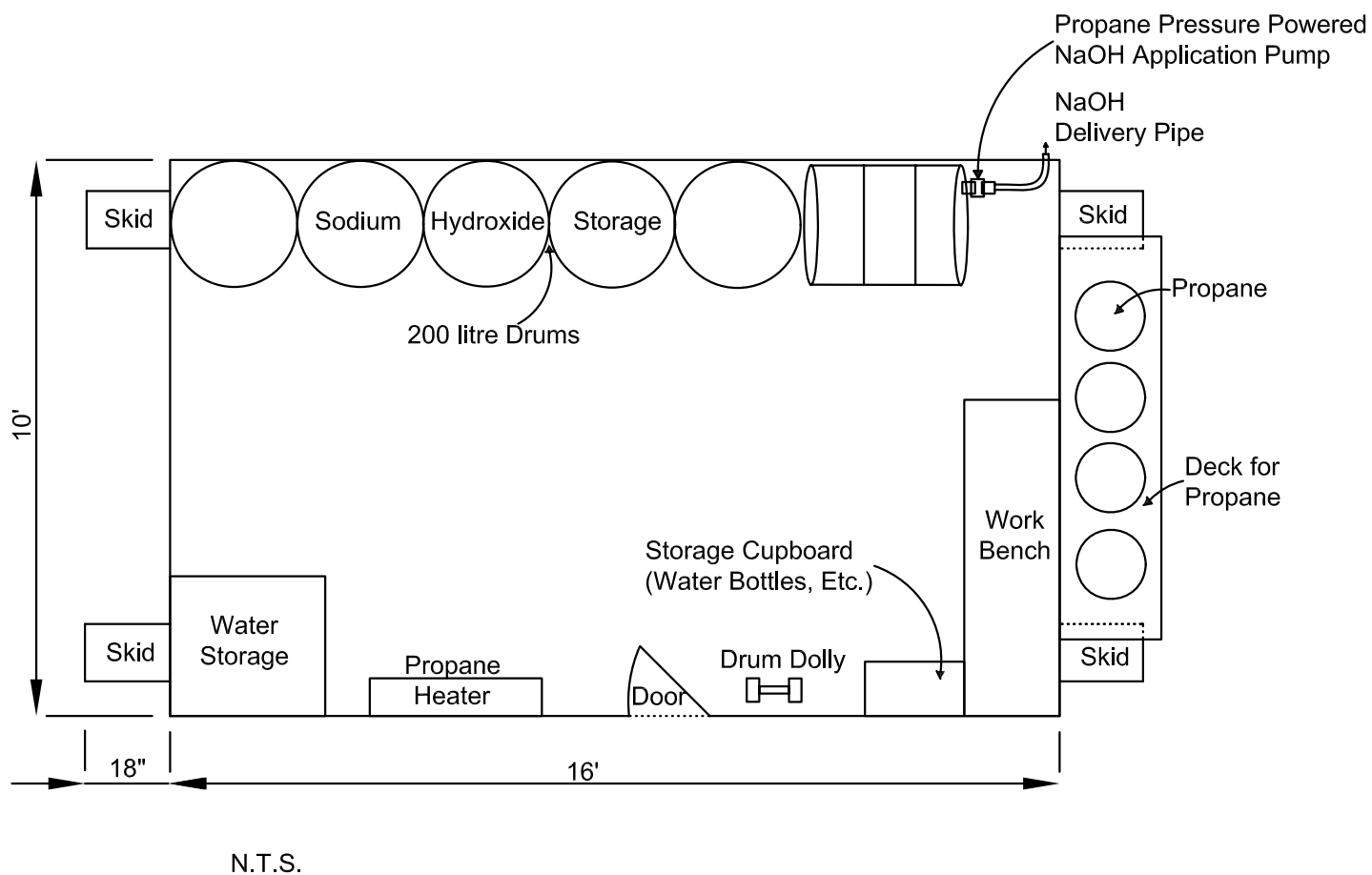
### **2.1 *Water Treatment Plant***

As recommended by HKP in the water license application (see letter in Appendix A), ACG has designed and constructed a portable Water Treatment Plant (WTP) for treatment of aqueous metals in effluent from the Minto Site. The WTP consists of a 10'x16' insulated, skid-mounted building that houses:

- 6 x 200L barrels of sodium hydroxide (NaOH, caustic soda);
- storage for approximately 150 AN1 Magnasol<sup>®</sup> anionic flocculant blocks for remote deployment;
- 4 x 100 lb propane tanks;
- 200 L water storage tank;
- propane pressure powered NaOH metering pump;
- propane heater; and
- work bench area and storage for water quality sampling and analytical activities.

This building was custom designed and built in Whitehorse by Glacier Dredge Co. The plant was built on skids to ensure portability, as during the initial construction period, the plant will be set up in multiple locations, as development of the site progresses. Initially, the plant will be positioned upstream of the location of the proposed settling facility/mill pond. Please see Figure 1 for a schematic layout of the portable water treatment plant.

The NaOH metering pump has a capacity of 12 L/hr, which will provide adequate pH buffering for metals removal. Minto Creek's average natural operating pH is around 8.0 and HKP advises that the optimal pH for copper removal as  $\text{Cu}(\text{OH})_2$  is 9.5.



Client:



Prepared By:



## Portable Water Treatment Plant Schematic

Minto Mine  
Water Treatment Contingency Plan

Drawn By: HD

Checked By: SK/RM

Date: March 2006

Figure: 1

Our File: D:\Project\AllProjects\Minto\dwg\H2OTreatPlanMar06\PlantSchem.dwg

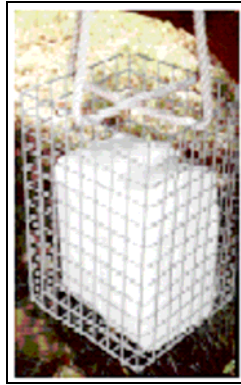
## **2.2 Sediment Control Systems**

The original water license application provides engineered details regarding the proposed primary sediment control facilities, namely the Main Water Dam with a downstream settlement basin, and the upstream milling/sediment pond. These structures, once in place, will provide permanent water retention and solids settling capacity for the total mine discharge. Prior to the construction of these facilities (expected in June 2006), interim sediment control measures must be implemented that will provide settling capacity for the suspended solids load through the spring freshet and the initial construction period.

Suspended solids often require only a reduction in flow velocity to settle out sediment in suspension, (i.e. a sediment control pond.) However sediment control can also be assisted with a settling promoter. The most common method of promoting settling is the addition of a flocculant. The interim (temporary) sediment control measures for site runoff and Minto Creek flow will be comprised of a series of sediment control ‘stations.’ Each station will consist of a coupling of:

- one or two replaceable solid anionic polymer flocculant blocks placed in a wire mesh cage (see Figure 2) and suspended in the flow to be treated; and
- a downstream (~15 m) installation of a straw bale and geotextile fabric check dam (see Figure 3.)

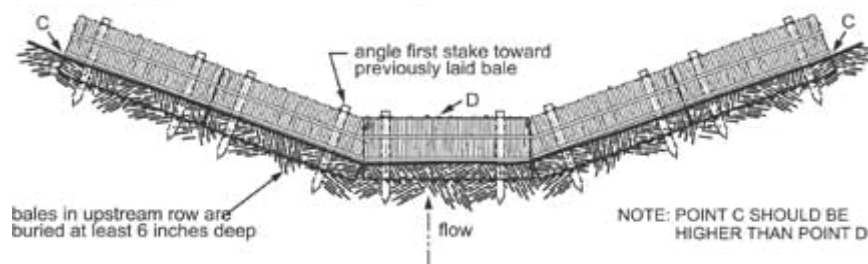
As flowing water slowly erodes the blocks, flocculant is released which reacts with sediment to bridge sediment particles creating complexed particles that will settle rapidly due to increased mass. Flocculant blocks are ideal for dosing flocculant in remote locations such as retention dams and in situations where continuous supervision of dosing is not practical. The anionic polyacrylamide flocculants are non-toxic to aquatic organisms and have zero capacity to bioaccumulate (See Appendix B).



**Figure 2. Flocculant blocks in wire mesh cage.**

Where possible, these will be installed in an area of natural turbulence (i.e. cascade or riffle), or if necessary a turbulent zone will be created where the blocks are installed to enhance erosion of the block and to promote complete mixing. Initially, these blocks will be suspended in channels excavated in the ice but anchored to the stream bank. As the spring thaw progresses, these will be maintained and adjusted to ensure optimal submersion.

The straw bales of the check dam will be anchored up against and wired to rebar anchor stakes. The stakes will be inserted into 2-foot deep holes drilled with a portable Pionjar rock drill. These dams will provide some flow retention and allow for the bridged floc particles to settle out above the dam and for clear water to decant over the low centre point of the check dam.



**Figure 3. General schematic of straw bale check dam installation.**

(source: [www.mt.nrcs.usda.gov/news/images/sbchckdam.jpg](http://www.mt.nrcs.usda.gov/news/images/sbchckdam.jpg))

The primary sediment control station will be located downstream of the site of the grout curtain (future site of Main Water Dam construction.) This check dam will be higher and wider than the others, with the intention of retaining more water at the final retention area, particularly during spring freshet and during the construction of the main tailings



dam, before the compliance point at water quality site W-3. Secondary stations will also be established upstream of this location, with one just below the confluence of Minto Creek and the flow that is presently glaciating over the access road east of the camp/mine site. Another station will be established just upstream of the WTP placement. This station will remove suspended sediments that can reduce the efficiency of the pH buffering and metals precipitation system. Due to the nature of these check dams, other secondary interim sediment control stations can be established if required.

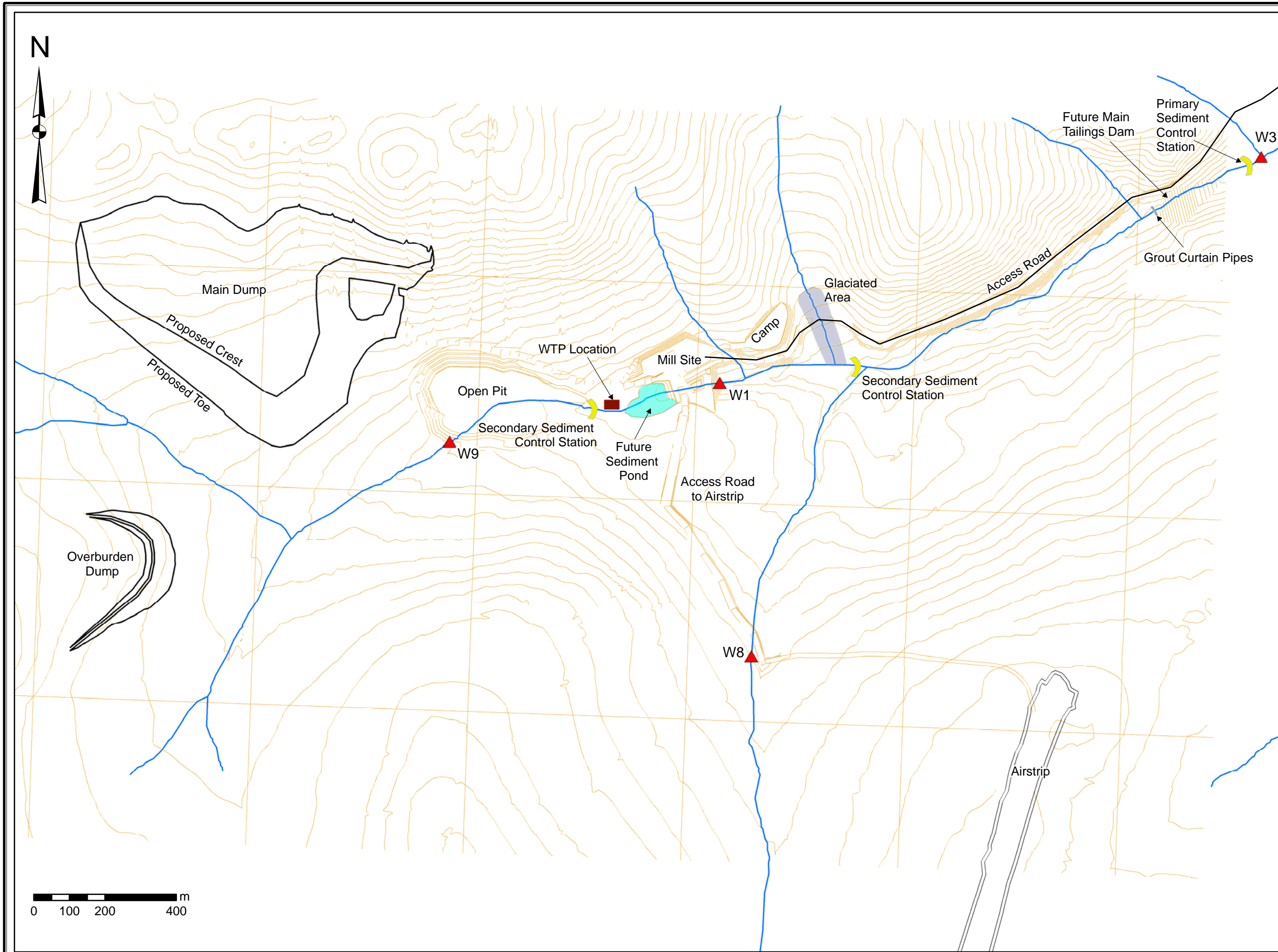
During the initial 2-3 weeks after installation and later during spring freshet, daily inspection of the check dams will ensure that any degradation can be remedied. Conditions expected to require attention will be rotting and disintegration of the bales and 'melting out' of the rebar anchors. Settled silt also will need to be cleaned out from above check dams periodically.

### 3.0 MONITORING REGIMEN AND TREATMENT IMPLEMENTATION PLAN

Appendix 3 of Water Use License QZ96-006 sets out the water quality monitoring schedule for the site (included in Appendix D). In the application for the Water License, Minto Explorations Ltd. submitted an Environmental Monitoring Plan (EMP), which included a Water Quality Monitoring Plan with the objective of ensuring that discharge quality as established in QZ06-006 is met. Appendix 3 instates a slightly more comprehensive surveillance program than that originally proposed in the EMP. The reported results from Site W-3 (the water license point of compliance prior to the construction of the main tailings dam) of the monitoring events will be compared with the discharge standards established in Part E – *Effluent Quality Standards* of WL QZ96-006 to assess compliance. The discharge standards are shown below:

<u>Parameter</u>	<u>Concentration</u>
pH .....	6.5 to 9.0 pH units
Suspended solids .....	15 mg/l
Aluminum (total) .....	0.5
Iron (total) .....	1.0 mg/l
Copper (total) .....	0.01 mg/l
Lead (total) .....	0.002 mg/l
Manganese (total) .....	0.2 mg/l
Nickel (total) .....	0.065 mg/l
Zinc (total) .....	0.03 mg/l
total Ammonia .....	1.0 mg/l
Oil and grease .....	no visible oil or grease
Toxicity (LT <sub>50</sub> ) .....	100% (pH non-adjusted) *

The primary parameters of concern, based dually on historical water quality data in Minto Creek and on the proposed construction/development activities on site are total suspended solids and total copper, aluminum, iron, lead, zinc and manganese. The timing of the implementation of water treatment for metals and sediment control measures and their modifications if required will be guided by an on-site screening program, that is supplemental to the Appendix 3 requirements from QZ06-006. This screening program will include daily flow observations along with collection and on-site analysis of water samples for total copper (metals indicator) and suspended solids/turbidity at specific monitoring locations. Figures 4 display the proposed monitoring locations for the proposed location(s) for the WTP.



# Phase I Water Treatment Plant and Sediment Control Station Locations

## Legend

- Water Quality Station
- Contours
- Water Course
- Sediment Control Station
- Water Treatment Plant
- Glaciated Area
- Future Sediment Pond

Projection: UTM Zone 8 NAD83  
Units: Meters  
NTS: 105/11

### Figure 4

### Minto Mine Water Treatment Contingency Plan

Client:

Prepared By:

Drawn by: HD	Checked by: SK/RM
Date: March 2006	
Our File: D:\Project\AllProjects\Minto\gis\mxd\H20TreatPlan\Mar06\Fig4_Phase1.mxd	

Screening will be conducted using a Hach Model DR/890 Portable Colorimeter. Table 2 outlines the instrument specifications related to the discharge screening requirements.

**Table 2. Hach DR/890 Colorimeter Specifications**

Parameter	Instrument Range	License Discharge Standard
<b><i>Total Copper</i></b>	0 - 0.210 mg/L	0.010 mg/L
<b><i>Suspended Solids</i></b>	0 - 750 mg/L	15 mg/L
<b><i>Turbidity</i></b>	0 - 1000 FAU	n/a

The treatment implementation plan is discussed in detail below in parameter-specific sections. The order of progression of the Phase I site development activities and the construction schedule has not been finalized as of the writing of this plan, but both the system design and contingency planning for the implementation of water treatment and sediment control on the site are flexible to allow for adaptive management of site water treatment as the development of the site progresses.

### **3.1 Total Suspended Solids**

The suspended sediment load in Minto Creek is anticipated to be naturally elevated above discharge standards upon initial thaw and during spring freshet in 2006, as evidenced by past monitoring events. As such, the contingency water treatment plan for suspended solids will be deployed stepwise, beginning immediately under frozen ground conditions, prior to any site development activities, in anticipation of high sediment loads. Recent observations of Minto Creek (March 2006) revealed zero flow at all stations with full freezing of the creek all the way to the creek bed. This situation is due in part to the very low snow cover this winter and the subsequent lack of insular capacity.

Recent and historic observations have identified a significant area of glaciation that overtops the mine access road just east of the present camp area. It is expected that this flow has the potential to contribute significantly to the suspended sediment load in Minto Creek, although historic water quality comparisons between upstream (W-9 and W-1) and downstream (W-3) sites are inconclusive as to the contribution of this flow.

The re-direction of this flow through the existing culvert and back into the subsequent channel downslope of the access road will be initiated immediately using steam-powered ice thawing equipment and possibly an excavator on site.

Check dams and flocculant blocks will be established as treatment and interim retention stations before thaw leads to any flow in Minto Creek. This will require the removal, by hand, of sections of ice to the streambed and the placement of straw bale and geotextile check dams as described in Section 2.0. This will be accomplished by hand methods to ensure that there is no disturbance of the vegetative mat on the stream banks. Similar ice removal will take place approximately 15m upstream of each check dam for the placement of wire cages containing the slow release anionic polymer flocculant blocks. These installations will be shallow (only bottom of cages submerged) initially and monitored/maintained until glaciation potential has subsided and thaw progresses, whereby they may be lowered or raised as required depending on Minto Creek stage.

Daily monitoring of the progression of the thaw and associated flow in Minto Creek will be conducted at Site W-3, and any flow will be subjected to onsite screening analysis to assess the efficacy of the sediment control measures. The monitoring program will be supervised by ACG. Daily analytical results will be recorded and compared with discharge standards and alteration of the sediment control features may be required based on the analytical results/trends. This may include additional sediment control installations at various locations based on runoff patterns, or the reconfiguration of initial installations. Site operators will conduct maintenance and replacement of the flocculant block installations accordingly.

One of the primary construction activities during Phase I will be the establishment of the Main Water Dam. The primary sediment control station will provide sediment settling capacity for this key construction effort and is expected to be retained and upgraded after dam construction as a tertiary settlement facility (seepage control pond). Other sediment control stations upstream can be removed as well if the main water pond levels rise, but the furthest upstream station should be maintained as a component of the metals treatment system.

### **3.2     *Total Metals***

A number of background metal concentrations in Minto Creek, based on past monitoring, may also be naturally elevated above water license discharge standards upon initial thaw in 2006. This also requires that the contingency water treatment plan for total aqueous metals be operational and ready for possible deployment at the first indication of flow in Minto Creek.

During Phase I Site Development, surface water pH adjustment - if required in response to screening analysis - will be applied directly to Minto Creek at a location just upstream of water quality Site W-1 (Figure 4.) Upon the construction of the containment coffer for the primary settling pond/mill pond, the WTP will be in an upstream position relative to the primary settling area, which will provide retention time for the settling of metal hydroxide precipitates.

Further site and pit development will require the redirection of Minto Creek into a channel that flanks the pit development upstream of the first sediment pond (Figure 4.) The initial placement of the WTP will be such that these redirection activities will be solely upstream of the treatment site, and relocation of the WTP will not be required.

## 4.0 CLOSURE

This plan has been prepared in accordance with Section 43 of Water Use License QZ-06-006, in accordance with normal scientific and engineering principles.

Please contact the undersigned if you have any questions at (867) 668-6463.

Respectfully Submitted,

**ACCESS CONSULTING GROUP**

A Registered Trade Name for Access Mining Consultants Ltd.

Prepared by:



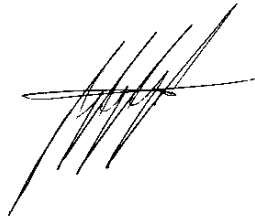
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**Scott Keeseey, B.Sc. CEPIT**

*Environmental Scientist*

*Certified Environmental Practitioner-in-Training*

Reviewed by:



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**Robert L. McIntyre, R.E.T., CCEP**

*Registered Engineering Technologist (Geology),*

*Certified Canadian Environmental Practitioner*



## **APPENDIX A**

HALLAM KNIGHT PIESOD (HKP) CONTINGENCY PLAN LETTER

FEBRUARY 3, 1997





***Hallam Knight Piésold Ltd.***  
ENVIRONMENTAL CONSULTANTS

February 3, 1997

YOUR REFERENCE  
OUR REFERENCE  
NUMBER

H3021

Klingmann--28/97

Mr. H. Lutz Klingmann  
MINTO EXPLORATIONS LTD.  
6411 Imperial Avenue  
West Vancouver, B.C.  
V7W 2J5

Dear Mr. Klingmann;

**Re: Minto Project  
Contingency Plan for Copper in Surface Runoff and Tailings Supernatant**

While there are no data for the Minto Project, or, to my knowledge, from other porphyry copper flotation projects of a similar nature, that would support the contention that copper levels will be significantly different than projected, we understand that the regulatory agencies in the Yukon have requested that Minto Explorations present contingency plans in the event that copper levels are higher than projected. This letter outlines contingency treatment measures for removal of copper in mine runoff water, and is based on the definition of "Best Practicable Treatment Technology" which forms the basis for the legislation which the Minto Project is subject to: the federal "Metal Mining Liquid Effluent Regulations."

Based on the information presented in the IEE and the January 1996 Water License Application, the tailings supernatant from the Minto operations are expected to contain approximately 0.004 mg/L copper on an average basis. During the period of minimum dilution (September, under average conditions), this will be discharged at a rate of 0.018 m<sup>3</sup>/s into Minto Creek. Minto Creek has a September flow of 0.037 m<sup>3</sup>/s and contains an average of 0.019 mg/L copper. On the basis of metallurgical tests, the level of copper in the supernatant is projected to be well below that in Minto Creek, and on the basis of water quality modelling, the supernatant is projected to have a diluting effect on the naturally high baseline copper concentrations in the creek.

Runoff from the waste rock dumps and low grade ore storage area drain to the open pit and then to the mill water pond, and may contribute minor copper loadings to the system (refer to letter Klingmann--27/97, dated January 31, 1996). Consequently the two potential sources of copper entering the tailings supernatant would be from the open pit runoff or from the mill circuit. It is not expected that a treatment facility will be necessary to remove copper, as natural background levels are relatively high, the ore body is non-acid generating, the host rock is alkaline, the operations will be run at a natural pH and the overall flow of Minto Creek will not be altered significantly.



However, should copper concentrations in water from the open pit or from the mill circuit be higher than anticipated, and high enough to create an adverse impact to the receiving environment, a range of treatment systems, depending on the source and volume of effluent, could be applied to reduce the copper concentrations.

The "Best Practicable Treatment Technology" consists of raising the pH with either lime or sodium hydroxide and precipitating dissolved copper as copper hydroxide. Note that the simplest hydroxide formed,  $\text{Cu}(\text{OH})_2$ , is relatively insoluble ( $K_{sp} = 2 \times 10^{-19}$ ) and forms best at pH 9.5. The resulting effluent under optimum conditions would be expected to contain between 0.001 to 0.01 mg/L copper (See attached Figures 1 through 4, for solubility curves for iron, copper, zinc and lead hydroxides). Note also that the projected copper concentrations in supernatant at Minto's natural operating pH of 7.5 (0.004 mg/L) falls well within this range of expected values.

Because it is uncertain that there will be high copper levels, and because there are two primary potential sources of elevated copper, we recommend the following phased approach as a Contingency Plan:

- operations should include for a skid mounted treatment system (insulated) that will house 4 barrels of sodium hydroxide (or the equivalent in lime), an adjustable reagent addition system and power connection;
- monitoring of the tailings thickener overflow and the open pit dewatering inflow to the mill water pond for potentially higher-than-expected copper concentrations;
- if high copper levels are encountered, sodium hydroxide can be added directly to the appropriate discharge stream to adjust the pH to approximately 9.5, as an interim or periodic measure;
- if high copper levels are persistent, a system could then be designed and set up to intercept water from either open pit runoff or from the mill circuit (or both, if necessary) and routed through a simple lime or sodium hydroxide precipitation plant;
- the plant would consist of a reagent storage tower (tank), a mixing tank and a primary settling pond, to allow for additional reaction time and for the precipitates to settle, if the mill water pond was not sufficiently quiescent, and
- assuming copper in solution is the element of concern, lime or sodium hydroxide should be added to achieve a pH of approximately 9.5.

If the primary source of additional copper is from the open pit, it would likely be most efficient to treat the relatively small flow from this source (approximately  $0.005 \text{ m}^3/\text{s}$ ) and then let it flow into the mill water pond for recirculation through the mill and discharge to the main water storage pond at the base of the tailings facility. However, if the mill circuit is the primary source of copper (assuming all mill processes have been optimized for copper extraction), it might be more efficient to treat the water as it leaves



the mill storage pond (where the flow rate is up to approximately  $0.040 \text{ m}^3/\text{s}$  during peak discharge in July), rather than the tailings thickener overflow. This would depend on the level of suspended solids in the thickener overflow, which would decrease the efficiency of the treatment system by consuming higher levels of reagents.

With such low flows, other metals removal systems may also be appropriate, and possibly more cost effective, if longer term treatment is required. These options might include systems such as industrial anaerobic or reverse osmotic water treatment systems, and should be considered if prolonged treatment becomes necessary.

If a lime or sodium hydroxide treatment plant is necessary, the primary settling pond would likely have to be lined to prevent metals release and to provide for encapsulation of the precipitates at mine closure, if appropriate. The precipitates would likely have to be characterized and tested to ensure that they would not qualify as a hazardous waste at that time. If encapsulation is either not appropriate or not acceptable to regulatory authorities at that time, the precipitates may have to be removed from the site during decommissioning of the mine.

I trust this addresses your current needs. Please do not hesitate to call Bob or me if you have any questions or require additional information.

Yours truly,

**HALLAM KNIGHT PIÉSOLD LTD.**

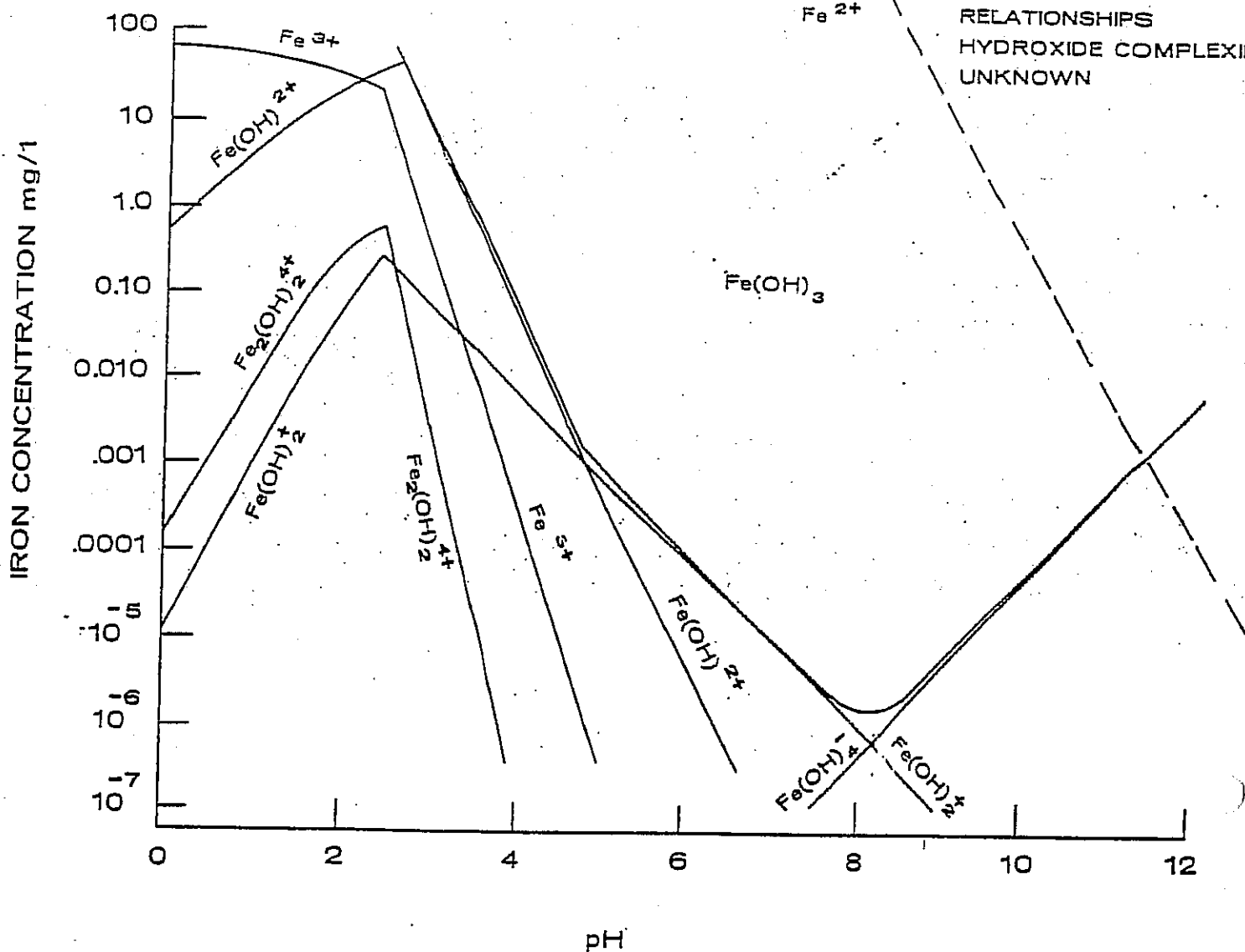
per: **Brian A. Soregaroli**  
Project Chemist

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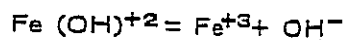
QZ96-006

FYHIRT 1 2 12

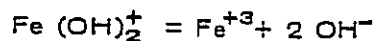
SUPERIMPOSED FROM  
SOLUBILITY PRODUCT  
RELATIONSHIPS  
HYDROXIDE COMPLEXING  
UNKNOWN



# REACTIONS:



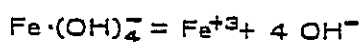
$$K = 1.5 \times 10^{-12}$$



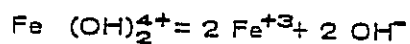
$$K = 5.6 \times 10^{-22}$$



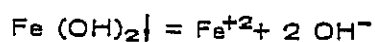
$$K_{sp} = 10^{-38}$$



$$K = 10^{-33}$$



$$K = 7 \times 10^{-28}$$



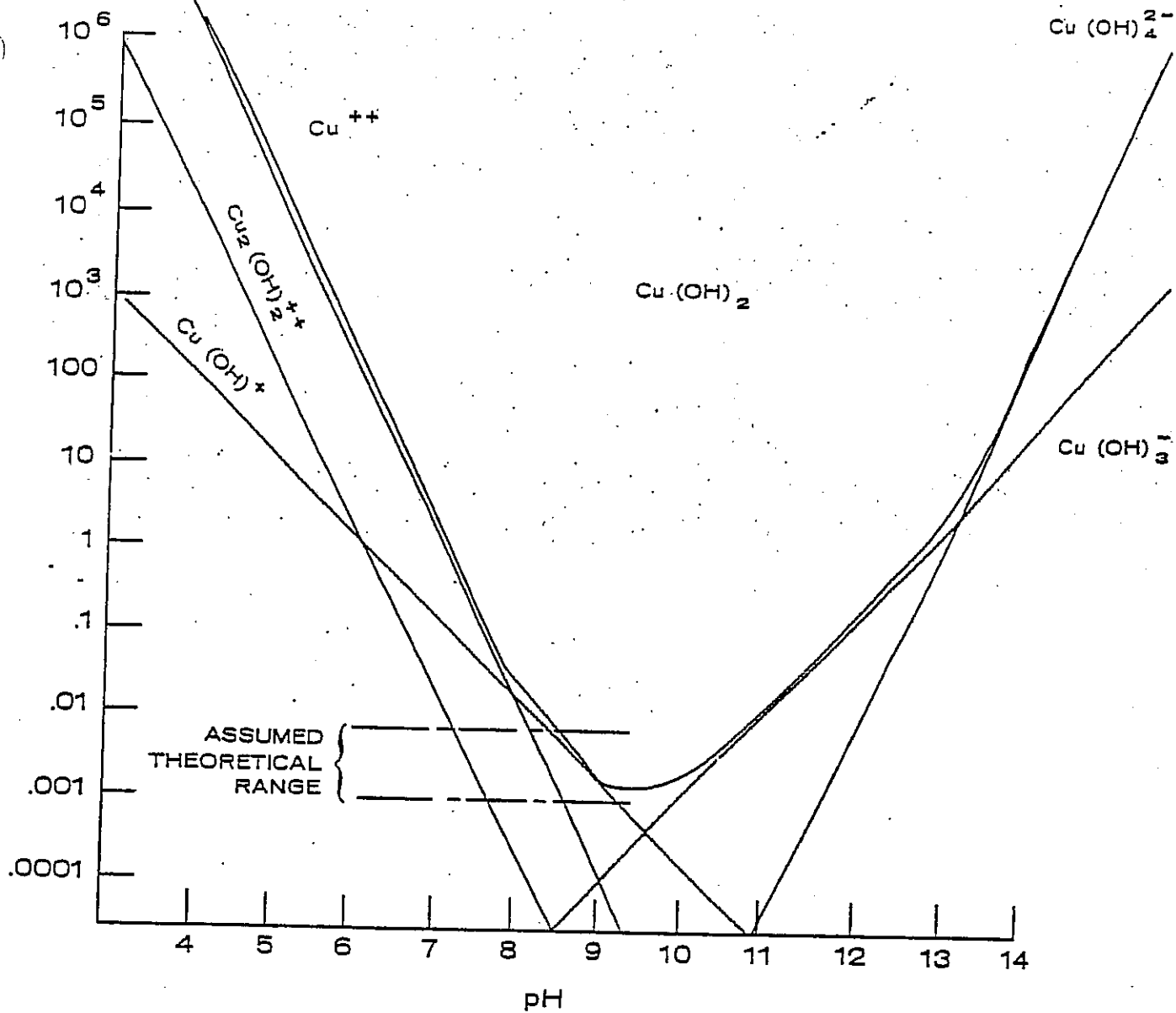
$$K_{sp} = 3.2 \times 10^{-14}$$

Figure 1. Iron Solubility (3)

QZ96-006

EXHIBIT 1.2.13

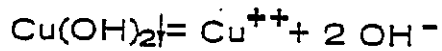
COPPER CONCENTRATION mg/l



## REACTIONS:



$$K = 10^{-6}$$



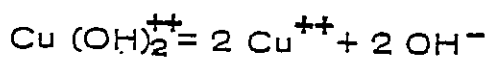
$$K_{sp} = 2 \times 10^{-19}$$



$$K = 6.2 \times 10^{-16}$$



$$K = 7.7 \times 10^{-17}$$

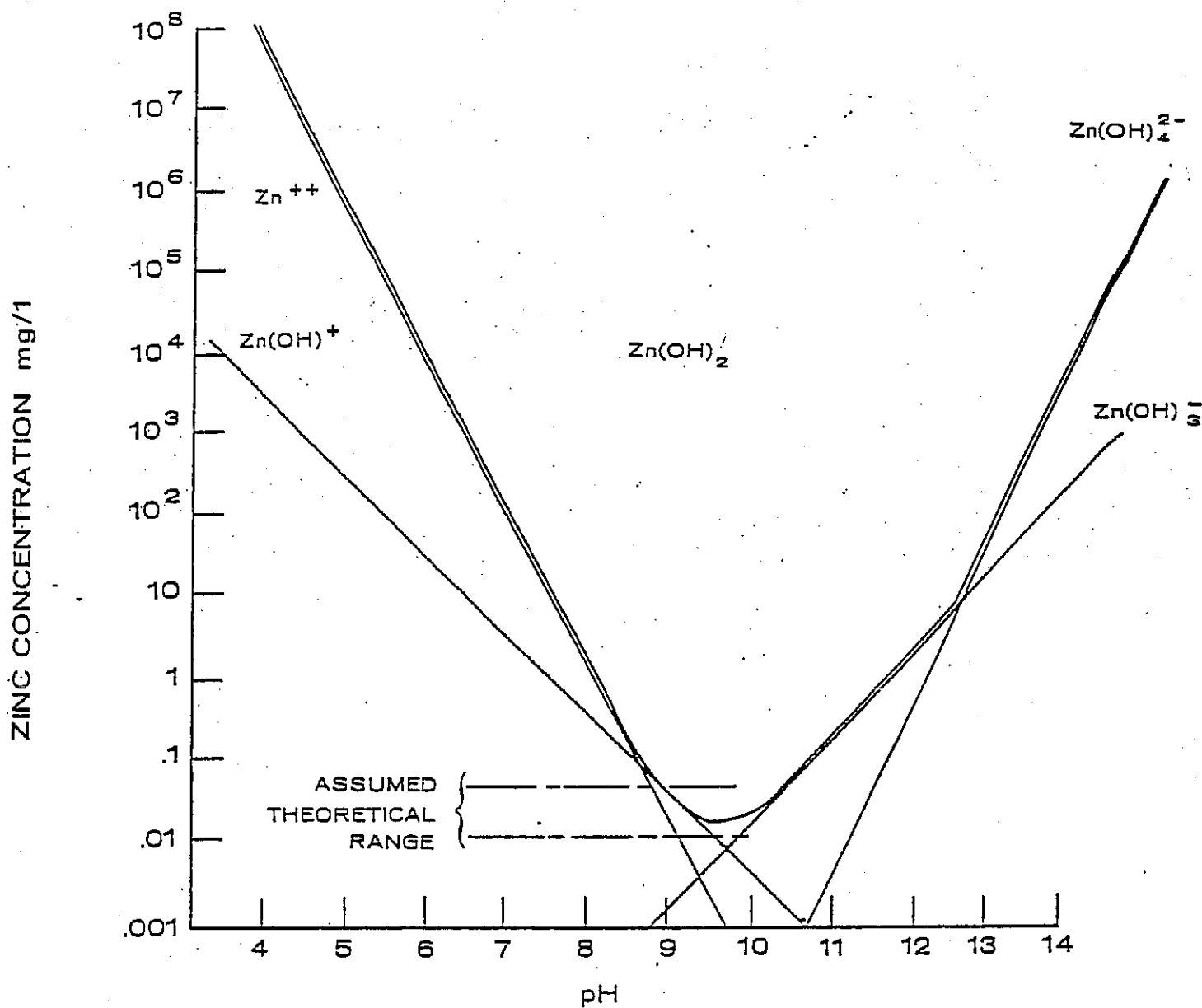


$$K = 10^{-17}$$

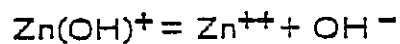
Figure 2. Copper Solubility(3)

QZ96-006

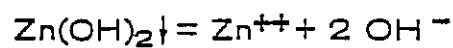
EXHIBIT 1.2.12



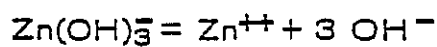
REACTIONS:



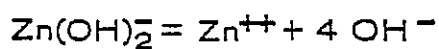
$$K = 9.1 \times 10^{-6}$$



$$K_{sp} = 4.5 \times 10^{-17}$$



$$K = 1.75 \times 10^{-14}$$

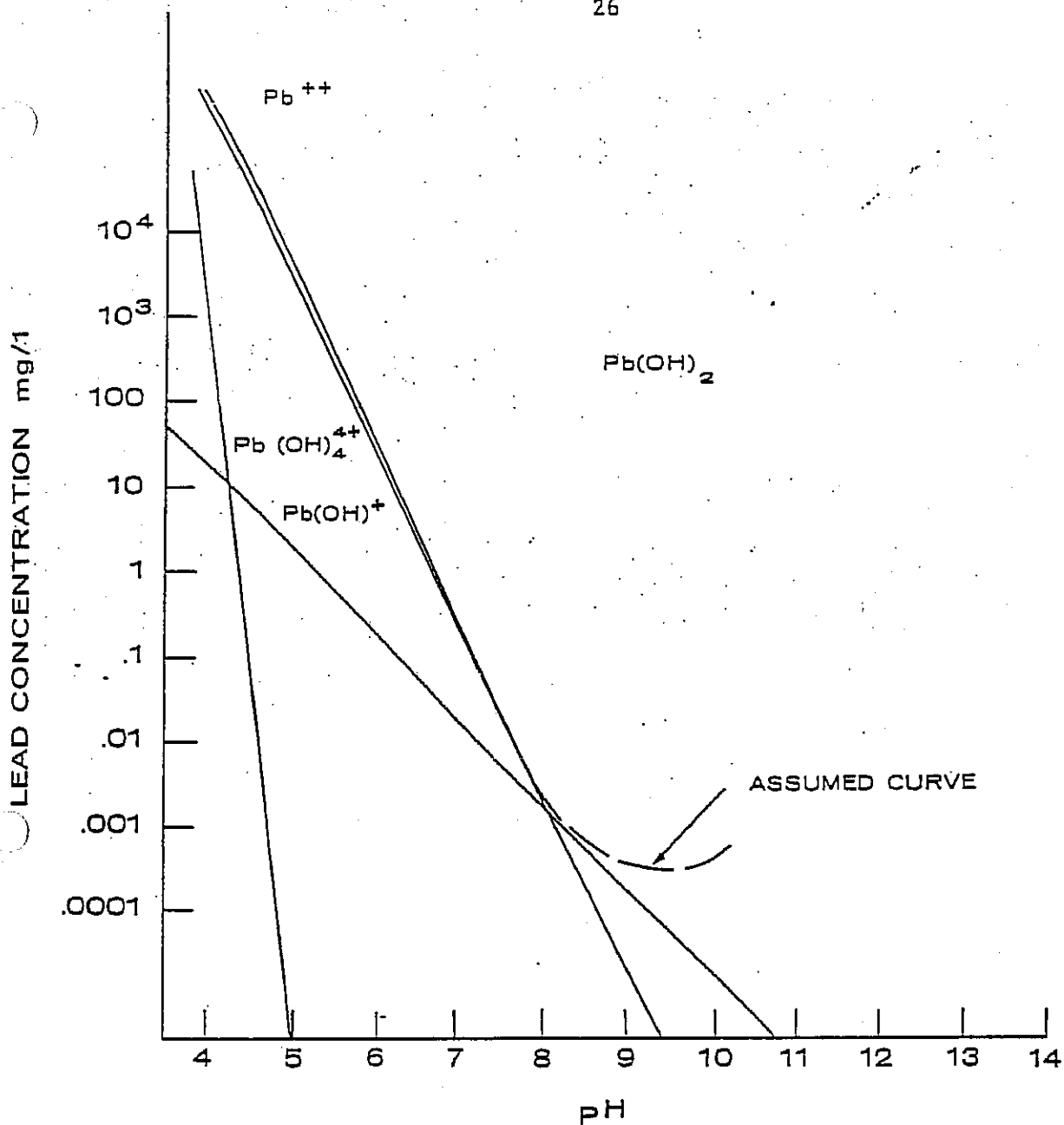


$$K = 8 \times 10^{-16}$$

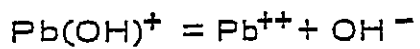
Figure 3. Zinc Solubility (3)

QZ96-006

EXHIBIT 1-2-13



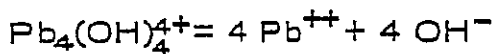
REACTIONS:



$$K = 1 \times 10^{-6}$$



$$K_{sp} = 1.1 \times 10^{-20}$$



$$K = 1.8 \times 10^{-37}$$

Figure 4. Lead Solubility (3)

QZ96-006  
EXHIBIT 1.2.13

## **APPENDIX B**

### **MSDS SHEETS**

### **WATER TREATMENT AND SEDIMENT CONTROL MATERIALS**



# Sodium Hydroxide

## MSDS Sheet

### \* SECTION 1. CHEMICAL IDENTIFICATION\*

CHEMINFO Record Number: 5  
CCOHS Chemical Name: Sodium hydroxide solutions of 50% or less  
  
Chemical Name French: Hydroxyde de sodium  
Chemical Name Spanish: Hidróxido de sodio  
  
CAS Registry Number: 1310-73-2  
UN/NA Number(s): 1824  
RTECS Number(s): WB4900000  
EU EINECS/ELINCS Number: 215-185-5  
Chemical Family: Sodium and compounds / inorganic sodium compound / alkali metal hydroxide  
Molecular Formula: H-Na-O  
Structural Formula: NaOH

#### Status of Record:

The CHEMINFO record for this chemical is complete. The full format provides a detailed evaluation of health, fire and reactivity hazards, as well as recommendations on topics such as handling and storage, personal protective equipment, accidental release and first aid.

### \* SECTION 2. DESCRIPTION\*

#### Appearance and Odour:

White, odourless, non-volatile, clear solution.(3,21,25)

#### Odour Threshold:

Odourless (3)

#### Warning Properties:

POOR - sodium hydroxide has no odour.

#### Composition/Purity:

Sodium hydroxide solutions are generally available in concentrations of 50% or less. More concentrated solutions (70% and higher) are not commonly available. The CHEMINFO review provides information on the hazards and control measures for sodium hydroxide solutions of 50% or less. For information on solid sodium hydroxide (which is available as cakes, flakes or beads), refer to the CHEMINFO review of sodium hydroxide solid. The major impurities in sodium hydroxide include sodium chloride, sodium carbonate, sodium sulfate, sodium chlorate, potassium and heavy metals such as iron and nickel.(25,35)

#### Uses and Occurrences:

The main uses of sodium hydroxide are in chemical manufacturing (pH

control, acid neutralization, off-gas scrubbing and catalyst); pulp and paper manufacturing; in petroleum and natural gas industry (removing acidic contaminants in oil and gas processing); manufacture of soap and detergents and other cleaning products; and cellulosics, such as rayon, cellophane and cellulose ethers; cotton mercerizing and scouring. Other uses include water treatment, food processing, flue-gas scrubbing, mining, glass making, textile processing, refining vegetable oils, rubber reclamation, metal processing, aluminum processing, metal degreasing, adhesive preparations, paint remover, disinfectant, rubber latex stabilizer and stabilization of sodium hypochlorite.(25,35)

### \* SECTION 3. HAZARDS IDENTIFICATION\*

#### EMERGENCY OVERVIEW:

White, odourless, non-volatile solution. Will not burn. Highly reactive. Can react violently with water and numerous commonly encountered materials, generating enough heat to ignite nearby combustible materials. Contact with many organic and inorganic chemicals may cause fire or explosion. Reaction with metals releases flammable hydrogen gas. EXTREMELY CORROSIVE. Can cause blindness, permanent scarring and death. Aerosols can cause lung injury--effects may be delayed.

#### \*POTENTIAL HEALTH EFFECTS\*

##### Effects of Short-Term (Acute) Exposure

##### Inhalation:

Sodium hydroxide does not readily form a vapour and inhalation exposure is only likely to occur to aerosols. Three case reports suggest that sodium hydroxide aerosols may cause severe irritation of the respiratory tract. In one case, permanent lung injury resulted. Due to its corrosive nature, sodium hydroxide aerosols could cause pulmonary edema (severe, life- threatening lung injury). The development of pulmonary edema may be delayed up to 48 hours after exposure. The early symptoms of pulmonary edema include shortness of breath and a tightness in the chest.

A worker, exposed to hot mists of sodium hydroxide in a confined space, experienced tightness of chest, dyspnea (difficult breathing) and cough during each exposure. The symptoms resolved when exposure stopped.(32) Irreversible obstructive lung disease resulted when an individual applied about 5 L of a 5% sodium hydroxide solution with a brush in a small room with very limited ventilation.(33) Severe lung injury occurred in a man who inhaled in an aerosol given off when water was poured on sodium hydroxide pellets.(18)

##### Skin Contact:

Sodium hydroxide is extremely corrosive and is capable of causing severe burns with deep ulceration and permanent scarring. It can penetrate to deeper layers of skin and corrosion will continue until removed. The severity of injury depends on the concentration of the solution and the duration of exposure. Burns may not be immediately painful; onset of pain may be delayed minutes to hours. Several human studies and case reports describe the corrosive effects of sodium hydroxide. A 4% solution of sodium hydroxide, applied to a volunteer's arm for 15 to 180 minutes, caused damage which progressed from destruction of cells of the hard outer layer of the skin within 15 minutes to total destruction of all layers of the skin in 60 minutes.(6) Solutions as weak as 0.12% have damaged healthy skin within 1 hour.(5) Sodium hydroxide dissolved the hair and caused reversible baldness and scalp burns when a concentrated solution (pH = 13.5) dripped onto a worker's head and treatment was delayed for several hours.(7)

#### Eye Contact:

Sodium hydroxide is extremely corrosive. The severity of injury increases with the concentration of the solution, the duration of exposure, and the speed of penetration into the eye. Damage can range from severe irritation and mild scarring to blistering, disintegration, ulceration, severe scarring and clouding. Conditions which affect vision such as glaucoma and cataracts are possible late developments. In severe cases, there is progressive ulceration and clouding of eye tissue which may lead to permanent blindness.(8,9,10,11)

#### Ingestion:

There are no reported cases of industrial workers ingesting sodium hydroxide solutions. Non-occupational ingestion has produced severe corrosive burns to the esophageal tissue, which has in some cases progressed to stricture formation. Should ingestion occur, severe pain; burning of the mouth, throat and esophagus; vomiting; diarrhea; collapse and possible death may result.

#### Effects of Long-Term (Chronic) Exposure

##### Lungs/Respiratory System:

A worker, exposed for 2 hours daily over 20 years to mists from boiling a solution of sodium hydroxide in 2 large containers in a small room with inadequate ventilation, developed severe obstructive airway disease. It was concluded that the massive and prolonged exposure induced irritation and burns to the respiratory system eventually leading to the disease. The authors noted that chronic exposure had not previously been reported, probably since the strong and immediate irritation would normally deter workers from further exposure.(32) Actual exposures to sodium hydroxide aerosols were not measured and the authors could not definitely exclude late onset asthma as a cause of the man's condition.

##### Skin:

Owing to its corrosive nature, repeated or prolonged skin contact would be expected to cause drying, cracking, and inflammation of the skin (dermatitis).

##### OTHER:

A report of workers exposed to sodium hydroxide aerosol for at least

16 months, was confounded by the presence of high concentrations of Stoddard solvent and other solvent vapours, as well as other chemicals.(2,4)

There was no trend of increased mortality in relation to duration (up to 30 years) or intensity of exposure (0.5 mg/m<sup>3</sup> to 1.5 mg/m<sup>3</sup>) among 291 workers exposed to sodium hydroxide dust during the production of flakes or beads of concentrated sodium hydroxide from chlorine cell effluent.(12) This study is limited by the small population size.

#### Carcinogenicity:

Sodium hydroxide has been implicated as a cause of cancer of the esophagus in individuals who have ingested it. The cancer may develop 12 to 42 years after the ingestion incident. Similar cancers have been observed at the sites of severe thermal burns. These cancers may be due to tissue destruction and scar formation rather than the sodium hydroxide itself.(15,16,17)

A case-control study reported an association between renal cancer and history of employment in the cell maintenance area of chlorine production. The major exposures in this work were presumed to be to asbestos and sodium hydroxide. An association was made between renal cancer and sodium hydroxide exposure.(34) This study is limited by factors such as small numbers of exposed workers, multiple exposures, reliance on work histories and is not considered sufficiently reliable.

The International Agency for Research on Cancer (IARC) has not evaluated the carcinogenicity of this chemical.

The American Conference of Governmental Industrial Hygienists (ACGIH) has not assigned a carcinogenicity designation to this chemical.

The US National Toxicology Program (NTP) has not listed this chemical in its report on carcinogens.

#### Teratogenicity and Embryotoxicity:

There is no human or animal information available.

#### Reproductive Toxicity:

There is no human or animal information available.

#### Mutagenicity:

There are no reports of human or animal in vivo studies available. Short-term testing (in vitro and bacterial) suggests that sodium hydroxide is not mutagenic.

#### Toxicologically Synergistic Materials:

No information available.

#### Potential for Accumulation:

Does not accumulate.

#### \* SECTION 4. FIRST AID MEASURES\*

#### Inhalation:

Remove source of contamination or move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice. DO NOT allow victim to move about unnecessarily. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure. Immediately transport victim to an emergency care facility.

#### Skin Contact:

Avoid direct contact with this chemical. Wear chemical protective clothing, if necessary. As quickly as possible, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Flush contaminated area with lukewarm, gently flowing water for at least 60 minutes, by the clock. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Transport victim to an emergency care facility immediately. Discard contaminated clothing, shoes and leather goods.

#### Eye Contact:

Avoid direct contact. Wear chemical protective gloves, if necessary. Quickly and gently blot or brush away excess chemical. Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 60 minutes, by the clock, while holding the eyelid(s) open. Neutral saline solution may be used as soon as it is available. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Take care not to rinse contaminated water into the unaffected eye or onto the face. Quickly transport victim to an emergency care facility.

#### Ingestion:

NEVER give anything by mouth if victim is rapidly losing consciousness, is unconscious or convulsing. Have victim rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. Have victim drink 240 to 300 mL (8 to 10 oz.) of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, repeat administration of water. Quickly transport victim to an emergency care facility.

#### First Aid Comments:

Provide general supportive measures (comfort, warmth, rest). Consult a doctor and/or the nearest Poison Control Centre for all exposures except minor instances of inhalation contact.

Some recommendations in the above sections may be considered medical acts in some jurisdictions. These recommendations should be reviewed with a doctor and appropriate delegation of authority obtained, as required.

All first aid procedures should be periodically reviewed by a doctor familiar with the material and its conditions of use in the workplace.

Flash Point:

Not combustible (does not burn)

Lower Flammable (Explosive) Limit (LFL/LEL):

Not applicable

Upper Flammable (Explosive) Limit (UFL/UEL):

Not applicable

Autoignition (Ignition) Temperature:

Not applicable

Sensitivity to Mechanical Impact:

Not sensitive; stable material.

Sensitivity to Static Charge:

Not applicable. Not combustible.

Combustion and Thermal Decomposition Products:

Sodium oxide fumes can be generated by thermal decomposition at elevated temperatures.(25)

Fire Hazard Summary:

Sodium hydroxide solutions will not burn or support combustion. However, reaction of sodium hydroxide with water and a number of commonly encountered materials (see Chemical Reactivity) can generate sufficient heat to ignite nearby combustible materials. Sodium hydroxide can react with metals, such as aluminum, tin and zinc, to form flammable hydrogen gas.

Extinguishing Media:

Use extinguishing media suitable for the surrounding fire. If water is used, care should be taken, since it can generate heat and cause spattering if applied directly to sodium hydroxide.

Fire Fighting Instructions:

Evacuate area and fight fire from a safe distance or a protected location. Approach fire from upwind. If possible, isolate materials not involved in the fire and protect personnel. Move containers from fire area if it can be done without risk. Water can be used with extreme caution to extinguish a fire in an area where sodium hydroxide is stored. The water must not come into contact with the sodium hydroxide. Water can be used in flooding quantities as a spray or fog to keep fire-exposed containers cool and absorb heat. At high temperatures, fuming may occur, giving off a strong, corrosive gas. Do not enter without wearing specialized protective equipment suitable for the situation. Firefighter's normal protective clothing (Bunker Gear) will not provide adequate protection. Chemical resistant clothing (e.g. chemical splash suit) and positive pressure self-contained breathing apparatus (MSHA/NIOSH approved or equivalent) may be necessary.

\*NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) HAZARD IDENTIFICATION\*

NFPA - Health: 3 - Short exposure could cause serious temporary or residual injury.  
NFPA - Flammability: 0 - Will not burn under typical fire conditions.  
NFPA - Instability: 1 - Normally stable, but can become unstable at elevated temperatures and pressures, or may react vigorously, but non-violently with water.

\* SECTION 6. ACCIDENTAL RELEASE MEASURES\*

Spill Precautions:

Restrict access to area. Provide adequate protective equipment and ventilation.  
Remove chemicals which can react with the spilled material.  
Notify occupational health and safety and environmental authorities.

Clean-up:

Contain spill or leak. Prevent material from entering sewers or waterways. Spilled solutions should be contained by diking with inert material, such as sand or earth. Solutions can be recovered or carefully diluted with water and cautiously neutralized with acids such as acetic acid or hydrochloric acid.  
Large spills: contact fire and emergency services and supplier for advice.

\* SECTION 7. HANDLING AND STORAGE\*

Handling:

This material is EXTREMELY CORROSIVE and HIGHLY REACTIVE. Before handling, it is important that engineering controls are operating and that protective equipment requirements and personal hygiene measures are being followed. People working with this chemical should be properly trained regarding its hazards and its safe use. Use the smallest possible amounts in a designated area separate from the storage area with adequate ventilation. Immediately report leaks, spills or failures of the engineering controls. Inspect containers for damage or leaks before handling. Use the type of containers recommended by the manufacturer.  
Unprotected persons should avoid all contact with this chemical including contaminated equipment. Do not use with incompatible materials such as strong acids, nitroaromatic, nitroparaffinic or organohalogen compounds and metals such as aluminum, zinc and tin. See Incompatibilities - Materials to Avoid section for more information. Protect from unintentional contact with water. Never add water to a corrosive. Always add corrosives to water. When

mixing with water, stir in small amounts slowly. Use cold water to prevent excessive heat generation. Avoid generating mist. Use corrosion-resistant transfer equipment when dispensing. Never transfer liquid by pressurizing original container with air or inert gas. Cautiously dispense into sturdy containers made of compatible materials. Never return contaminated material to its original container. Immediately contact the chemical supplier/manufacturer for handling instructions if drums of caustic appear to be swollen. Label containers. Keep containers closed when not in use. Empty containers may contain residues which are hazardous. Have emergency equipment (for fires, spills, leaks, etc.) readily available. Follow the handling precautions on Material Safety Data Sheet. Practice good housekeeping. Maintain handling equipment. Comply with applicable regulations.

#### Storage:

Store in a cool, dry, well-ventilated area. Keep quantity stored as small as possible. Restrict access to storage area. Post warning signs when appropriate. Keep storage area separate from populated work areas. Inspect periodically for deficiencies such as damage or leaks.

Store away from incompatible materials such as strong acids, nitroaromatic, nitroparaffinic or organohalogen compounds. Protect from contact with water. See Incompatibilities - Materials to Avoid section for more information. Keep empty containers in separate storage area. Empty containers may contain hazardous residues. Keep closed.

Inspect all incoming containers to make sure they are properly labelled and not damaged. Always store in original labelled container, or in the type of container recommended by the manufacturer/supplier. Protect the label and keep it visible. Keep containers tightly closed when not in use and when empty. Protect from damage.

Storage area should be clearly identified, clear of obstruction and accessible only to trained and authorized personnel. Keep storage area separate from work areas. Post warning signs. Inspect periodically for damage or leaks. Floors should be watertight and without cracks.

Have appropriate fire extinguishers and spill clean-up equipment in storage area. Follow any special instructions for storage on Material Safety Data Sheet (e.g. maximum storage quantities). Use corrosion-resistant structural materials and lighting and ventilation systems in the storage area.

Containers made of nickel alloys are preferred. Steel containers are acceptable if temperatures are not elevated. Storage tanks should be above ground and surrounded with dikes capable of holding entire contents.

Contain spills or leaks by storing in trays made from compatible materials. Keep absorbents for leaks and spills readily available. Provide raised sills or ramps at doorways or create a trench which drains to a safe location.

Container contents may develop pressure after prolonged storage. Drums may need to be vented. Venting should only be performed by trained personnel. Follow supplier/manufacturer recommendations. If drums are swollen, contact the manufacturer/supplier immediately for assistance. Handling swollen drums requires special procedures and



equipment.

## \* SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION\*

NOTE: Exposure to this material can be controlled in many ways. The measures appropriate for a particular worksite depend on how this material is used and on the extent of exposure. This general information can be used to help develop specific control measures. Ensure that control systems are properly designed and maintained. Comply with occupational, environmental, fire, and other applicable regulations.

### Sampling and Analysis:

Use appropriate instrumentation and sampling strategy (location, timing, duration, frequency, and number of samples). Interpretation of the sampling results is related to these variables and the analytical method. Sampling should be carried out by trained personnel.

### OSHA Analytical Methods:

\*NOTE: The method described below has been reported for metal and metalloid particulates and may also be suitable for sodium hydroxide solutions. OSHA Method ID-121 - OSHA Analytical Methods Manual, 2nd ed. (39). Metal and Metalloid Particulates in Workplace Atmospheres (Atomic Absorption). Validated method. Collection on mixed cellulose ester membrane filter. Extraction with de-ionized water. Analysis by atomic absorption spectrophotometry or by atomic emission spectrophotometry. Detection limit: 0.009 ug/mL (analytical) and 0.0002 ug/mL (qualitative).

### NIOSH Analytical Methods:

NOTE: The method described below has been reported for alkaline dusts including sodium hydroxide solutions. NIOSH METHOD 7401, Issue 2 - NIOSH Manual of Analytical Methods. 4th ed. (40). Alkaline Dusts. Fully evaluated method. Collection on PTFE membrane filter. Extraction with 0.01N hydrochloric acid. Analysis by acid-base titration with 0.01N sodium hydroxide under nitrogen with endpoint by pH electrode. Estimated LOD: 0.03 mg per sample (as sodium hydroxide).

### Colorimetric Detector Tubes:

Not commercially available.

### Engineering Controls:

Engineering methods to control hazardous conditions are preferred. General methods include mechanical ventilation (dilution and local exhaust), process or personnel enclosure, control of process conditions and process modification (e.g., substitution of a less hazardous material). Administrative controls and personal protective equipment may also be required.

Use a corrosion-resistant ventilation system separate from other exhaust ventilation systems. Exhaust directly to the outside. Use local exhaust ventilation, and process enclosure if necessary, to control airborne dust and mist. Supply sufficient replacement air to make up for air removed by exhaust systems.

Personal Protective Equipment:

If engineering controls and work practices are not effective in controlling exposure to this material, then wear suitable personal protective equipment including approved respiratory protection. Have appropriate equipment available for use in emergencies such as spills or fire. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection. Refer to the CSA Standard Z94.4-93, "Selection, Use, and Care, of Respirators," available from the Canadian Standards Association, Rexdale, Ontario, M9W 1R3.

Respiratory Protection Guidelines:

NIOSH RECOMMENDATIONS FOR SODIUM HYDROXIDE CONCENTRATIONS IN AIR (3):

UP TO 10 mg/m<sup>3</sup>: SAR operated in a continuous-flow mode; or full-facepiece respirator with high-efficiency particulate filter(s); or powered air- purifying respirator with dust and mist filter(s); or full-facepiece SCBA; or full-facepiece SAR.

EMERGENCY OR PLANNED ENTRY INTO UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SCBA with an auxiliary positive pressure SCBA.

ESCAPE: Full-facepiece respirator with high-efficiency particulate filter(s); or escape-type SCBA.

NOTE: The IDLH concentration for sodium hydroxide is 10 mg/m<sup>3</sup>.

NOTE: The purpose of establishing an IDLH value is to ensure that the worker can escape from a given contaminated environment in the event of failure of the most protective respiratory protection equipment. In the event of failure of respiratory protective equipment every effort should be made to exit immediately.

NOTE: Substance causes eye irritation or damage; eye protection needed.

Air-purifying respirators do not protect against oxygen-deficient atmospheres.

ABBREVIATIONS: SAR = supplied-air respirator; SCBA = self-contained breathing apparatus. IDLH = Immediately Dangerous to Life or Health.

Recommendations apply only to NIOSH approved respirators.

Eye/Face Protection:

Chemical safety goggles. A face shield may also be necessary.

Skin Protection:

Chemical protective gloves, coveralls, boots and/or other resistant protective clothing.

Have a safety shower/eye-wash fountain readily available in the immediate work area.

Resistance of Materials for Protective Clothing:

Guidelines for sodium hydroxide solutions, 30-70% (22):  
RECOMMENDED (resistance to breakthrough longer than 8 hours): Butyl rubber, Natural rubber, Neoprene rubber, Nitrile rubber, Polyethylene, Polyvinyl chloride, Viton(TM), Viton(TM)/Butyl rubber, Barrier (PE/PA/PE), Silver Shield/4H(TM) (polyethylene/ethylene vinyl alcohol), Responder(TM), Trellchem(TM) HPS, Tychem(TM) BR/LV, Tychem(TM) SL, Tychem(TM) TK.  
NOT RECOMMENDED for use (resistance to breakthrough less than 1 hour): Polyvinyl alcohol.

Guidelines for sodium hydroxide, saturated solution (22):  
RECOMMENDED (resistance to breakthrough longer than 8 hours): Polyethylene, Tychem(TM) SL.

Guidelines for sodium hydroxide, above 70% (22):  
RECOMMENDED (resistance to breakthrough longer than 8 hours): Neoprene rubber, polyvinyl chloride, Trellchem(TM) HPS, Tychem(TM) BR/LV.

There is evidence that this material can cause serious skin injury (e.g., corrosion or absorption hazard).  
Recommendations are NOT valid for very thin natural rubber, neoprene, nitrile and pvc gloves (0.3 mm or less).  
Resistance of specific materials can vary from product to product. Breakthrough times are obtained under conditions of continuous contact, generally at room temperature. Evaluate resistance under conditions of use and maintain clothing carefully.

#### Personal Hygiene:

Remove contaminated clothing promptly. Keep contaminated clothing in closed containers. Discard or launder before rewearing. Inform laundry personnel of contaminant's hazards. Do not eat, drink or smoke in work areas. Wash hands thoroughly after handling this material. Maintain good housekeeping.

#### \*EXPOSURE GUIDELINES\*

THRESHOLD LIMIT VALUES (TLVs) / AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH) / 2003

Ceiling Exposure Limit (TLV-C): 2 mg/m<sup>3</sup>  
TLV Basis - Critical Effect(s): Irritation

#### TLV Comments:

NOTE: In many jurisdictions, exposure limits are similar to the ACGIH TLVs. Since the manner in which exposure limits are established, interpreted and implemented can vary, obtain detailed information from the appropriate government agency in each jurisdiction.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPGs) / AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA) / 2001

ERPG-1: 0.5 mg/m<sup>3</sup>  
ERPG-2: 5 mg/m<sup>3</sup>

ERPG-3: 50 mg/m3

The ERPG-1 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

The ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

PERMISSIBLE EXPOSURE LIMITS (PELs) / FINAL RULE LIMITS / US OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

Ceiling Exposure Limit (PEL-C): 2 mg/m3

NOTE: The OSHA PEL Final Rule Limits are currently non-enforceable due to a court decision. The OSHA PEL Transitional Limits are now in force.

PERMISSIBLE EXPOSURE LIMITS (PELs) / TRANSITIONAL LIMITS / US OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

Time-Weighted Average (PEL-TWA): 2 mg/m3

Transitional Limit PEL Comments:

These Permissible Exposure Limits are taken from 29 CFR 1910.1000 Table Z - 1.

#### \* SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES\*

Molecular Weight: 40.00

Conversion Factor:  
Not applicable

Melting Point: 12 deg C (53.6 deg F) (50% solution; freezing point) (25)

Boiling Point: 140 deg C (284 deg F) (50% solution) (25)

Relative Density (Specific Gravity): 1.53 (50% solution) (25)

Solubility in Water: Soluble in all proportions.

Solubility in Other Liquids: Soluble in all proportions in ethanol, methanol and glycerol

Coefficient of Oil/Water Distribution (Partition Coefficient):  
Essentially zero (25)

pH Value: 12 (0.05% solution) (25); 13 (0.5% solution) (25); 14 (5% solution) (25)

Vapour Density: Not applicable

Vapour Pressure: Not applicable

Saturation Vapour Concentration: 1980 ppm (0.2%) at 20 deg C (50%)

solution) (calculated)

Evaporation Rate: Not applicable

#### \* SECTION 10. STABILITY AND REACTIVITY\*

##### Stability:

Normally stable. Sodium hydroxide rapidly absorbs carbon dioxide from the air (forming sodium carbonate).(25)

##### Hazardous Polymerization:

Does not occur

##### Incompatibility - Materials to Avoid:

Sodium hydroxide reacts vigorously, violently or explosively with many organic and inorganic chemicals, such as strong acids, nitroaromatic, nitroparaffin and organohalogen compounds, glycols and organic peroxides.

Reacts violently with water generating significant heat, causing possible localized overheating and dangerously spattering corrosive sodium hydroxide.

Violently polymerizes acetaldehyde, acrolein or acrylonitrile.

Produces flammable and explosive hydrogen gas if it reacts with sodium tetrahydroborate or metals, such as aluminum, tin, or zinc.

Can form spontaneously flammable chemicals upon contact with 1,2-dichloroethylene, trichloroethylene or tetrachloroethane.

Can produce carbon monoxide upon contact with solutions of sugars, such as fructose, lactose and maltose.

References 21 and 36 provide more complete lists of chemicals that may react hazardously with sodium hydroxide.

##### Hazardous Decomposition Products:

None reported

##### Conditions to Avoid:

Water

##### Corrosivity to Metals:

Corrosive to aluminum, tin, zinc, copper, brass and bronze.

Corrosive to steel at elevated temperatures (above 40 deg C). Not corrosive to nickel.(35,37)

##### Stability and Reactivity Comments:

Slowly attacks glass at room temperature.(38)

#### \* SECTION 11. TOXICOLOGICAL INFORMATION\*

Standard animal toxicity values are not available.

##### Eye Irritation:

Sodium hydroxide has been extensively studied in animals because of its ability to cause severe injury to the eyes. Factors which determine the extent and reversibility of the injury include,

concentration of solution, the amount of sodium hydroxide which comes into contact with the tissue and the duration of contact. Effects can range from mild irritation to severe corrosion with tissue destruction, and may include blindness.(2,8,20) The following studies are typical of the research available for sodium hydroxide.

Application of a 1% solution of sodium hydroxide produced necrosis covering about 3/4 of the cornea, or a more severe necrosis covering a smaller area (a score of greater than 5.0 out of 10) in a standard Draize test with rabbits.(24)

#### Skin Irritation:

Sodium hydroxide has been extensively studied in animals because of its ability to cause severe injury to the skin. Factors which determine the extent and reversibility of the injury include, concentration of solution, the amount of sodium hydroxide which comes into contact with the tissue and the duration of contact. Effects can range from mild irritation to severe corrosion with tissue destruction, and may include permanent scarring and death.(2,8,20) The following studies are typical of the research available for sodium hydroxide.

Application of 0.5 mL of 5, 10, 15 and 30% solutions of sodium hydroxide produced severe necrosis in 6/6 rabbits in 4 hours. The 15 and 30% solutions produced severe ulcerative necrosis.(26)  
Application of 500 mg in a standard Draize test with rabbits produced severe damage to the skin in 24 hours.(19)

#### Effects of Short-Term (Acute) Exposure:

##### Inhalation:

In one experiment, male rats were exposed to aerosols composed of sodium hydroxide, sodium carbonate and their hydrated forms. Because sodium hydroxide reacts rapidly with carbon dioxide in air to form sodium carbonate which is less alkaline, the researchers maintained a high concentration of sodium hydroxide by humidifying the air at 85%; later they removed all carbon dioxide from the dilution air.(1) This experiment is not considered relevant because of the combined exposure and the extraordinary measures the researchers took to maintain the sodium hydroxide aerosol. The researchers stated that the chemical reaction between sodium hydroxide and carbon dioxide to form sodium carbonate is so predominant, especially in the respiratory tract, the toxicity of sodium carbonate may be the only factor worth considering". Other historical studies on sodium hydroxide aerosol exposures have also been criticized from this viewpoint.(4)

##### Ingestion:

Short-term oral exposure in animals has produced severe corrosive damage to the esophagus extending into surrounding tissues. In some cases, death has resulted. In some cases, esophageal strictures have subsequently developed in surviving animals.(27,28)

#### Effects of Long-Term (Chronic) Exposure:

#### Inhalation:

Rats were exposed to a finely dispersed aerosol of a 40% sodium hydroxide solution twice weekly for 30 minutes for 2.5 months.(14) In a similar study, 20 rats were exposed to an aerosol generated from a 5, 10, 20 or 40% sodium hydroxide solution, twice a week for 30 minutes for a month before and a month after exposure to quartz dust for 3 days.(13) The concentrations of sodium hydroxide aerosol achieved were not specified for either study. In addition, neither study took into account the reaction of sodium hydroxide with carbon dioxide in air and, in one study the results are also confounded by the quartz exposure. Therefore, no conclusions can be drawn.

### \* SECTION 12. ECOLOGICAL INFORMATION\*

NOTE : Inclusion of Ecological Information on an MSDS is optional under the US Hazard Communication Standard and the Canadian Controlled Products Regulations (WHMIS). In other jurisdictions, inclusion of Ecological Information may be a requirement. For specific requirements, contact the relevant regulatory authorities in the jurisdiction where the MSDS is intended to be used.

The American National Standard for Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation (ANSI 2400.1-1998) provides advice on data that could be included in this section, as well as ecotoxicological tests and issues.

Databases in CCOHS's CD-ROM and Web collection which contain useful Ecological Information include CESARS

<<http://www.ccohs.ca/products/databases/cesars.html>>, HSDB® (Hazardous Substances Data Bank)

<<http://www.ccohs.ca/products/databases/hsdb.html>> and CHRIS (Chemical Hazards Response Information System)

<<http://www.ccohs.ca/products/databases/chris.html>>.

### \* SECTION 13. DISPOSAL CONSIDERATIONS\*

Federal, provincial and local regulations should be reviewed prior to disposal. May be possible to neutralize, dilute and flush the material into a sewer. May be possible to atomize dilute solutions in an approved combustion chamber.

### \* SECTION 14. TRANSPORT INFORMATION\*

### \*CANADIAN TRANSPORTATION OF DANGEROUS GOODS (TDG) SHIPPING INFORMATION\*

Shipping Name and Description: SODIUM HYDROXIDE SOLUTION  
UN Number: UN1824

Class: 8

Packing Group/Risk Group: II  
Special Provisions: ---  
Passenger Carrying Road/Rail Limit: 1 kg or L  
Marine Pollutant: ---

Packing Group/Risk Group: III  
Special Provisions: ---  
Passenger Carrying Road/Rail Limit: 5 kg or L  
Marine Pollutant: ---

NOTE: This information incorporates the Transportation of Dangerous Goods Regulations SOR/2001-286, effective October 2003.

\*US DEPARTMENT OF TRANSPORT (DOT) HAZARDOUS MATERIALS SHIPPING INFORMATION (49 CFR)\*

Shipping Name and Description: SODIUM HYDROXIDE SOLUTION  
Hazard Class or Division: 8  
Identification Number: UN1824  
Packing Group: II III

NOTE: This information was taken from the US Code of Federal Regulations Title 49 - Transportation and is effective October 2003.

\* SECTION 15. REGULATORY INFORMATION\*

\*CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)\*

CCOHS WHMIS Classification:  
E - Corrosive material

E

WHMIS Health Effects Criteria Met by this Chemical:  
E - Corrosive to skin  
E - TDG class 8 - corrosive substance

WHMIS Ingredient Disclosure List:  
Included for disclosure at 1% or greater.

Detailed WHMIS Classification According to Criteria:

Class A - Compressed Gas:  
Does not meet criteria.

Class B - Flammable and Combustible Material:  
Does not meet criteria.  
Non- combustible (does not burn).



Class C - Oxidizing Material:

Does not meet criteria.

Class D - Poisonous and Infectious Material. Division 1 - Immediate and Serious Toxic Effects:

Insufficient information for classification.

Acute Lethality:

Insufficient information.

Class D - Poisonous and Infectious Material. Division 2 - Other Toxic Effects:

Does not meet criteria.

See detailed evaluation below.

Chronic Health Effects:

Insufficient information.

Carcinogenicity:

Does not meet criteria. Not included in standard reference lists.

Teratogenicity and Embryotoxicity:

Insufficient information.

Reproductive Toxicity:

Insufficient information.

Mutagenicity:

Insufficient information.

No in vivo studies reported.

Respiratory Tract Sensitization:

Does not meet criteria.

Not reported as human respiratory sensitizer.

Skin Irritation:

Corrosive materials are not also classified as irritants.

Eye Irritation:

Corrosive materials are not also classified as irritants.

Skin Sensitization:

Insufficient information.

Class E - Corrosive Material:

Meets criteria.

Corrosive to animal skin and aluminum; TDG Class 8

Class F - Dangerously Reactive Material:

Does not meet criteria.

\*US OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200)\*

OSHA Hazard Communication Evaluation:

Meets criteria for hazardous material, as defined by 29 CFR 1910.1200.

\*EUROPEAN UNION (EU) CLASSIFICATION AND LABELLING INFORMATION\*

EU Classification:

Corrosive. Causes severe burns. [C] (21)

EU Risk Phrases:

Causes severe burns [R35]

EU Safety Phrases:

Keep locked up and out of reach of children.\* In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable gloves. Wear eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). [S:(1/2-)\*26-37/39-45].

\*This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.

EU Comments:

CONCENTRATIONS LIMITS:

CONCENTRATION GREATER THAN OR EQUAL TO 5%: Corrosive. Causes severe burns. [C; R35].

CONCENTRATION LESS THAN 5% AND GREATER THAN OR EQUAL TO 2%: Corrosive. Causes burns. [C; R34].

CONCENTRATION LESS THAN 2% AND GREATER THAN OR EQUAL TO 0.5%: Irritant. Irritant to eyes and skin. [Xi; R36/38].

Safety phrases relate to the highest concentration division indicated, but may also be applicable to lower concentrations.

\* SECTION 16. OTHER INFORMATION\*

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Information on chemicals reviewed in the CHEMINFO database is drawn from a number of publicly available sources. A list of general references used to compile CHEMINFO records is available in the database Help.

\*Review/Preparation Date: 1995-11-29\*

#### Revision Indicators:

Conditions to avoid	1996-12-01
Stability and reactivity comments	1996-12-01
Storage	1996-12-01
Handling	1996-12-01
Inhalation (health)	1997-12-01
US transport	1998-03-01
ERPG	2001-03-01

TDG	2002-05-29	
PEL transitional comments		2003-11-18
Resistance of materials for PPE		2004-03-31
Bibliography	2005-03-21	
Sampling/analysis	2005-03-21	
Synonyms	2005-10-14	
Chemical name	2005-10-14	
Composition/purity	2005-10-14	
Melting point	2005-10-14	
Relative density	2005-10-14	

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Mail: 250 Main Street East, Hamilton Ontario L8N 1H6

## SECTION 1 – PRODUCT INFORMATION

<b>Product Name:</b>	Propane	<b>Supplier:</b>	Superior Propane A Division of Superior Plus Inc. 1111 - 49th Avenue N.E. Calgary, AB T2E 8V2 Business: (403) 730-7500
<b>Trade Name:</b>	LPG (Liquefied Petroleum Gas), LP-Gas		
<b>Chemical Formula:</b>	C <sub>3</sub> H <sub>8</sub>		
<b>WHMIS Classification:</b>	Class A – Compressed Gas Class B, Division 1 – Flammable Gas	<b>24-Hour Emergency Contact:</b>	Canutec (613) 996-6666

**Application and Use:** Propane is commonly used as a fuel for heating, cooking, automobiles, forklift trucks, crop drying and welding and cutting operations. Propane is used in industry as a refrigerant, solvent and as a chemical feedstock.

## SECTION 2 – HAZARDOUS INGREDIENTS

COMPONENTS	CASE NO.	% VOLUME (v/v)	LD <sub>50</sub> (RAT, ORAL)
Propane	74-98-6	90%-99%	Not Applicable
Propylene	115-07-1	0% - 5%	Not Applicable
Ethane	74-84-0	0% - 5%	Not Applicable
Butane and heavier hydro carbons	106-97-8	0% - 2.5%	Not Applicable

**Occupational Exposure Limit:**

Based upon animal test data, the acute toxicity of this product is expected to be inhalation: 4 hour LC<sub>50</sub> = 280,000 ppm (Rat)

**Note:** Composition is typical for HD-5 Propane per The Canadian General Standard Board CGSB 3.14 National Standard of Canada. Exact composition will vary from shipment to shipment.

## SECTION 3 – CHEMICAL AND PHYSICAL DATA

<b>Form:</b>	Liquid and vapour while stored under pressure	<b>pH:</b>	Not available
<b>Boiling Point:</b>	-42°C @ 1 atm	<b>Solubility in Water:</b>	Slight, 6.1% by volume @ 17.8°C
<b>Freezing Point:</b>	-188°C	<b>Specific Gravity:</b>	0.51 (water = 1)
<b>Evaporation Rate:</b>	Rapid (Gas at normal ambient conditions)	<b>Appearance/Odour:</b>	Colourless liquid and vapour while stored under pressure. Colourless and odourless gas in natural state at any concentration. Commercial propane has an odourant added, ethyl mercaptan, which has an odour similar to boiling cabbage.
<b>Vapour Pressure:</b>	1435 kPa (maximum) @ 37.8°C	<b>Odour Threshold:</b>	4800 ppm
<b>Vapour Density:</b>	1.52 (Air = 1)		
<b>Coefficient of Water/ Oil Distribution:</b>	Not available		

With proper handling, transportation and storage, adding a chemical odourant such as ethyl mercaptan has proven to be a very effective warning device, but all odourants have certain limitations. The effectiveness of the odourant may be diminished by a person's sense of smell, by competing odours and by oxidation which may cause a potentially dangerous situation.

## SECTION 4 – FIRE OR EXPLOSION HAZARD

<b>Flash Point:</b> -103.4°C	<b>Fire Extinguishing Precautions:</b> Use water spray to cool exposed cylinders or tanks. Do not extinguish fire unless the source of the escaping gas that is fueling the fire can be turned off. Fire can be extinguished with carbon dioxide and/or dry chemical (BC). Container metal shells require cooling with water to prevent flame impingement and the weakening of metal. If sufficient water is not available to protect the container shell from weakening, the area will be required to be evacuated. If gas has not ignited, liquid or vapour may be dispersed by water spray or flooding.
<b>Method:</b> Closed cup	
<b>Flammable Limits:</b> Lower 2.4%, Upper 9.5%	
<b>Auto Ignition Temperature:</b> 432°C	
<b>Hazardous Combustion Products:</b> Carbon monoxide can be produced when primary air and secondary air are deficient while combustion is taking place.	
<b>Fire and Explosive Hazards:</b> Explosive air-vapour allowed to leak to atmosphere.	
<b>Sensitivity to Impact:</b> No	
<b>Sensitivity to Static Discharge:</b> Yes	
	<b>Special Fire Fighting Equipment:</b> Protective clothing, hose monitors, fog nozzles, self-contained breathing apparatus.

## SECTION 5 – REACTIVITY DATA

<b>Stability:</b> Stable	<b>Hazardous Decomposition Products:</b> Deficient primary and secondary air can produce carbon monoxide.
<b>Conditions To Avoid:</b> Keep separate from oxidizing agents. Gas explodes spontaneously when mixed with chloride dioxide.	<b>Hazardous Polymerization:</b> Will not occur.

**Incompatibility:** Remove sources of ignition and observe distance requirements for storage tanks from combustible material, drains and openings to building.

## SECTION 6 – TOXICOLOGICAL PROPERTIES OF MATERIAL

**Routes of Entry:** Skin Contact, Eye Contact, Inhalation

**Inhalation:** Simple asphyxiant. No effect at concentrations of 10,000 ppm (peak exposures). Higher concentrations may cause central nervous system disorder and/or damage. Lack of oxygen may cause dizziness, loss of coordination, weakness, fatigue, euphoria, mental confusion, blurred vision, convulsions, breathing failure, coma and death. Breathing high vapour concentrations (saturated vapours) for a few minutes may be fatal. Saturated vapours may be encountered in confined spaces and/or under conditions of poor ventilation. Avoid breathing vapours or mist.

**Skin and Eye Contact:** Exposure to vapourizing liquid may cause frostbite (cold burns) and permanent eye damage.

**Ingestion:** Not considered to be a hazard.

**Acute Exposure:** Contact with Liquefied Petroleum Gas may cause frostbite or cold burns. Propane acts as a simple asphyxiant as oxygen content in air is displaced by the propane. At increasing concentration levels, propane may cause dizziness, headaches, loss of coordination, fatigue, unconsciousness and death.

**Chronic Exposure:** No reported effects from long term low level exposure.

**Sensitization to Product:** Not known to be a sensitizer.

**Occupational Exposure Limits:** American Conference of Governmental Industrial Hygienists (ACGIH) lists as a simple asphyxiant.

**ACGIH TLV:** 1000 ppm

**Carcinogenicity, Reproductive Toxicity, Teratogenicity, Mutagenicity:** No effects reported.

**Other Toxicological Effects:** None

## SECTION 7 – PREVENTATIVE MEASURES

**Eyes:** Safety glasses or chemical goggles are recommended when transferring product.

**Skin:** Insulated gloves required if contact with liquid or liquid cooled equipment is expected. Wear gloves and long sleeves when transferring product.

**Inhalation:** Where concentration in air would reduce the oxygen level below 18% air or exceed occupational exposure limits in section 6, self-contained breathing apparatus is required.

**Ventilation:** Use in well-ventilated areas. Use with explosion proof mechanical ventilation in confined spaces or poorly ventilated areas.

## SECTION 8 – EMERGENCY AND FIRST AID PROCEDURES

**Eyes:** Should eye contact with liquid occur, flush eyes with lukewarm water for 15 minutes. Obtain immediate medical care.

**Skin:** In case of "Cold Burn" from contact with liquid, immediately place affected area in lukewarm water and keep at this temperature until circulation returns. If fingers or hands are frostbitten, have the victim hold his hand next to his body such as under the armpit. Obtain immediate medical care.

**Ingestion:** None considered necessary.

**Inhalation:** Remove person to fresh air. If breathing is difficult or has stopped, administer artificial respiration. Obtain immediate medical care.

**Spill or Leak:** Eliminate leak if possible. Eliminate source of ignition. Ensure cylinder is upright. Disperse vapours with hose streams using fog nozzles. Monitor low areas as propane is heavier than air and can settle into low areas. Remain upwind of leak. Keep people away. Prevent vapour and/or liquid from entering into sewers, basements or confined areas.

## SECTION 9 – TRANSPORTATION, HANDLING AND STORAGE

- Transport and store cylinders and tanks secured in an upright position in a ventilated space away from ignition sources (so the pressure relief valve is in contact with the vapour space of the cylinder or tank).
- Cylinders that are not in use must have the valves in the closed position and be equipped with a protective cap or guard.

**Transportation of Dangerous Goods (TDG)**

**TDG Classification:** Flammable Gas 2.1

- Do not store with oxidizing agents, oxygen, or chlorine cylinders.

- Empty cylinders and tanks may contain product residue. Do not pressurize, cut, heat or weld empty containers.

- Transport, handle and store according to applicable federal and provincial codes and regulations.

**TDG Shipping Name:** Liquefied Petroleum Gas (Propane)

**PIN Number:** UN1075

## SECTION 10 – PREPARATION INFORMATION

**Prepared by:** Superior Propane  
Health Safety and Environment Team

Telephone: (403) 730-7500  
Revision: May 9, 2005  
Supersedes: October 2004

The information contained herein is believed to be accurate. It is provided independently of any sale of the product. It is not intended to constitute performance information concerning the product. No express warranty, implied warranty of merchantability or fitness for a particular purpose is made with respect to the product information contained herein.



## Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant

MSDS date: 19-Oct-2005

### 1. PRODUCT AND COMPANY IDENTIFICATION

**Product Name:** MAGNASOL AN1  
**Product Number:** 8763303

**Chemical Family:** Copolymer of sodium acrylate and acrylamide.

**Intended Use:** Flocculant

**Manufacturer/Supplier:** Ciba Specialty Chemicals Canada Inc.  
2626 Argentia Road  
Mississauga, Ontario  
L5N 5N2  
8am - 5pm Phone Number: 1-866-679-2422

CANUTEC Emergency: (613) 996-6666  
**Emergency 24-Hour Health/Environmental Phone: 1-800-873-1138**

### 2. HAZARDS IDENTIFICATION

#### EMERGENCY OVERVIEW

**Signal Word:** CAUTION!  
**Physical Form:** Solid  
**Color:** White  
**Odor:** Little or no  
**Health:** This product has no known adverse effect on human health.  
**Physical Hazards:** Refer to MSDS Section 7 for Dust Explosion information. , Slip hazard when wet. .

**WHMIS Designation:** This product is not WHMIS controlled.

**Potential Health Effects:** Eye contact may cause slight irritation and/or redness. Repeated or prolonged exposure may cause slight skin irritation. Inhaled dust may cause some respiratory irritation.

**Primary Route(s) of Entry:** Ingestion, Skin, Inhalation, Eyes.

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Component Information:** This material does not contain any hazardous components that are reportable according to WHMIS criteria.



## 4. FIRST AID MEASURES

<b>Eyes:</b>	In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
<b>Skin:</b>	Wash off immediately with soap and plenty of water. Get medical attention if irritation occurs.
<b>Inhalation:</b>	Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.
<b>Ingestion:</b>	Do not induce vomiting. If vomiting occurs naturally, have casualty lean forward to reduce the risk of aspiration. Seek medical attention immediately.

## 5. FIRE FIGHTING MEASURES

<b>Fire Fighting Measures:</b>	Standard procedure for chemical fires.
<b>Suitable Extinguishing Media:</b>	Carbon dioxide, dry chemical, foam or water mist.
<b>Unsuitable Extinguishing Media:</b>	The product becomes slippery when wet.
<b>Fire Fighting Equipment:</b>	Wear self-contained breathing apparatus and protective suit.
<b>Unusual hazards:</b>	The product can form an explosive dust/air mixture. For further information, see Section 7 Explosion Hazards.
<b>Hazardous Combustion Products:</b>	Burning may produce oxides of carbon.

## 6. ACCIDENTAL RELEASE MEASURES

<b>Cleanup Instructions:</b>	Product becomes slippery and difficult to handle when wet. Sweep up and shovel into suitable containers for disposal. Avoid dust formation. Wear suitable protective equipment. Should not be released into the environment.
------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## 7. HANDLING AND STORAGE

<b>Handling:</b>	As with all industrial chemicals, use good industrial practices when handling. Avoid eye, skin, and clothing contact. Do not inhale. Do not taste or swallow. Use only with adequate ventilation.
<b>Storage:</b>	Keep containers tightly closed. Store in a cool, dry, well-ventilated place.

**Explosion Hazards:**

- Combustible powder.
- Avoid creating dusty conditions.
- Grounding is required when emptying into a conductive container.
- When flammable solvents are present, the container must be inerted or the system otherwise designed to prevent or contain an explosion. Seek expert advice.

In addition, for products packaged in fused-lined (coated) fiber drums, fiber drums with conductive liners, steel drums, steel pails, and Type "C" FIBC (bulk bags), or other conductive the following instructions also apply:

- Always ground this package before emptying.

The user is responsible for designing the system to handle solid and ensuring proper training of employees in the system's use.

**For Industrial Use Only**

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**Exposure Guidelines:**

There are no OSHA or ACGIH exposure guidelines available for component(s) in this product.

**Personal Protective Equipment**

- Eye/Face Protection:** Wear safety glasses or goggles to protect against dust particles.
- Skin Protection:** Wear chemical resistant gloves and protective clothing.
- Respiratory Protection:** Use NIOSH approved respirator as needed to mitigate exposure.
- Engineering Controls:** Work in well ventilated areas. Do not breathe dust.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Physical Form:</b>	Solid
<b>Color:</b>	White
<b>Odor:</b>	Little or no.
<b>Freezing/Melting Point:</b>	Not determined
<b>Solubility in water:</b>	Soluble
<b>Vapor Density:</b>	Not applicable
<b>Vapor Pressure:</b>	Not applicable
<b>Density:</b>	Not determined
<b>Specific Gravity:</b>	~1
<b>pH:</b>	6.5 (1 % solution)
<b>Percent Volatile:</b>	Not determined
<b>VOC:</b>	Not determined
<b>Partition Coefficient (Octanol/Water):</b>	Not determined
<b>Decomposition Temperature:</b>	Not determined
<b>Flammability Limits in Air:</b>	
<b>Flash point:</b>	Not applicable
<b>Test Method (for Flash Point):</b>	Not applicable

## 10. STABILITY AND REACTIVITY

- Stability:** Stable.

<b>Conditions to Avoid:</b>	Avoid temperature extremes. Avoid wet or humid conditions.
<b>Incompatibility:</b>	Strong oxidizing agents, strong acids, strong bases.
<b>Hazardous Decomposition Products:</b>	No decomposition expected under normal storage conditions.
<b>Possibility of Hazardous Reactions:</b>	None expected.

## 11. TOXICOLOGICAL INFORMATION

<b>Acute Oral Toxicity:</b>	Not determined.
<b>Acute Dermal Toxicity:</b>	Not determined
<b>Acute Inhalation Toxicity:</b>	Not determined.
<b>Eye Irritation:</b>	Not determined.
<b>Skin Irritation:</b>	Not determined.
<b>Skin Sensitization:</b>	Not determined
<b>Respiratory Sensitization:</b>	Not determined
<b>Carcinogenicity (IARC; NTP; OSHA; ACGIH):</b>	None of the components in this product at concentrations greater than 0.1% are listed by IARC; NTP, OSHA or ACGIH as a carcinogen.
<b>Carcinogenicity Studies:</b>	Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH.
<b>Mutagenicity:</b>	No data for product.
<b>Reproductive Toxicity:</b>	No data for product.
<b>Teratogenicity:</b>	No data for product.
<b>Neurotoxicity:</b>	Not determined
<b>Subacute Toxicity:</b>	Not determined
<b>Subchronic Toxicity:</b>	Not determined
<b>Chronic toxicity:</b>	Not determined
<b>Absorption / Distribution / Excretion / Metabolism:</b>	Not determined
<b>Additional Information:</b>	Not determined

## 12. ECOLOGICAL INFORMATION

<b>Toxicity to Fish:</b>	Not determined
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**Toxicity to Invertebrates:** Not determined

**Toxicity to Algae:** Not determined

**Toxicity to Sewage Bacteria:** Not determined

**Activated Sludge Respiration Inhibition Test:** Not determined

**Biochemical Oxygen Demand (BOD):** Not determined

**Chemical Oxygen Demand (COD):** Not determined

**Total Oxygen Demand (TOD):** Not determined

**Biodegradability:** Not determined

**Bioaccumulation:** Not determined

**Additional Environmental Data:** Not determined

### 13. DISPOSAL CONSIDERATIONS

**Waste Disposal:** Dispose in accordance with local, state, provincial and federal regulations.

### 14. TRANSPORT INFORMATION

**Transportation of Dangerous Goods (TDG):**

Not regulated for transport by road or rail.

**International Maritime Dangerous Goods (IMDG):**

Not regulated for this mode of transport.

**International Air Transportation Authority (IATA):**

Not regulated for this mode of transport.

### 15. REGULATORY INFORMATION

#### **Federal Regulations**

**Workplace Hazardous Materials Information System (WHMIS):** This product is not WHMIS controlled.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

**Domestic Substance List (DSL) Status:** All components either exempt or listed on the DSL.

### **International Regulations**

**TSCA Section 8(b) Inventory Status:** All component(s) comprising this product are either exempt or listed on the TSCA inventory.

**Chemical Weapons Convention (CWC):** This product does not contain any component(s) listed under the Chemical Weapons Convention Schedule of Chemicals.

## **16. OTHER INFORMATION**

**Reason for revision:** New MSDS Format.

**Contact Information Safety, Regulatory and Environmental:** Marlene Dorcas (905) 812-7280

**Disclaimer:** The information contained herein is based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to such data or information. The user is responsible for determining whether the product is suitable for its intended conditions of use.



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## **Anionic Polyacrylamide**

### **Environmental Profile**

Anionic polyacrylamide is the generic name for a group of very high molecular weight macromolecules produced by the free-radical polymerization of acrylamide and an anionically charged co-monomer, mainly the sodium salt of acrylic acid, sodium acrylate. The combination of molecular weight and ionic charge results in extremely viscous aqueous solutions, one of the main properties of these polymers. Both the charge density (ionicity) and the molecular weight can be varied. By varying the acrylamide/anionic monomer ratio, a charge density from 0 to 100% along the polymer chain can be obtained. The molecular weight is determined by the type and concentration of the reaction initiator and the reaction parameters.

Anionic polyacrylamide has no systemic toxicity to aquatic organisms or microorganisms. The polymer is much too large to be absorbed into tissues and cells. The functional anionic groups do not interfere with the functioning of fish gills or daphnia respirators. Any adverse effects observed in laboratory tests are always seen at concentrations of over 100 mg./l and are probably due to the resulting viscosity of the test medium. The preparation of the test solutions at such concentrations requires high energy stirring for long periods of time, sometimes several hours. Therefore, it can be concluded that these harmful concentrations will not exist in the natural environment.

The test data given in this document was obtained using a highly charged anionic polyacrylamide. Low charge density polymers demonstrate even lower toxicity to aquatic and micro-organisms. The results of assays on anionic polyacrylamides are determined mainly by the viscosity of the test solution.

Anionic polyacrylamide has no potential to bioaccumulate, being completely soluble in water (solubility is only limited by viscosity) and insoluble in octanol. Additionally, being a flocculant, it adsorbs onto suspended matter and, in this way, is removed from the water phase.

The sensitivity of polyacrylamide to ultra-violet light is well known and has been described in the scientific literature. Photolysis leads to the degradation of the polymer chain and the formation of much smaller molecules, or oligomers, which are accessible to

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microbial attack. A recent study financed by the manufacturer of Horta-Sorb® brand super absorbents has demonstrated that photolysis followed by aerobic or anaerobic treatment resulted in efficient mineralization of the polymer. This study provides evidence that acrylamide polymers have the potential to be naturally broken down and biodegraded and do not persist or accumulate in the environment.

Two recently conducted, major environmental risk assessments concluded that anionic polyacrylamide does not represent a danger to the environment. STOWA, the Netherlands Waste-Water Authority calculated a PEC/NEC ratio much lower than 1 for organic polyelectrolytes in general and concluded that their use in waste-water treatment does not constitute a risk to the natural environment. Another review of polyelectrolytes by Environment

Agency of the United Kingdom concluded that anionic polyacrylamide, like the other organic polyelectrolytes, is not a priority for the sensing of environmental quality standards (EQS) and of little environmental concern.

### **Chemical Identity**

Chemical name: 2-propenic acid, sodium salt polymer with 2-propenamide

Other names: Copolymer of acrylamide and acrylic acid, sodium salt Acrylamide, sodium acrylate copolymer

CAS number: 25085 - 02 - 3

### **Physical Chemical Properties**

Molecular weight: greater than 1,000,000 Daltons, usually greater than 5,000,000

Solubility: totally miscible in water, insoluble in nectanol and other solvents

pH: 6 to 8 in solution at 5g/L

Apparent density: 1.08

Melting point: > 150C

### **Aquatic Toxicology**

#### **A. Toxicity to fish**

LC50/ Brachydanio rerio/96 hrs. 357 mg/l

LC0/ Brachydanio rerio/96 hrs. 178 mg/l

#### **B. Toxicity to daphnia**

EC50/Dapbnia Magna/48 hrs 212 mg/l

#### **C. Toxicity to algae**

EC50/Chlorella vulgaris/96 hrs 1,000 mg/l

No Observed Effect Concentration 708 mg/l

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#### D. Toxicity to bacteria

EC10/Pseudomonas putida/18 hrs. 127 mg/l

EC50/Pseudomonas putida/18 hrs. 892 mg/l

### ENVIRONMENTAL DATA

#### A. Bioaccumulation

Anionic polyacrylamide being totally soluble in water and insoluble in solvents has a very low octanol/water partition coefficient (POE), and for all practical purposes:

$$\log P_{OW} = 0$$

Thus, the potential for anionic polyacrylamide to bioaccumulate is zero.

#### B. Abiotic degradation (photolysis)

Anionic polyacrylamide is sensitive to ultra-violet light, which breaks down the polymer backbone into oligomers. A positive correlation is observed between the length of exposition to light and the degree of breakdown (i.e., reduction in molecular weight).

#### C. Biodegradation

Non-degraded anionic polyacrylamide has been shown to be recalcitrant to microbial degradation. This is probably related to the extremely high molecular weight, which renders microbial attack very difficult. However, once the polymer has been degraded through photolysis (i.e., the action of UV light), and the macromolecule broken down into oligomers, it becomes bioavailable and is biomineralized.

A study using C14 labeling, designed to evaluate the potential to biodegrade anionic polyacrylamide demonstrated that a combination of photolysis and microbial attack leads to natural attenuation of these polymers. After 48 hours of exposure to UV, the oligomers (MW < 3,000 Daltons) increased from under 2% to 80%. This enabled after 38 days incubation for the polymer to be biodegraded at least 29% aerobically and 17% anaerobically.

#### D. Residual Monomers

SNF takes the utmost care to ensure that the constituent monomers (in this case acrylamide and sodium acrylate) are as completely reacted as possible during polymerization. However, technically unavoidable traces can and do remain in the finished polymer, especially in powder products. For standard products, our quality assurance guarantees that all Floerger polyacrylamides contain less than 0.1% w/w (< 1000 ppm) of residual acrylamide monomer and less than 0.5% w/w (< 5000 ppm) or residual sodium acrylate. In fact, on average, there is about 0.04% (400 ppm) of residual

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acrylamide and about 0.2% (2,000 ppm) of residual sodium acrylate. Special applications, such as for the treatment of drinking water, food contact paper and agriculture may have lower residual monomer specifications.

Both acrylamide and sodium acrylate are readily biodegradable under aerobic conditions at over 90% in 2S days. Even at operating doses as high as 50 mg/l, the residual monomers released into the environment will never reach concentrations that could constitute a risk to the aquatic life. Their high biodegradability negates the possibility of accumulation in the natural environment.

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## **APPENDIX C**

### **WATER QUALITY SURVEILLANCE PROGRAM WATER USE LICENSE QZ06-006**

## Appendix 3 - Part 1

EXPLANATION OF SYMBOLS - WATER QUALITY SURVEILLANCE PROGRAM

Symbol	Explanation
D	Daily
W	Weekly
W2	Every two weeks
W/M	Weekly, except monthly if no discharge
WC	Weekly during construction, monthly thereafter except weekly if no surface discharge from Main Water Storage Pond
M	Monthly
Md	Monthly while discharging
Ms	Monthly if no surface discharge from Main Water Storage Pond
Q	Quarterly
+I	Plus ICP Dissolved Metals
S	According to physical monitoring program
A	External Suite A - Physical Parameters, Conductivity, Suspended Solids, Dissolved Solids, Hardness, Alkalinity, Sulphate, Ammonia, Nitrogen-Nitrite, Nitrogen-Nitrate, ICP Scan - Total Metals
B	External Suite B - Physical Parameters, Conductivity, Dissolved Solids, Alkalinity, Sulphate, Ammonia, Nitrogen-Nitrite, Nitrogen-Nitrate, ICP Scan - Dissolved Metals.

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**APPENDIX 3 - PART 2****WATER QUALITY SURVEILLANCE PROGRAM**

Parameter Site- as described in Appendix 1	Flow	Temperature, Field pH, Field Conductivity	External Suite	Internal Suite	Dissolved Organic Carbon	LT50 Static Bioassay 96 Hrs at 100% pH non-adjusted
W7	Q	Q	Q, A			
W6	Q	Q	Q, A			
W10	M	M	M, A			
W15	M	M	M, A			
W3	M	WC	WC, +I, A			Ms
W2	M	M	M, +I, A		M	
W11	M	M	M, A			
W18	M	M	M, A			
W12	M	M	M, A			
W13	W2	W2	W2, B	D		
W14	M	M	M, B			
W19	M	M	M, A			
W20	W	W	W, A			
W16	W/M	W/M	W/M, A			Md
W17	M	M	M, A			
W21	S	M	M, B			

External Suite A: Physical Parameters, Conductivity, Suspended Solids, Dissolved Solids, Hardness, Alkalinity, Sulphate, Ammonia, Nitrogen-Nitrite, Nitrogen-Nitrate, ICP Scan - Total Metals

External Suite B: Physical Parameters, Conductivity, Dissolved Solids, Alkalinity, Sulphate, Ammonia, Nitrogen-Nitrite, Nitrogen- Nitrate, ICP Scan - Dissolved Metals.

Internal Suite: Physical Parameters, Dissolved Copper

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