Attachment M Pilot Treatment Plant

The attached Water Treatment Report containing designs for the Velvet Wood pilot treatment plant was prepared by Lyntek September 24th, 2008.



Mine Water Treatment Report Uranium One, Velvet Mine Utah, USA



Prepared for



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1550 Dover Street - Lakewood, CO 80215 - 303.623.8365

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1.0 Introduction

Lyntek Inc. was contracted by Uranium One - Utah to develop a treatment method and portable water treatment system for the Velvet Mine located near Moab Utah. The Mine is currently shut down but Uranium One is planning to re-open the underground workings in the near future. The mine will require dewater to allow for underground mining to commence.

The Velvet Mine is an underground uranium-vanadium mine consisting of several working faces. Uranium one has maintained a self-monitoring program of the site and has decided to start the dewatering process this year if permits can be obtained. Portions of the mine workings are currently flooded and would need to be dewatered before they could be accessed for mineral exploration.

The mine has an approximate lower depth of 795 feet. The current static water level is approximately 395 feet. The total volume of water is approximately 42,000,000 and it must be pumped out, treated and discharge prior to re-opening the mine.

The available historical data indicates that the average ground water inflow was 25 to 35 GPM. The ground water inflow is originating from the Mossback member of the Chinle Formation, which hosts the mine workings. The ground water or sub-surface water enters the mine through various methods and natural fractures in the rock.

The historic and current water quality data show that the mine drainage water has a pH ranging from 6.9 to 7.2 with low levels of sulfides, suspended solids and most other contaminants. Based on the available data, the following metal species may be present in the untreated water at higher levels than allowable for surface release without treatment: Radium, Uranium, and Zinc. Two other metals are potentially of concern Arsenic and Selenium.

2.0 Water Treatment Chemistry

A water treatment plant will be designed to treat mine water over a range of reported values for Radium, Uranium and Zinc. Historical mine drainage data for the Velvet Mine was obtained from information provide to Lyntek Inc by Uranium One.

The discharge standards presented below are from Utah Standards of Water Quality and (UPDES) the existing self-monitoring permit, Permit No. UT0023914 issued for this facility.

The historical data shows only that Radium, Uranium and Zinc metal species are of concern. Of these, only Radium, Uranium have historically been at levels requiring treatment.

Lyntek Inc. after reviewing the data was requested to visit the site, sample the water and test various treatment options to determine the best method to treat the water to achieve acceptable discharge levels for the state of Utah. Traditional water treatment methods are described below.

<u>Radium</u>

Expected range of activity levels: 1 to 5 pCi/L Discharge standard: Maximum discharge limits of 5 pCi/L.

Radium is traditionally removed from waters by the addition of barium chloride (BaCl). Test work by Lyntek with analyses by Hazen Research, on water with a similar chemical profile found that the addition of 30 mg/L of BaCl is sufficient to reduce the Radium levels to 1.2 pCi/L, which is less than the target discharge level.

Recent bench scale testing by Lyntek at another mine in the same formation (near La Sal, Utah) with similar water showed a 69% reduction in the Radium level when treated with barium chloride and ferric sulfate, at the design dosage. The untreated water had a Radium-226 level of 13 (+/-1) pci/L, which was reduced to 4.0 (+/- 0.9) pci/L.

Test work by Hazen Research and others has identified the optimum pH for radium removal at 8.0 to 9.0, the water at site currently has a pH of which is the reported naturally occurring pH of the mine discharge (8.4 to 9.0). Therefore, no pH adjustment is anticipated at this time.

<u>Uranium</u>

Expected range of concentrations: 0.1 to 1.7 mg/L Discharge standard: Average and maximum discharge limits of 2.0 and 4.0 mg/L, respectively.

Uranium, like radium, may be removed from water by the addition of barium chloride (BaCl). Lyntek's bench scale testing at the La Sal, Utah mine showed that uranium concentrations in mine water with a pH of 8.8 were reduced from 0.1 mg/L (68 pCi/L) to 0.049 mg/L (33 pCi/L) with the addition of barium chloride and ferric sulfate at the design dosage. Additional secondary treatment with filters and resin columns are typically necessary to achieve the drinking water standard of 0.030 mg/L.

<u>Zinc</u>

Expected range of concentrations: 0.002 to 0.2 mg/L Discharge standard: Average of 1.0 mg/L

Removal of most metals is commonly accomplished by raising the pH of the feed water to a pH of 10.00 or higher, with the addition of lime or caustic. This treatment will produce metal hydroxides, which are insoluble in water. Zinc will precipitate best at a pH of 8.8, so if elevated zinc levels are encountered lime can be added to precipitate this metal.

<u>Arsenic</u>

Expected range of concentrations: 0.002 to 0.2 mg/L Discharge standard: Average of 0.1 mg/L

Dissolved arsenic can be precipitated from water by raising the pH to 10.00 or higher, by the addition of lime or caustic. This is considered unrealistic for this project due to the resulting high volume of sludge produced. Elevated levels of arsenic can be also be removed from water to achieve levels of less than 10 parts per billion (<0.01 mg/L) by elevating the pH to a range of 8.7 to 8.8, <u>if sufficient levels of iron are present</u>.

The current available data shows that the average pH of the mine drainage is 8.5 to 8.8; this pH range should be sufficiently high to precipitate the metals species of concern without addition of lime to raise the pH.

A co-precipitation occurs with the arsenic and the available iron. Dissolved iron is relatively low in the mine water (<0.1 mg/L) but can be increased by adding ferric sulfate (FeSO₄) during treatment with an approximate ratio of 3:1, Iron (as Fe⁺³) to arsenic. Iron should only be added in sufficient quantity to precipitate the arsenic to meet the site-specific discharge standard, while remaining in compliance with the discharge limit for dissolved iron (i.e., 0.3 mg/L).

At this time it is not anticipated that any treatment for Arsenic will be required.

<u>Selenium</u>

Expected range of concentrations: 0.002 to 0.02 mg/L Discharge standard: Average of 0.02 mg/L

It has been shown that Selenium can co-precipitate with iron. The water treatment system proposed could provide excess iron that is necessary to co-precipitate some of the Selenium. This should be adequate for the Velvet mine water, which has selenium concentrations below the discharge limit. However, if higher concentrations (i.e., up to 0.035 mg/L) were to be encountered, it would probably. To add iron for this co-precipitation reaction to occur

At this time it is not anticipated that any treatment for Selenium will be required.

3.0 Site Laboratory Scale Testing

To confirm what is the best method for treating the water at the Velvet mine. Lyntek Inc. sent a senior engineer to site to perform a combination of tests to determine the best method for treating the current water at this site. As no recent water analysis has been done Lyntek proposed a total of four (4) possible combinations to confirm the best treatment scheme.

Water Volume

Water was pumped from the underground mine workings at a depth of approximately 740 feet. This provided a representative sample of the existing water. A submersible pump was installed and water was pumped from this zone for several hours to provide a "fresh sample"

During this pumping period a sufficient quantity of water was collected for the following tests to be performed. The water tested was pumped from the lower of the two (2) vent shafts.

Head sample

A sample of the water source was collected for comparison against four treatment methods. The untreated head sample as well as the treated samples were analyzed for selected Dissolved and Total metals, Uranium Radium, as well as Total Dissolved and Total Suspended Solids.

3.1 Test Protocol

Water Treatment tests 1-4

The water source was tested using the below outlined treatment method, a 5 gallon sample was treated using each of the four test as shown.

The treated water was gross filtered and split into multiple samples for the various, previously listed constituents, (Uranium, Radium, etc.)

Test # 1 – BaCl only

Water

(Test Equivalent)

5.0 Gallons

18.9 liters

Reagents

30.00 mg/L of BaCl 0.567 grams

- 1) The pumped water was measured into a calibrated 5 gal baffled bucket
- 2) Add the equivalent grams of BaCl
- 3) Agitate the sample for 10 minutes with a mechanical agitator
- 4) Allow the sample to settle
- 5) Gross filter the sample to recover the formed solids save and label the formed solids
- 6) Take a 500ml sample of the gross filtrated water for total metals sample bottle
- 7) Take two (2), two Liter samples for Uranium & Radium testing.
- 8) Take one (1) one liter sample for Total and suspended solids

Test # 2 – BaCl and Lime

Water	(Test Equivalent)
5.0 Gallons	18.9 liters
Reagents	
30.00 mg/L of BaCl	0.567 grams
TBD grams of Lime	TDB
1) The pumped water was mea	sured into a calibrated 5 gal baffled bucket

- 2) Add the equivalent grams of BaCl
- 3) Add hydrated Lime to raise the pH to 9.0 record the weight of lime added
- 4) Agitate the sample for 10 minutes with a mechanical agitator
- 5) Allow the sample to settle
- 6) Gross filter the sample to recover the formed solids save and label the formed solids
- 7) Take a 500ml sample of the gross filtrated water for total metals sample bottle
- 8) Take two (2), two Liter samples for Uranium & Radium testing.
- 9) Take one (1) one liter sample for Total and suspended solids

<u>Test # 3 – BaCl & FeSO4 & Lime</u>

If Arsenic is present it will Co-precipitate if sufficient Iron is present, as we currently do not have any Iron analysis, Lyntek will perform a colorimetric test on the untreated water to determine the total Iron, to estimate the necessary Iron addition if necessary. (The known treatment regime is a 3:1 ratio of Iron (as Fe⁺³) to arsenic.

Water	(Test	Equivalent)
5.0 Gallons		18.9 liters
Reagents		
30.00 mg/L of BaCl		0.567 grams
TBD grams of Lime		TDB
TBD grams of FeSO4		Anticipated 0.06g/L or1.0grams

1) The pumped water was measured into a calibrated 5 gal baffled bucket

- 2) Add the equivalent grams of BaCl
- 3) Add hydrated Lime to raise the pH to 9.0 record the weight of lime added
- 4) Agitate the sample for 10 minutes with a mechanical agitator
- 5) Add the calculated grams of FeSO4 and agitate for 2 minutes
- 6) Allow the sample to settle
- 7) Gross filter the sample to recover the formed solids save and label the formed solids
- 8) Take a 500ml sample of the gross filtrated water for total metals sample bottle
- 9) Take two (2), two Liter samples for Uranium & Radium testing.
- 10) Take one (1) one liter sample for Total and suspended solids

<u>Test # 4 – BaCl / FeSO4 / Bi-Sulfate & Lime</u>

This test is an optional test and can be performed to confirm the reported ability of Meta-Bi-Sulphate to reduce Selenium concentration in water. Currently one operating plant designed by Lyntek is using this method to successfully produce treated water to Utah discharge standards.

Water	(Test Equivalent)
5.0 Gallons	18.9 liters

Reagents

30.00 mg/L of BaCl	0.567 grams
TBD grams of Lime	TDB
TBD grams of FeSO4	Anticipated 0.06g/L or1.0grams
13 ppm Meta-Bi-Sulphate	Anticipated 0.25 grams

1) The pumped water was measured into a calibrated 5 gal baffled bucket

- 2) Add the equivalent grams of BaCl
- 3) Add hydrated Lime to raise the pH to 9.0 record the weight of lime added
- 4) Agitate the sample for 10 minutes with a mechanical agitator
- 5) Add the calculated grams of FeSO4 and Bi-Sulphate then agitate for 2 minutes
- 6) Allow the sample to settle
- 7) Gross filter the sample to recover the formed solids save and label the formed solids
- 8) Take a 500ml sample of the gross filtrated water for total metals sample bottle
- 9) Take two (2), two Liter samples for Uranium & Radium testing.
- 10) Take one (1) one liter sample for Total and suspended solids

3.2 Test Summary

Water Sampling

	Pump				Cumulative	Cumulative	Static	
	Rate				Minutes of	Gallons	Water	General Comments Head
Time	GPM	pН	ORP	Comments	Pumping	Pumped	level	Sample
				Start pumping / Clear				
11:42	12.85	8.9	10	Water			395'	water clear- No Odor
11:52	12.88		5		10	128		
								Total Iron 0.135mg/L - light
12:00	12.57				18	230		rain
12:13	12.85	9.2	5 to 2		31	397		Sulfide Ordor - mild
12:50	12.86	9.3	11		68	871		Sulfide Odor - stong
1:15		9.29	2		93	1191		Oily smell - water clear
1:45	12.81				123	1575	397'	
2:00		Pull 25	gallon of	Sample -Shut off pump	138	1767		Total iron 0.236mg/L
2:10	N/A	9.2	5 to 2	Start Test #1	N/A	N/A	N/A	
2:20	N/A	9.2	5 to 2	Start Test #2	N/A	N/A	N/A	
2:40	N/A	9.2	5 to 2	Start Test #3	N/A	N/A	N/A	
3:00	N/A	9.2	5 to 2	Start Test #4	N/A	N/A	N/A	Total iron 0.236mg/L
Averages	12.80	9.18	4.3					

Summary of Water Sampleing TABLE 3.1

Test Results

Lyntek had a senior engineer at the Velvet mine on July 21st 2008 to perform the above described tests.

Summarized below are the laboratory assay results of the untreated head sample and the four possible treatment methods.

Velvet Mine - Laboratory Scale Test at Site Date of Test: July 21, 2008

					Utah Water Quality Standards			
	Dissolved Metals mg/L	Total Metals mg/L	Total Dissolved Solids TDS mg/L	Total Suspended Solids TSS mg/L	Lower Detection Limits mg/L	Daily Max.	Monthly Average	Units
Head Sample			5360	Non Detect	5 / 10	20	30	mg/LTSS
Arsenic	0.00235			-	0.00200	1		
Iron	Non Detect				0.200	1		
Selenium	Non Detect				0.00200	.0.50	mg/L Agr.	& Domestic
Antimony		Non Detect			0.00200			
Arsenic		Non Detect			0.0020			
Beryllium		Non Detect			0.0010			
Cadmium		Non Detect			0.00050			
Chromium		0.0048			0.00220			
Copper		Non Detect			0.010			
Iron		Non Detect			0.020			
lead		Non Detect			0.0020			
Molybdenum		1.5			0.0050			
Mercury		Non Detect			0.00010			
Nickel		Non Detect			0.010			
Silver		Non Detect			0.00020	1		
Thallium		Non Detect			0.0010	1		
Zinc		0.0097			0.0050	1.0	0.5	mg/L dissolved
Uranium (ug/L) (T)		22			0.7	4.0	2.0	mg/L
Uranium (pCi/L) (T)		15			0.5			
			Accuracy					
Radium-226 (pCi/L)(T)		2.2	(+/-0.7)		0.1 pCi/L	30.0	10.0	pCi/L
Radium-226 (pCi/L)(D)	0.7		(+/-0.4)		0.1 pCi/L			
Gross Alpha pCi/L (T)		27	(+/-5)		3.3 pCi/L	15.0		pCi/L
Gross Alpha pCi/L (T)**		12	(+/-5)		3.3 pCi/L	4.0		mrem/yr.
Gross Beta pCi/L (T)		5.8	(+/-5.1)		5.0 pCi/L]		

(T) = total

(D) = Dissolved

(T)** =Less Radon & Uranium Uranium results reported assumes natural activity of U = 6.77x 10-7 Ci/gm

						Utah Water Quality Standar		y Standards
			Total	Total	Lower			
			Dissolved	Suspended	Detection			
	Dissolved	Total Metals	Solids	Solids	Limits		Monthly	
	Metals mg/L	mg/L	TDS mg/L	TSS mg/L	mg/L	Daily Max.	Average	Units
Test#1			5360	25.5	5 / 10	20	30	mg/LTSS
Arsenic	Non Detect				0.00200			
Iron	Non Detect				0.200	I		
Selenium	Non Detect				0.00200	.0.50	mg	g/L Agr. & Dome:
Antimony		Non Detect			0.00200			
Arsenic		Non Detect			0.0020	ľ		
Beryllium		Non Detect			0.0010	ľ		
Cadmium		Non Detect			0.00050	Î		
Chromium		Non Detect			0.00220	Î		
Copper		Non Detect			0.010			
Iron		Non Detect			0.020	ĺ		
lead	1	Non Detect			0.0020			
Molybdenum	1	1.58			0.0050			
Mercury		Non Detect			0.00010	ĺ		
Nickel		Non Detect			0.010	Î		
Silver		Non Detect			0.00020	Î		
Thallium		Non Detect			0.0010			
Zinc		0.0329			0.0050	1.0	0.5	mg/L dissolved
Uranium (ug/L) (T)		15			0.7	4.0	2.0	mg/L
Uranium (pCi/L) (T)		10			0.5	1		-
			Accuracy					
Radium-226 (pCi/L)(T)		1	(+/-0.5)		0.2 pCi/L	30.0	10.0	pCi/L
Radium-226 (pCi/L)(D)	0.5		(+/-0.3)		0.1 pCi/L			
Gross Alpha pCi/L (T)		18	(+/-5)		3.3 pCi/L	15.0		pCi/L
Gross Alpha pCi/L (T)**		8	(+/-5)		3.3 pCi/L	4.0		mrem/yr.
Gross Beta pCi/L (T)		14	(+/-5)		5.0 pCi/L	Ι		
(T) = total			-			-		

(T) = total (D) = Dissolved

(T)** =Less Radon & Uranium Uranium results reported assumes natural activity of U = 6.77x 10-7 Ci/gm

						Utah Water Quality Standards		
			Total	Total	Lower			
		_	Dissolved	Suspended	Detection			
	Dissolved	Total Metals	Solids	Solids	Limits	_ ,	Monthly	
	Metals mg/L	mg/L	TDS mg/L	TSS mg/L	mg/L	Daily Max.	Average	Units
Test # 2			5350	25	5 / 10	20	30	mg/LTSS
Arsenic	Non Detect				0.00200			
Iron	Non Detect				0.200			
Selenium	Non Detect				0.00200	.0.50	mų	g/L Agr. & Dome
Antimony	<u> </u>	Non Detect			0.00200	1		
Arsenic		Non Detect			0.0020	1		
Beryllium	1	Non Detect			0.0010	1		
Cadmium		Non Detect			0.00050	1		
Chromium		Non Detect			0.00220	1		
Copper		Non Detect			0.010	1		
Iron	Ī	Non Detect			0.020	1		
lead	1	Non Detect			0.0020	1		
Molybdenum	1	1.42			0.0050	1		
Mercury		Non Detect			0.00010	1		
Nickel		Non Detect			0.010	1		
Silver		Non Detect			0.00020	1		
Thallium	1	Non Detect			0.0010	1		
Zinc		0.0484			0.0050	1.0	0.5	mg/L dissolved
Uranium (ug/L) (T)	<u> </u>	22			0.7	4.0	2.0	mg/L
Uranium (pCi/L) (T)		15			0.5	1		-
Radium-226 (pCi/L)(T)	╉─────	2.1	Accuracy (+/-0.7)		0.2 pCi/L	30.0	10.0	pCi/L
Radium-226 (pCi/L)(D)	0.1		(+/-0.2)		0.1 pCi/L	1		r
Gross Alpha pCi/L (T)	<u> </u>	24	(+/-5)		3.3 pCi/L	15.0		pCi/L
Gross Alpha pCi/L (T)**	+	9	(+/-5)		3.3 pCi/l	4.0		mrem/vr
Gross Beta pCi/L (T)	<u> </u>	5.6	(+/-5.2)		5.0 pCi/L			
(T) = total			-					

(T) = total (D) = Dissolved

(T)** =Less Radon & Uranium Uranium results reported assumes natural activity of U = 6.77x 10-7 Ci/gm

						Utah W	Utah Water Quality Standards		
			Total	Total	Lower				
			Dissolved	Suspended	Detection				
	Dissolved	Total Metals	Solids	Solids	Limits		Monthly		
	Metals mg/L	mg/L	TDS mg/L	TSS mg/L	mg/L	Daily Max.	Average	Units	
Test#3			5360	23.5	5 / 10	20	30	mg/LTSS	
Arsenic	Non Detect				0.00200				
Iron	Non Detect				0.200				
Selenium	Non Detect				0.00200	.0.50	mg	g/L Agr. & Dome:	
]			
Antimony		Non Detect			0.00200]			
Arsenic		Non Detect			0.0020				
Beryllium		Non Detect			0.0010]			
Cadmium		Non Detect			0.00050]			
Chromium		Non Detect			0.00220	1			
Copper		Non Detect			0.010	1			
Iron		0.588			0.020	1			
lead		Non Detect			0.0020	1			
Molybdenum		1.53			0.0050	1			
Mercury		Non Detect			0.00010	1			
Nickel		Non Detect			0.010	1			
Silver		Non Detect			0.00020	1			
Thallium		Non Detect			0.0010	1			
Zinc		0.0139			0.0050	1.0	0.5	mg/L dissolved	
					0.7	1		-	
Uranium (ug/L) (T)	-	22			0.7	4.0	2.0	mg/L	
Uranium (pCi/L) (T)		15			0.5	1			
			Accuracy			1			
Radium-226 (pCi/L)(T)	1	0.1	(+/-0.2)		0.1 pCi/L	30.0	10.0	pCi/L	
Radium-226 (pCi/L)(D)		1.2	(+/-0.5)		0.1 pCi/L	1			
			· ,			1			
Gross Alpha pCi/L (T)		15	(+/-5)		4.6 pCi/L	15.0		pCi/L	
Gross Alpha pCi/L (T)**	1	0	(+/-5)		4.6 pCi/L	4.0		mrem/yr.	
Gross Beta pCi/L (T)		7.3	(+/-5.0)		4.9 pCi/L	1			
(T) = total			· /						

 (T) = total

 (D) = Dissolved

 (T)** =Less Radon & Uranium

 Uranium results reported assumes natural activity of U = 6.77x 10-7 Ci/gm

						Utah W	/ater Qualit	y Standards
			Total	Total	Lower			
			Dissolved	Suspended	Detection			
	Dissolved	Total Metals	Solids	Solids	Limits		Monthly	
	Metals mg/L	mg/L	TDS mg/L	TSS mg/L	mg/L	Daily Max.	Average	Units
Test#4			5380	23	5 / 10	20	30	mg/LTSS
Arsenic	Non Detect				0.00200			
Iron	Non Detect				0.200			
Selenium	Non Detect				0.00200	.0.50	mg/L Agr.	& Domestic
Antimony		Non Detect			0.00200			
Arsenic		Non Detect			0.0020]		
Beryllium		Non Detect			0.0010]		
Cadmium		Non Detect			0.00050			
Chromium		Non Detect			0.00220	1		
Copper		Non Detect			0.010	1		
Iron		0.861			0.020	1		
lead		Non Detect			0.0020	1		
Molybdenum		1.44			0.0050	1		
Mercury		Non Detect			0.00010	1		
Nickel		Non Detect			0.010	1		
Silver		Non Detect			0.00020	1		
Thallium		Non Detect			0.0010	1		
Zinc		0.0234			0.0050	1.0	0.5	mg/L dissolved
					0.7	1		0
Uranium (ug/L) (T)		29			0.7	4.0	2.0	mg/L
Uranium (pCi/L) (T)		20			0.5	1		-
			Accuracy					
Radium-226 (pCi/L)(T)		2.1	(+/-0.6)		0.1 pCi/L	30.0	10.0	pCi/L
Radium-226 (pCi/L)(D)	0.5		(+/-0.3)		0.1 pCi/L	1		
<u> </u>			/			1		
Gross Alpha pCi/L (T)		21	(+/-4.0)		3.0 pCi/L	15.0		pCi/L
Gross Alpha pCi/L (T)**		1	(+/-4.0)		3.0 pCi/L	4.0		mrem/yr.
Gross Beta pCi/L (T)		20	(+/-6.0)		5.4 pCi/L	1		
(T) = total			r í					

(I) = total

(D) = Dissolved

(T)** =Less Radon & Uranium

Uranium results reported assumes natural activity of U = 6.77x 10-7 Ci/gm

3.3 Interpretation of Test Results

The sampled and tested water on the day of the test is somewhat different than expected in that the pH was considerably higher than expected. The historical operating data indicated that the water should be slightly higher than neutral i.e. 7.1. On the day of testing the actual pH was between 8.9 and 9.2. This high pH resulted in very low to non detect on all metals species, with the exception of Molybdenum and Zinc. This is normal for these metals as they will re-solubilize when the pH is above 8.5. Please refer to table 3.7 " Metal Hydroxide solubility as a function of pH".

Table 3.7



4.0 Water Treatment Process

Based on the tests run in the field and the historical data, the water to be treated will respond well to a single treatment step of Barium Chloride, followed by settling. The only components of the water of any concern at this time are the Uranium and the Radium, both of which were reduced with the treatment by Barium Chloride. On the day of the test none of the metals or components assayed for were above the Utah mandated standard for release. Historical data again indicated that the former treatment scheme of Barium Chloride and settling of the resulting sludge have produced acceptable results. Lyntek see no need to deviate from this treatment scheme.

The Water should be monitored and if the pH or other conditions change then an additional chemical or treatment step might be considered, I.E. adding lime to raise the pH if the pH drops below 7.0.

Uranium One is proposing to dewater the mine in a two-step process: The flow sheet presented on Lyntek drawing 08019-A-F-01 Rev A and 08019-F-05 Rev 0 provides an overview of the treatment process (See Appendix A for all drawings).

Phase One (250 GPM Pilot plant)

Uranium proposed to set-up a "Pilot test program" during the initial mine dewatering. A temporary plant will be brought to the site. The water will be pumped out of the mine at a maximum flow rate of approximately 250 GPM. Barium Chloride will be combined in an agitated tank with sufficient residence time to react with the Radium & Uranium, the design contact time is 10 minutes, but to insure sufficient contact time this tank will be oversized. Lyntek proposes to use an 11' diameter by 20' (+) tall tank, with an overflow (outlet) at the 16' to 17' level. The minimum tank volume required would be 3,000 gallons; this tank would have an operating volume of 12,000 gallons, approximately 4 times larger than the minimum. The discharge from this tank will flow by gravity to a series of settling tanks. The insoluble precipitate will be retained within the settling tanks and the treated water will be released.

As this is a temporary facility the settling will occur in roll off or Frac Tanks, but will be sized to allow for sufficient settling time to allow for retention of the produced solids. Please refer to Lyntek Inc drawing # 08019-F-05. This will be a temporary facility and will be removed from the site after the pilot-testing phase is complete. All the treatment and settling equipment will be located down gradient of the south vent near where the "old" collection ponds were located, and will be placed on a secondary lined containment areas.

A conceptual layout for locating the "Pilot Plant" equipment is shown Site Map 08019-C-01 & 02. When the majority of the water has been pumped out of the mine and treated the second phase of operations will commence.

Phase Two (Permanent Plant)

Once the pilot-testing phase is complete a more permanent facility will be brought to the site. This will be a 25 GPM circuit to treat the on going mining operation needs. This is proposed as a semi-fixed facility, consisting of a 48' trailer van and an above ground settling tank, that will be placed within a secondary lined containment areas. Please refer to Lyntek Inc drawing # 08019-F -01, and 07004A-G-01 Rev A for the flow sheet and a general arrangement drawing.

4.2 Treatment Plant Operations – Long term treatment

Both the "Pilot Plant" and the "Permanent Plant" will both operate with the same chemistry and operating philosophy. Described below is the 25 GPM circuit for sake of brevity.

The mine water will be pumped to the water treatment trailer, which has been designed to operate at 25 GPM or less. This treatment rate is approximately the same as the estimated maximum steady-state flow conditions when the mine is operating. The treatment plant, shown on Drawing 07017-G-01 Rev A, is a fully self-contained treatment unit, complete with mix tanks, reaction tanks, and reagent storage.

A 250-gallon head tank will receive the water from the mine and will allow for some flexibility within the system and the mine. To prevent overflow of the Untreated Water Tank, a level sensor will be installed in the head tank and will be interconnected to the mine water pump. If the tank should ever reach the preset maximum level, the level sensor would automatically shut off the mine pump until the water level in the tank is lowered. Installation and operation of the level sensor is discussed in more detail in Section 7.0, Monitoring Systems.

Chemicals from the reagent mix tanks are added to the untreated water as it is pumped from the Untreated Water Tank to the two, 300-gallon reaction tanks. The reaction tanks are sized to allow for at least 12 minutes of retention time per tank. Design calculations indicate that only one tank is needed; the second tank provides flexibility of operation and the potential for treating higher flows if needed.

The trailer has three (3) reagent mix/storage tanks; each tank has approximately 300 gallons of storage. The first two tanks are for barium chloride and the third tank is for ferric sulfate or lime if required in the future. One of the two barium chloride tanks can be converted to a lime tank, if lime addition is required in the future. Each tank is equipped with an agitator to properly mix each reagent. The operator will first fill the tank with water and then add the appropriate weight of reagent. The agitators within each tank will be operated constantly to ensure proper mixing or suspension of reagent. Reagents will be fed (metered) into the water at the designed dose rate. The reagent dosing pumps are adjustable to provide more or less dosing depending on flow rates and water quality. The projected initial dose rate for each reagent is shown in table 3.1.

To insure adequate contact with the water and the reagents, the dosed water is fed into an inline static mixer. The chemical reactions start in the static mixer and continue as the water and reagents mix in the reaction tanks. The reaction tanks are fed via the pump located at the Head Tank; the first reaction tank will overflow by gravity into the second tank. The final treated water will discharge from the second reaction tank by gravity and flow into the Settling Tank or Ponds.

4.3 Settling Tanks or Ponds

Phase one – "Pilot Plant"

During this initial phase of operation the mine water will be treated at a flow rate of 250 GPM. The treated water will flow via a gravity pipeline into settling tanks. Natural settling will occur in about 40 to 45 minutes. To insure sufficient settling time and volume for sludge collection Uranium One will procure two (2) 40 cubic yard roll off or Baker (Frac) tanks. Which type of container has not been fully determined and will depend on the availability of these units.

At the design flow rate of 250 GPM; two (2) 40 Yd^3 containers will give a total of 60 minutes (+) of retention time. The resulting sludge will be contained with the frac tank. The settled sludge will remain in the tanks and the treated water will be decanted off the top of the tanks for release into the natural drainage.

Please refer to Lyntek drawing 08019-C-01 / 02 for the proposed location.

Calculated retention time and sludge volumes are summarized below.

Table 4.1

Settling Tank Volumes for 250 GPM Circuit

For 250 GPM System									
Flow Rate	250 GPM	945 Liters/Min	Volume of Baker tank						
Time Req.	40 Minutes		20 CuYd =	540 CuFt					
			25 CuYd =	675 CuFt					
	10,000.0 Volume Re	equired (Gallons)	30 CuYd =	810 CuFt					
			40 CuYd =	1080 CuFt					
	1,336.9 Volume Re	equired (CuFt)							
		,	32.3 Minutes of reter	ntion / 40Yd3 container					

If the formed precipitate does not settle sufficiently within the Settling Tank, flocculent can be added to aid in the settling process. Flocculent has been included in the sludge volume calculation, although its use will probably not be required. The trailer has sufficient space to add this additional reagent if deemed necessary.

Table 4.2

Sludge Volumes for 250 GPM circuit

Reagent or Metal	Grams of PPT per day	Design dose or concentration mg/L	Assumptions					
BaCl	40,824.0	30	Assume 90% Precipitation					
TSS	136.1	10	Assume 90% Precipitation					
TDS	-	5360	Assume 10% Removal					
All other Metals	2		Assume 90% Removal - for safety factor					
Totals	40,962	g/day of PPT	90.22485 #/day of PPT					

For 250 GPM System

35#/CuFt Wet Bulk Density

2.6 CuFt of Sludge Per day

The total volume of sludge that will be produced during this phase of dewatering is difficult to project, as we do not know the volume of water contained within the mine.

Phase two – "Permanent Plant"

The treated water will discharges from the trailer and flow into a settling tank for collection of the precipitated sludge. The 12,000-gallon mix tank used in the "pilot plant" will replace the Frac tanks that had been to act as the collecting vessel for the produced sludge. The precipitate formed by the addition of barium chloride is an insoluble solid (sludge) that naturally settles and separates from the treated water. The settling time required is 45 to 60 minute without settling aid (flocculent) to insure a low TDS outflow of treated water Lyntek is proposing to add flocculent to the treated water to assist in settling.

Please refer to Lyntek drawing 08019-M-1 for the mixing / settling tank.

Table 4.3

Settling Tank Volumes for 25 GPM Circuit

Settling Tank		Units
Operating Volume CuFt	2,185	CuFt
Gallons	16,341	Gallons
Retention Time @ 25GPM	653.6	Minutes
	10.9	Hours

Field test work and prior operating knowledge indicate the need for a minimum of 1 hour for quiescent settling. But as the flow will be constant into the tank this minimum time has been increased significantly to allow for settling during operations.

4.3 Sludge Handling & Volumes

The mine has a projected operating life of 6 to 10 years, for this report Lyntek has selected a 10 year operating life to calculate the projected volumes of sludge that will be produced.

Plant Operations	7	days/week
	24	Hr/ operating day
	364	Total days of sludge production/year
Sludge Produced		
	3,128.1	Total #'s of Sludge per year
	71.1	CuFt/ Year
Sludge production I	ife of mine	•
	31,281.4	Total #'s of Sludge
	710.9	Total CuFt of sludge storage

Table 4.4						
Sludge Volumes	for 25 (GPM (Circuit			

During dewatering activities, the water treatment plant will likely operate 7 days per week, 24 hours per day.

The sludge tank capacity has been sized assuming plant operation of 7 days per week 24 hours per day. This is a much higher rate that the historical data indicates and should

result in a sufficient safety factor in the event of extended mine life or if additional treatment requirements are imposed. The treatment plant will probably only operate 5 to 6 days per week. So the calculated volume reported above is potentially high.

The mine has an anticipated life of 10 years of operation. The formed precipitate or sludge will have a bulk density of approximately 35 Lb./Cuft. (This is very conservative as the calculated bulk density is 38 to 44 Lb/Cuft. Assuming 9.2 Lb./day of PPT, the volume of sludge generated over the life of the mine can be calculated as shown in Table 4.4.

The calculated Sludge volume of 710 Cuft should contained easily with in the tank and still allow for sufficient settling time. If the settling time remains sufficient, removal of sludge may not be required until the end of the mine life. However, if the sludge were to build up to the point where the retention time is too short, the sludge would need to be periodically removed and disposed of in accordance with applicable regulations. An inadequate retention time can be identified by a higher than normal TDS.

As a tank is being used to collect the produced sludge, it will be easy to dispose of this sludge. A fitting will be installed in the base of the tank to allow for a vacuum truck hook-up when it becomes necessary to dispose of the sludge. When disposal of sludge becomes necessary the treatment plant will be turned off the tank and sludge allowed to settle. Then the sludge will be removed to a level sufficient to allow for continued operations. Then the treatment plant will be restarted. This sludge disposal will be repeated as necessary.

Please note that the attached drawings are conceptual at this time, the final design of the tanks, treatment plant and containment liner thickness and type will need to be approved by the state of Utah.

5.0 Environmental & Reagent Information

The Velvet water treatment facility is proposed to be a fully self-contained within a 47foot semi trailer. At this time only one reagent will be used in the treatment system: Barium Chloride. If the water chemistry changes and additional reagents are required sufficient space and tank age has been designed into the mobile facility. The calculated chemical usage is show in table 5.1 below.

5.1. Reagent Storage

Barium chloride is supplied in dry powder form in 50# bags. The dry reagents will be technical grade and will be 98 to 100% strength. These reagents will be purchased in pallet quantities; typically pallets of reagents are supplied as 1000# net of chemical. Sufficient space is provided in the treatment trailer to store one (1) pallet of each reagent. Thus the maximum anticipated quantities of each reagent to be stored on site would be:

Barium Chloride:	980# (98% strength)
Ferric Sulfate:	None at this time

This will be sufficient dry bulk Barium Chloride for four to five months of operation and Ferric Sulfate for over two years of operation if required.

Chemical or Reagent	Use Rate g/L	Gram/day	#/Day	#/ 5 day week	#/Year	Tons/ Year
BaCl	0.03	4,082.4	9.0	45.0	3,285.1	1.6
FeSO4	none at this time	0.0	0.0	0.0	0.0	0.0

Table 5.1 - Chemical Consumption for Water Treatment

5.2 Reagent Mixing and Usage

The reagent mix tanks have been sized to supply the design reagent dosing for a 9-day period. The Mix tanks are approximately 300 gallons each and will have the following solution strengths:

 Barium Chloride:
 0.026% (+/-)

 Ferric Sulfate:
 0.004% (+/-) (if Required)

Both are very dilute solutions and present minimal health risk as a dilute solution. The dilute solution of each reagent will be pumped into the treatment line via a metering pump. The precipitation reaction will take place in the reactor tanks and the resulting precipitate will be collected in the Settling Tank or Pond.

5.3 Additional Treatment and Contingency

One of the Barium Chloride tanks can be converted to a Lime and or a FeSO4 mix tank in the event that it becomes necessary to adjust (raise) the pH or add additional iron to the water, to facilitate precipitation of other non-specified metals.

Additionally, flocculent may be added to help settle the formed solids. Neither of these reagents is anticipated for treatment of the water at this time. This information is being provided in the event that the water chemistry changes.

In the event that the treatment plant must be shut down for maintenance or repair, pumping of mine water can be stopped for many weeks and the water can remain within the mine until treatment operations can resume.

5.4 Environmental & Operator Safety

Materials Safety Data Sheets (MSDS) for Barium Chloride and those additional reagents that could be added, Lime and Flocculant, can be found in Appendix B. The appropriate personal protective equipment (PPE) for all these chemicals consists of rubber gloves, dust and acid vapor respirators, chemical splash goggles, and steel-toed boots. The work area should be kept well ventilated. A summary of the health and environmental effects of barium chloride and ferric sulfate follow.

I. Barium Chloride

Human Health Effects

Barium Chloride is a water-soluble powder; it must be handled with appropriate personnel protective equipment (PPE).

Route of Entry

Skin Contact:	May cause irritation				
Eye:	May cause irritation				
Inhalation:	Harmful if inhaled				
Ingestion:	Harmful if ingested				
Sensitization:	May cause allergic skin reaction				
Carcinogenicity:	Does not meet WHMIS criteria				
Teratogenicity:	Does not meet WHMIS criteria				
Mutagenicity:	Does not meet WHMIS criteria				
Reproductive Toxicity: Does not meet WHMIS criteria					

(WHMIS - Workplace Hazardous Materials Information System)

Environmental Health Effects

This reagent is listed under CAS # 10361-37-2 This material does not contain any hazardous air pollutants This material is not listed as a hazardous substance under TSCA This material has no reportable quantity This material is not listed as a hazardous substance under the Clean Water Act This material is not listed as a toxic substance under the Clean Water Act This material is not listed as a hazardous substance under the Clean Water Act This material is not listed as a hazardous substance under CERCLA (TSCA – Toxic Substances Control Act, CERCLA – Comprehensive Environmental Response, Compensation and Liability Act)

5.5 Disposal of Wastes

Wastes from the materials packaging will be placed in the site's roll-off container for solid wastes. Any chemical wastes from use of the reagents will be contained within the

trailer. If any spillage of dry chemicals occurs, the material will be swept-up and placed into a proper storage container for reuse. Spillage of chemical solutions will be cleaned up with a water hose and directed toward a floor drain near the back of the trailer. The trailer is set up so the back of the trailer is slightly lower (i.e., ¹/₄ to ¹/₂ inch lower) than the front to provide adequate drainage. A flexible plastic pipe connects the floor drain to a 400-gallon storage tank located outside the trailer. Any solution that collects in the storage tank will be evaluated for reuse or proper disposal, as appropriate.

The settled sludge will be stored in the Settling Tank or Tanks. The sludge will be removed and disposed of at the end of the mine life or sooner if retention time is compromised. The sludge will be sampled to determine its radium and uranium content and disposed of appropriately in accordance with TENORM regulations promulgated by the Utah Department of Public Health and Environment.

A sludge sample from a similar treatment pond at a mine facility in Utah and had the sample analyzed for uranium and radium content. A Toxicity Characteristic Leach Procedure (TCLP) test was also performed to determine whether the sludge could be classified as a hazardous waste. The laboratory results are presented in Appendix C. The radium activity level and uranium content were found to be 2.1 pCi/g and 25.2 mg/kg (equivalent to 17.1 pCi/g), respectively. This sludge is essentially a very low-grade uranium ore. Under the Utah Department of Public Health and Environment's (UDPHE's) interim policy on TENORM, this material would be exempt from UDPHE regulation as its radium and uranium activity levels are less than 3 pCi/g and 30 pCi/g, respectively. The TCLP results were also negative for the eight Resource Conservation and Recovery Act (RCRA) metals.

Uranium One will collect and analyze a sample of the tank sludge prior to making arrangements for it removal and disposal. Depending on the analytical results, the sludge may be disposed of by:

- 1. Pumping it out of the tank with a vacuum truck, mixing it with cement grout and then placing it in a mined out area of the underground workings.
- 2. Mixing it with ore and sending it to a uranium mill for processing.

3. Allowing it to dry and then disposing of it at an approved landfill. The sludge analytical results and disposal methods will be documented and reported to the appropriate regulatory agencies.

6.0 Chemicals and Materials Handling Plan

The proposed water treatment facility will house all the reagents necessary for this operation. The trailer will act as the storage facility as well as the mixing and reagent usage location for this operation.

The Barium Chloride used in this treatment process does not have any known toxic or acid-forming potential and does not cause any known environmental hazard in the quantities used and stored on site.

All reagents will be stored and used within the trailer; a monthly inventory of reagents used and in storage will be maintained.

During periods of inactivity, the trailer will be locked to prevent unauthorized entry or the potential of an environmental release of chemicals. During periods of inactivity the treatment plant tanks will be drained and emptied for maintenance reasons and to prevent an uncontrolled release of chemicals or untreated water.

The reaction tanks can be supplied with secondary containment, but at his time Lyntek feels this is not necessary.

All handling and mixing of reagents will be performed by trained plant operators. The operators will be provided with the necessary PPE and will be instructed on the proper handling, operating, cleanup, and reporting procedures for these reagents. The operators will also be trained on potential chemical reactions and safety hazards.

A detailed, site-specific chemical and material-handling plan will be prepared at the time of plant startup. This plan will include proper storage and handling methods for the various chemical products, inspection procedures and check lists, preventive maintenance requirements, personnel training, emergency response procedures in the event of a spill or release, and spill reporting requirements.

7.0 Monitoring Systems

The Velvet Project is located in a relatively remote area; power lines exist to the site and will be the source of site power. Telephone service is via a satellite dish system. This situation is not conducive to establishing an electronic monitoring system that can alert off-site operators of upset conditions. The treatment plant trailer is, however, can be equipped with a Webmaster Status Indicator System. Once the site obtains more reliable telephone service, this system can be setup to provide status information to Uranium One's on-site mine offices and/or the office in Moab. The system can provide emergency warnings via telephone and information on flow rates and which units are operating via the Internet or Cell phone service.

Until such time that the Webmaster System can be operated effectively, Uranium One will have personnel on site when the water treatment system is operating so that any problems may be identified and fixed quickly. Operators will, at a minimum, check the treatment facilities at the start, mid-point, and end of each shift.

Operators will be trained to inspect and identify potential problems associated with the:

- 1. Pumping Systems
- 2. Waterlines and Tanks
- 3. Treatment Plant

A daily checklist will be developed and used by the operators to ensure that the entire system is inspected thoroughly. Potential problems will be corrected by the plant operator or reported to management for follow-up if the situation cannot be corrected immediately. Monitoring of each of the three treatment system components is discussed below.

7.1 Pumping Systems

A level sensor will be installed in the Head Tank that will be interconnected electrically to the mine water pump so that the pump will automatically shut off if the water level reaches the preset maximum level. The plant operator will be responsible for verifying that all pumps are operating at normal flow rates and that tank volumes are within normal operating ranges. Pumping rates and tank levels will be noted on the inspection checklist. Unusually high or low pumping rates will be investigated and corrected. Higher rates may be produced if bypass valves are closed. Plugging, cavitation, waterline leaks, or pump component failure could cause lower rates.

7.2 Waterlines and Tanks

Initial dewatering of the mine will be via a down-hole pump located at the Lower or lower vent shaft (the South vent). It is anticipated that the down-hole pump once the pipe line is above ground will use flexible hose and a HDPE line to connect to the pilot plant mix tank and ultimately to the Permanent plant. All the treatment and settling equipment will be located down gradient of the south vent near where the "old" collection ponds were located. The line feeding the treatment facilities will be an above ground HDPE pipe. This will be constructed of fused 6 to 8-inch, HDPE pipe. The pipe was pressure tested prior to continuous use. The pipe will not be buried, as it will be in use for only a short period of time. It will be inspected daily to ensure that there were no leaks. Please refer to 08019-C-02 for the proposed pipeline location.

All lines within the trailer-mounted plant will be PVC pipe and will be supported on the walls of the trailer.

A chain link fence is to be constructed around the tanks, ponds and treatment plant to prevent access by large wildlife and unauthorized personnel.

The plant operators will be responsible for daily inspection of each of the tanks and the areas around the tanks. The inspection will include checking freeboard and looking for evidence of damaged liner, leaks, or erosion. The potential for leaks is generally small. Pipes, pipe connections, and overflow points will also be inspected to verify that there are no obstructions or damaged areas.

The plant operators will inspect sludge levels in the Settling Tank or Tanks to verify that there is adequate water storage capacity and the water is not being short-circuited directly to land disposal.

7.3 Treatment Plant

The degree of water treatment required during exploration and mining operations is expected to change over time. However, the water quality is expected to be relatively good during exploration thus requiring less addition of chemicals. As the operation transitions from exploration to mining, the volume of water is expected to decrease but levels of radium, uranium, and other trace metals may increase in the water due to recirculation of the water within the ore zone for drilling and other uses.

Required water monitoring will be established by the state of Utah, at that time a monitoring and sampling plan will be implemented by Uranium One.

When water samples are collected, field parameters (location, time, pH, temperature, conductivity, oxygen levels, etc.) will be recorded on a monitoring form. Field filtering and addition of preservatives will be performed in accordance with laboratory instructions. The water samples will be placed into a cooler and packed with ice for shipment to the laboratory. A completed chain-of-custody form will accompany each shipment.

Additional sampling will also be needed to properly calibrate the treatment system and trouble shoot if problems develop. More frequent water quality monitoring will probably be needed at startup and during the transition phase from "Pilot Plant" to "Permanent plant" operations. Samples of untreated water, partially treated water, and treated water may be needed to determine the correct dosing levels and to make adjustments in treatment. Field measurements (e.g., pH, conductivity) and colorimetric analysis for selected constituents (e.g., iron, Zinc) may be helpful in adjusting the treatment system in the field.

Once the untreated water reaches a steady-state situation, dosing levels are expected to become more standardized and water quality monitoring for operating purposes may be needed less frequently.

The plant operators will be responsible for ensuring that reagent tanks are full and operating properly. The reactor tanks will be inspected and cleaned as needed. The inspections will include recording flow rates, chemicals added, dosing rates, and remaining chemical inventory. The treatment trailer will be kept clean and any spillage of chemicals or solution will be cleaned up and containerized immediately.

Appendices

Appendix A

Drawings



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CONCEPTUAL PILOT PLANT LAYOUT

URANIUM ONE	
VELVET MINE WATER TREATMENT	

В	MOVED TANKS/TRAILER PER CLIENT REQUEST	KES	10-10-08			
Α	RELEASED FOR REPORT	KES	10-03-08			
6	REVISIONS	BY	DATE			





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	TYPICAL FLOW DIAGRAM 250 GPM PILOT PLANT							
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OUTFLOW 250 GPM

GRAVITY DISCHARGE TO SURFACE DRAINAGE



			Y					
SETTLING		BERM	gravity To sur	DISCHARGE	GE			
TANK	C	ONTAINMENT	OUTE	10W 2	5 GP	м		
			<u></u>	<u> </u>				
SECONDARY LINER CONTAINMENT SYNTHETIC								
SECONDART EINER CONTAINMENT STATIETIC								
					10-03	5-08		
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	NOZZLE AND MAN WAY SCHEDULE										
MARK	SIZE	RATING	FACING	PROJ.	ANGLE	SERVICE					
A	12"	150#	FLANGED	4"	45°	DISCHARGE OUTLET FOR MIXING TANK					
В	12"	150 #	FLANGED	4"	45 °	OUTLET FOR SETTLING TANK					
С	8"	150 #	FLANGED	4"	240*	FED INLET					
D	12"	150#	FLANGED	4"	315°	VENT					
E	18" MANWAY	150 #	FLANGED	3.5"/7.0"	225°	MANWAY COVER					
F	4'X4' OPENING	ATM	HOLE	-	0.	INLET					

Appendix B

Material Safety Data Sheets

Legend:

CAS # - Chemical Abstracts Service Registry Number

- CERCLA- Comprehensive Environmental Response, Compensation, and Liability Act
- CFR Code of Federal Regulations
- DOT Department of Transportation
- EPA Environmental Protection Agency
- LC_{50} The concentration of material in air expected to kill 50% of a group of test animals
- LD₅₀ Lethal Dose expected to kill 50% of a group of test animals
- MSHA Mine Safety and Health Administration
- NIOSH National Institute for Occupational Safety and Health
- PEL Permissible Exposure Limit
- PVC Polyvinyl chloride
- RCRA Resource Conservation and Recovery Act
- SARA Superfund Amendments and Reauthorization Act of the U.S. EPA
- STEL Short Term Exposure Limit
- TDG Transportation of Dangerous Goods Act/Regulations
- TLV Threshold Limit Value
- TSCA Toxic Substances Control Act
- TWA Time-Weighted Average



MATERIAL SAFETY DATA SHEET

Page 1

Printed: 11/1/01

BARIUM CHLORIDE ANHYDROUS

Ph	RODUCT IDENTIFICATION AND USE
MANUFACTURER	ATOFINA CANADA INC. 700 THIRD LINE OAKVILLE, ONTARIO L6J 5A3
EMERGENCY PHONE NUMBER:	(905) 827-9841 (ATOFINA) (613) 996-6666 (CANUTEC)
PRODUCT IDENTIFIER:	BARIUM CHLORIDE ANHYDROUS
PRODUCT CODE:	AP9020
PRODUCT USE:	CHEMICAL PROCESSING INTERMEDIATE
WHMIS CLASSIFICATION:	D18 TOXIC MATERIAL CAUSING IMMEDIATE AND SERIOUS TOXIC EFFECTS. D28 - TOXIC MATERIAL CAUSING OTHER TOXIC EFFECTS.

HAZARDOUS INGREDIENTS						
0.0100000	PERCENT	CAS#	TLV			
BARIUM CHLORIDE ANHYDROUS LD50: 300-500 KG/MG (ORAL-RAT)	60-100	10361-37-2	0.5 MG/M3 (AS BA)			

ADDITIONAL INGREDIENT INFORMATION (WHMIS NOT CONTROLLED): NA

PHYSICAL DATA				
PHYSICAL STATE:	SOLID			
ODOUR AND APPEARANCE:	WHITE GRANULAR POWDER, ODOURLESS.			
ODOUR THRESHOLD:	NE			
SPECIFIC GRAVITY/DENSITY (G/ML):	3,900 KG/M3 (20°C)			
VAPOUR PRESSURE:	NE			
VAPOUR DENSITY (AIR=1):	NE			
VOLATILITY/VOL(%):	NE			
SOLUBILITY IN H20:	330 G/L (20°C)			
EVAPORATION RATE:	NE			
BOILING POINT:	NE			
FREEZING POINT:	962°C (MELTING POINT)			
PH:	5 - 6 (IN AQUEOUS SOLUTION: 100 G/L)			
LOG KOW:	NE			
	SHIDDING INFORMATION			

UN 1564, 6.1, III, BARIUM COMPOUNDS NOS (BARIUM CHLORIDE.)

FIRE AND EXPLOSION HAZARD					
FLAMMABILITY:	NOT FLAMMABLE.				
CONDITIONS:	NA				
MEANS OF EXTINCTION:	WATER SPRAY, FOAM. USE EXTINGUISHING MEDIA APPROPRIATE				
	FOR SURROUNDING FIRE.				
FLASHPOINT:	NONE				
UPPER EXPLOSION LIMIT (% V):	NA				
LOWER EXPLOSION LIMIT (%V):	NA				
AUTO-IGNITION TEMPERATURE:	NA				
HAZARDOUS COMBUSTION PRODUCTS:	HYDROGEN CHLORIDE, PHOSGENE.				
EXPLOSION DATA:	DUST CLOUDS GENERATED DURING HANDLING / AND OR				
NA - NOT APPLICABLE	NE - NOT ESTABLISHED				



Page 2

MATERIAL SAFETY DATA SHEET

Printed: 11/1/01

BARIUM CHLORIDE ANHYDROUS

0.00	and the second second		-		
SENS	IIVITY	IO IMPA	CI:		
SENS	TIVITY 1	TO STAT	TIC DISC	HARGE:	

STORAGE CAN FORM EXPLOSIVE MIXTURE WITH AIR. NO NO

		REACTIVITY			
CHEMICAL ST/	ABILITY:	STABLE			
INCOMPATIBLE	E MATERIALS:	BORON TRIFLUORIDE, OXIDIZING AGENTS, REDUCING AGENTS, ACIDS FINE METALS.			
CONDITIONS (OF REACTIVITY:	NE			
HAZARDOUS	ECOMPOSITION	NE			
PRODUCTS:					
		HEALTH HAZARD INFORMATION			
ROUTE OF EN	TRY				
SKIN	CONTACT:	MAY CAUSE IRRITATION.			
SKIN	ABSORPTION:	NE			
EYE		MAY CAUSE IRRITATION.			
ING	ESTION:	HARMFUL IF SWALLOWED.			
INHA	ALATION:	HARMFUL IF INHALED.			
ACUTE OVER	EXPOSURE EFFECTS:	NE			
CHRONIC OVE	R EXPOSURE EFFECT	TS: NE			
SENSITIZATIO	N:	MAY CAUSE ALLERGIC SKIN REACTION.			
CARCINOGENI	CITY:	DOES NOT MEET WHMIS CRITERIA.			
TERATOGENIC	ITY:	DOES NOT MEET WHMIS CRITERIA.			
MUTAGENICITY	t:	DOES NOT MEET WHMIS CRITERIA.			
REPRODUCTIN	E TOXICITY:	DOES NOT MEET WHMIS CRITERIA.			
		PREVENTIVE MEASURES			
PERSONAL PR	OTECTIVE EQUIPMEN	IT: WEAR SAFETY GLASSES AND USE IMPERVIOUS GLOVES. A NIOSH ADDROVED DUST DESCRIPTION IS ADVISED.			
		NIOSH APPROVED DUST RESPIRATOR IS ADVISED.			
SPECIFIC ENC		5. LUCAL EXTRUST IS RECOMMENDED.			
LEAK AND SPI	LL PROCEDURES.	SWEEP OR SCOOP OF AND PLACE IN A CLOSED			
MACTE DICDO	CAL	LAZADDOUG MASTE DONOT ALLOW DDODUCT TO ENTER			
WASTE DISPO	SAL	THE ENVIRONMENT, CONSULT FEDERAL OR LOCAL			
		AUTHORITES FOR APPROVED DISPOSAL METHODS.			
HANDLING PR	OCEDURES AND EQU	IPMENT: WASH BEFORE EATING, DRINKING, USING TOBACCO			
		PRODUCTS OR REST ROOMS.			
STORAGE REG	UIREMENTS:	AREA.			
		FIRST AID MEASURES			
EYE	FLUSH EYES WITH L	ARGE AMOUNT OF WATER FOR 15 MINUTES WHILE HOLDING EYELIDS			
1000	OPEN. SEEK MEDICA	AL ATTENTION.			
SKIN	WASH SKIN WITH WA PERSISTS.	ATER AND SOAP. SEEK MEDICAL ATTENTION IF IRRITATION OCCURS OR			
INGESTION	STION DO NOT GIVE LIQUIDS IF PERSON IS UNCONSCIOUS OR VERY DROWSY. OTHERWISE GIVE ONE TABLESPOON OF EPSON SALTS AND SEEK IMMEDIATE MEDICAL ATTENTION. INDUCE				
INHALATION	REMOVE PERSON TO ARTIFICIAL RESPIRA ATTENTION.	O FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, APPLY ATION AND ADMINISTER OXYGEN IF NECESSARY. SEEK MEDICAL			
	ICABLE	NE - NOT ESTABLISHE			



MATERIAL SAFETY DATA SHEET

Page 3

BARIUM CHLORIDE ANHYDROUS

Printed: 11/1/01

PREPARATION DATE
PREPARED BY: TECHNICAL DEPARTMENT.
PHONE NUMBER OF PREPARER: 905-827-9841
DATE PREPARED (MM/DD/YY): 01/16/92
DATE REVISED (MM/DD/YY): 11/01

MINIMUM CONTACT WITH THIS AND ALL CHEMICALS IS RECOMMENDED AS A GOOD GENERAL POLICY TO FOLLOW,

THE INFORMATION PRESENTED HEREIN HAS BEEN COMPILED FROM SOURCES CONSIDERED TO BE DEPENDABLE AND IS ACCURATE TO THE BEST OF OUR KNOWLEDGE. HOWEVER, SINCE DATA, SAFETY STANDARDS, AND GOVERNMENT REGULATIONS ARE SUBJECT TO CHANGE AND THE CONDITIONS OF HANDLING AND USE, OR MISUSE ARE BEYOND OUR CONTROL, ATOFINA CANADA MAKES NO WARRANTY EXPRESSED OR IMPLIED, WITH RESPECT TO COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN AND DISCLAIMS ALL LUBILITY FOR RELIANCE THEREON. USER SHOULD SATISFY HIMSELF THAT HE HAS ALL CURRENT DATA RELEVANT TO HIS PARTICULAR USE.

NA - NOT APPLICABLE

NE - NOT ESTABLISHED



Univar USA Inc. 6100 Carillon Point Kirkland, WA 98033 (425) 889-3400

For Emergency Assistance involving chemicals call - CHEMTREC (800) 424-9300

The Version Date for this MSDS is : 06/12/2002

PRODUCT NAME: FERRIC SULFATE, GRANULAR

MSDS NUMBER: P17978VS

DATE ISSUED: 08/18/00

SUPERCEDES: 07/96

ISSUED BY: 008516

MATERIAL SAFETY DATA SHEET

FERRIC SULFATE GRANULAR

This information Is required to be disclosed for safety to the workplace. This MSDS has been prepared within the guidelines of the Federal OSHA, Hazard Communication Standard, 29CFR 1910.1200. The D.O.T. and EPA consider Ferric Sulfate a Hazardous Substance,

I. PRODUCT IDENTIFICATION

Formula: Fe2(SO4)3 X 9H2O Synonyms/Common Names: Iran Sulfate; Ferric Sulfate

KEMWATER FERIX-3. CAS Number 10028-22-6 DOT Proper Shipping Name- Environmentally hazardous substances. solid, N.O.S. DOT Hazard Class: 9 DOT I.D. Number. UN 3077. PG III DOT Hazardous Substance: RQ= 1000lbs.

II PHYSICAL DATA

Appearance and Odor- Hydtoscopic, yellowish crystals or grayish-while powder. Slight odor. Freezing Point. N/A Boiling Point, N/A Malting Point; 896 F (480 C) Water Solubility-. 99% pH: <1 In solution Molecular weight: 562.0 Specific Gravity: 3.1

III. FIRE AND EXPLOSION DATA

Flesh Point; N/A Autoignition Temperature; N/A

Extinguishing Media: Use extinguishing media as appropriate for surrounding fire. Negligible fire hazard when used to heat or flame. No acute hazard. Move container from fire area if possible. Avoid breathing vapors or dust; keep upwind. Ferric Sulfate is not considered flammable but breathing the fumes or dusts from an ensuing fire in the area can be harmful to the respiratory tract and eyes.

Emergency Wash Facilities: Where there is any possibility that an employee's eyes or skin may become exposed to this substance the employer should provide a safety shower and eye wash station within the immediate work area for emergency use.

Clothing: Protective clothing is not required for Ferric Sulfate. Avoid repeated or prolonged contact with this substance. Gloves: Protective gloves are not required but are recommended.

Proper decontamination procedures should be followed after any contact with the substance. Thoroughly wash any clothing and equipment with roptous amounts of water. Dispose of the wash water to a suitable waste water facility.

IV. SPILL OR LEAK HANDLING

IN CASE OF EMERGENCY, CALL CHEMTREC (800) 424-9300.

Reportable Quantity per 40 GFR 3024 Is 1000 pounds.

Occupational Spills: For large splills, sweep up with minimum of dusting and place into suitable clean, dry containers for reclamation or later disposal. Residue should be cleaned up using a high efficiency particulate filter vacuum.

The Reportable Quantity or 1000 pounds requires notification to the local Emergency Planning Committee and the State Emergency Response Commission. It the release is reportable under CERCLA, the National Response Center must be notified immediately at (800) 424-8802

V. PROTECTIVE EQUIPMENT REQUIREMENTS

Ventilation Requirements: Provide local exhaust ventilation system to meet published exposure limits.

Eye Protection: Employees must wear splash-proof or dust resistant safety goggles and a face shield to prevent contact with this substance.

Respiratory Requirements. The following respirators are recommended based on Information found in the physical data. toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection. The specific respirator selected must be based on contamination levels found in the work place. They must be based on the specific operation, and must not exceed the working limits of the respirator. The National Institute must jointly approve them for Occupational Safety and Health and the Mine Safety and Health Administration. For fire fighting any supplied-air respirator that has a full facepiece and is operated in a pressure demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.

VI. HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substances Store in dry, well-closed containers. Store away from incompatible substances.

The following facilities should be readily accessible in all areas where this material is handled or stored: Safety showers with quick opening valves which open. Water should be supplied through insulated and heat traced lines to prevent freeze ups in cold weather; Eye wash fountains - or other means of washing the eyes with a gentle flow of tap water.

VII. TOXICOLOGY

Inhalation: ACUTE EXPOSURE: May cause irritation with coughing, sneezing or difficulty breathing.

CHRONIC EXPOSURE: No data available.

ANHYDROUS: 601 mg/kg Intrapar/toneal-mouse LD50, mutagenic data (RTECS), Hydrate: No data available.

CARCINOGEN STATUS: NONE

LOCAL EFFECTS: Irritant- Inhalation. skin, and eyes,

ACUTE TOXICITY LEVEL: insufficient data

TARGET EFFECTS: Poisoning may offset the liver and kidneys. At increased risk from exposure: Persons with preexisting skin disorders, eye problems, or impaired liver, kidney, or respiratory function.

Skin Contact FERRIC SULFATE; IRRITANT ACUTE EXPOSURE: Ferric sulfate may cause irritation, CHRONIC EXPOSURE: No data available

Eye Contact: IRRITANT ACUTE EXPOSURE: May cause Irritation. redness. and corneal burns due to the reaction of the compound with Moisture to form sulfuric acid. CHRONIC EXPOSURE. Repeated or prolonged contact with irritants may cause conjunctivitis or effects similar to those fear acute exposure. Exposure Limit Information.

The Fed	leral OSHA	1	mg/m3	TWA
ACGIH		1	mg/m3	TWA
NIOSH 1	recommended	1	mg/m3	TWA

OSHA revoked the final rule limits of January 19, 1989 In response to the 11th Circuit Court of Appeals decision (AFL-CIO v, OSHA) effective June 30, 1993. See 29 CFR 1910,1000 (88 FR 35388)

VIII. FIRST AID

INHALATION FIRST AID. Remove from exposure area to fresh air immediately. Perform artificial respiration it necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

Ingestion: If patient is not in shock or coma, Induce emisis with syrup of ipecac, if vomiting has not occurred. Follow with gastric lavage using deferoxamine, 2 grams in 1 liter of water containing sodium bicarbonate in the stomach. Maintain airway, blood pressure and respiratory Treatment should be administered by qualified medical personnel. Get medical attention immediately. Skin Contact: Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes.)

Eye Contact: Immediately flush the eyes with large quantities of running water for a minimum of 15 minutes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eye and lids with water. Do not attempt to neutralize with chemical agents. Obtain medical attention as soon as; possible. Oils or ointments should not he used. Continue the flushing for an additional 15 minutes If the physician is rot Immediately available.

NOTE TO PHYSICIAN:

ANTIDOTE:

The following antidote has been recommended However. the decision as to where the seventy of poisoning requires administration of any antidote and actual dose required should be made by qualified medical personnel. Iron Salt Poisoning. Give deferoxamine, 15 mg/kg hour by continuous intravenous infusion to a maximum of 80 mg/kg In each 12 hour period. Monitor the blood pressure during administration of deferoxamine and reduce the rate of administration if the blood pressure falls. Single doses should not exceed 1 gram and the maximum to 24 hours should not exceed 6 grams. Deferoxamine is hazardous in patients with severe renal disease or anuria, and dialysis is necessary.

Injected deferoxamine is associated with a high risk and should be reserved for serious poisoning. Continue deferoxamine therapy until the patient is free of symptoms and signs for 24 hours.

IX. REACTIVITY DATA

REACTIVITY: Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:

Prevent dispersion of dust to the air.

INCOMPATIBILITIES Mineral Acids- Incompatible Hazardous Decomposition;- Thermal decomposition products may include toxic and hazardous oxides or Iron and sulfur.

POLYMERIZATION: Not applicable

X. TRANSPORTATION DATA

D.O.T. Proper Shipping Description: Environmentally Hazardous Substance, Solid, N.O.S. (Ferric Sulfate (Granular), 9, UN 3077, PGIII

D.O.T. Hazard Class or Division: 9 D.O.T. Packing Group. PGIII D.O.T. Labeling Requirements: Class 9

XI DISPOSAL

If this product becomes a hazardous waste, it must be disposed of in accordance with all federal, state. and local health and pollution regulations.

XII. ADDITIONAL REGULATORY STATUS INFORMATION

TSCA STATUS: YES

CERCLA SECTION 103 (40CFR302A): SARA SECTION 302 (40CFR366.30); NO SARA SECTION 304 (40CFR366AO): NO SARA SECTION 313 (40CFR372.65); NO

OSHA PROCESS SAFETY (29CFR1910.119): NO

CALIFORNIA PROPOSITION 65: NO

SARA HAZARD CATEGORIES

SARA SECTIONS 311/312 (40CFR370.21)ACUTE HAZARDYESCHRONIC HAZARDNOFIRE HAZARDNOREACTIVITY HAZARDNOSUDDEN RELEASE HAZARDNO

XIII, ADDITIONAL INFORMATION

All information is offered in good faith, without guarantee or obligation for the accuracy or sufficiency thereof, or the results obtained. and is accepted at user's risk. The uses referred to are for the purpose of illustration only, User should investigate and establish the suitability of such use(s)) in every case, Nothing herein shall be construed as a recommendation for use which infringe valid patents or as extending license under valid patents.

XIV SOURCE OF REFERENCES

1. ACGIH Guide to Protective Clothing. Cincinnati. OH: American Conference of Government Industrial Hygienists, 1987.

Z ANSI Z88.2 Recommended Practice for Respiratory Protection. American National Standards Institute. New York, NY,

3. Baker, C.J., The Fire Fighter's Handbook of Hazardous Materials, 4th Ed., Indiana: Maltese Enterprises, Inc, 1984.

4. 8retherick, L.. Handbook of Reactive chemical Hazards, 3rd Ed, Boston, MA: Sulterworths, 1985.

5 Casarelt L. and J. Doull, Eds., Toxicology: the Basic Science of Poisons, 3rd Ed., New York: Macmillan Publishing Co., Inc, 1986

6. Chemical Degradation and Permeation Database and Selection Guide for Resistant Protective Materials. Austin, Texas.

7. Clayton G, and F. Clayton, Eds., Patty's Industrial Hygiene and Toxicology, Vol. 2A-C 3rd Ed., New York; John Wiley & Sons, 1981 1982.

8. Code of Federal Regulations, Titles 21, 29, 40 and 49, Washington, DC: U.S. Government Printing office. 9. Emergency Response Guide (DOT), Washington, DC: U.S. Government Printing Office, 1987.

10. Fire Protection Guide on Hazardous Materials. 9th Ed., National Fire Protection Association, Batterymarch Park, Quincey, MA, 1986.

11. Gosselin. R., et al., Gosselin-Clinical Toxicology of Commercial Products, 5th Ed., Baltimore; Willaims and Wilkins, 1984.

12. Hazendilne. Occupational Health Service, Inc,, New York, NY.

13. Lenga. R., The Sigma-Aldricb Library Chemical Safety Data, 1st Ed., Milwaukee, WI: Sigma-Aiddeh Corporation, 1985.

14. Lowls, R and D. Sweet Eds. Registry of Toxic Effects of Chemical Substances, 1985 1986, Washington, DC, U.S, Government Printing Office 1987.

15. NIOSH Pocket Guide to Chemical Hazards, Washington, DC, U.S. Government Printing Office, 1992.

16, Sax, N. Irving, Dangerous Properties of Hazardous Materials 6th Ed.. New York. Van Nostrand Reinhold Company. 1984.

17. Threshold Limit Values and Biological Exposure Indices for 1991-1992. Cincinnati, OH: American Conference of Government Industrial Hygienists, 1992.

18. Toxic Substance Control Act Inventory, Washington, DC; U.S. Government Printing Office, 1985.

FOR FURTHER PRODUCT INFORMATION CONTACT:

KEMIRON ATLANTIC P.O. BOX 2247 EAST PRESIDENT ST. Ext SAVANNAH, GEORGIA 31404 (800) 342-8755 CUSTOMER SERVICE (912) 234-8605 PLANT (912) 234-7041 FAX

For Additional Information: Contact: MSDS Coordinator - Univar USA During business hours, Pacific Time - (425) 889-3400

NOTICE

Univar USA expressly disclaims all express or implied warranties of merchantibility and fitness for a particular purpose with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this MSDS as a product specification. For product specification information refer to a Product Specification Sheet and/or a Certificate of Analysis. These can be obtained from your local Univar USA Sales Office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar USA makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar USA's control. Therefore, users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes, and they assume all risks of their use, handling, and disposal of the product or from the publication or use of, or reliance upon, information contained herein. This information relates only to the product designated herein and does not relate to its use in combination with any other material or in any other process.

END OF MSDS

MSDS 5500 PAGE 1 OF 3

MATERIAL SAFETY DATA SHEET

PRODUCT: GREATFLOC 5500

GREAT DIVIDE LIMITED PO BOX 901415 SANDY, UT 84090-1415 **Emergency Telephone Number** 801-943-6609

SECTION 1 PRODUCT IDENTIFICATION TRADE NAME: GREATFLOC 5500 DESCRIPTION: An acrylamide polymer NFPA 704M/HMIS RATING: 1/1 HEALTH 1/1 FLAMMABILITY 0/0 REACTIVITY 0 OTHER 0=Insignificant 1= Slight 2= Moderate 3= High 4= Extreme

SECTION 2 HAZARDOUS INGREDIENTS

Our hazard evaluation of the ingredient(s) under OSHA'S Hazard Communication Rule, 29 CFR 1910.1200 has found the following ingredient(s) hazardous. CAS# APPROX % INGREDIENT NONE

SECTION 3 PRECAUTIONARY LABEL INFORMATION

CAUTION: Avoid contact with skin, eyes and clothing. Do not take internally Empty containers may contain residual product.

SECTION 4 FIRST AID INFORMATION

EYES: Flush with water for 15 minutes. Call a physician. SKIN: Wash thoroughly with soap and water. Rinse thoroughly. INGESTION: Do not induce vomiting. Give Water. Call a physician. NOTE TO PHYSICIAN: No specific antidote is known. CAUTION: If unconscious, having trouble breathing or in convulsions, do not induce vomiting or give water.

SECTION 5 HEALTH EFFECTS INFORMATION

PRIMARY ROUTE(S) OF EXPOSURE: Eye, Skin EYE CONTACT: Can cause slight irritation. SKIN CONTACT: Can cause slight irritation. SYMPTOMS OF EXPOSURE: A review of available data does not identify any symptoms from exposure.

AGGRAVATION OF EXISTING CONDITIONS: A review of available data does not identify any worsening of existing conditions.

SECTION 6 TOXICOLOGY INFORMATION None available

SECTION 7 PHYSICAL AND CHEMICAL PROPERTIES

COLOR: White FORM: Dry granule/powder ODOR: None DENSITY: 40-50 lbs/cu. ft. SOLUBILITY IN WATER: 100% SOLUBILITY IN WATERS ASTM D-1298 ASTM E-70 pH (NEAT) = NA FREEZE POINT: NA ASTM D-1177 FLASH POINT: >200 ° F (PMCC) ASTM D-93 VAPOR PRESSURE: >1.0 mm Hg @ 20 ° C ASTM D-323 NOTE: These physical properties are typical values for this product.

SECTION 8 FIRE AND EXPLOSION INFORMATION

PAGE 2 OF 3 MSDS 5500

FLASH POINT: Greater than 200 ° F (PMCC) ASTM D-93

PREFERRED FIRE EXTINGUISHING AGENTS: FOAM, CARBON DIOXIDE, OR DRY CHEMICAL. CAUTION: WATER MAY CAUSE EXTREMELY SLIPPERY CONDITIONS. Use water to cool containers

exposed to fire.

UNUSUAL FIRE AND EXPLOSION HAZARD: May evolve NOx under fire conditions.

SECTION 9 REACTIVITY INFORMATION

INCOMPATABILITY: Avoid strong oxidizers, chlorine, peroxide, nitric acid, etc., which can generate heat with splattering or boiling and the release of toxic fumes.

THERMAL DECOMPOSITION PRODUCTS: In the event of combustion CO, CO2, NOx may be formed. Do not breathe smoke or fumes. Wear suitable protective equipment.

SECTION 10 PERSONAL PROTECTION EQUIPMENT

RESPIRATORY PROTECTION: Respiratory protection is not normally needed since the volatility and toxicity are low when product is in solution. OSHA approved dust mask should be used when opening and emptying containers of dry product.

VENTILATION: General ventilation is recommended.

PROTECTIVE EQUIPMENT: Use impermeable gloves and chemical splash goggles when attaching feeding equipment or doing maintenance.

If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

SECTION 11 SPILL AND DISPOSAL INFORMATION

IN CASE OF TRANSPORTATION ACCIDENTS, CALL 801-943-6609

SPILL CONTROL AND RECOVERY:

Small liquid solution spills: Contain with absorbent material, such as clay, soil or any commercially available absorbent. Shovel reclaimed liquid and absorbent into recovery or salvage drums for disposal. Refer to CERCLA in Section 14.

Large liquid solution spills: Dike to prevent further movement and reclaim into recovery or salvage drums or tank truck for disposal. Refer to CERCLA in Section 14.

DISPOSAL: If this product becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.

As a non-hazardous liquid waste, it should be solidified with stabilizing agents (such as sand, fly ash, or cement) so that no free liquid remains (if in solution) before disposal to an industrial waste landfill. A non-hazardous waste can also be incinerated in accordance with local, state and federal regulations.

SECTION 12 ENVIRONMENTAL INFORMATION

If released into the environment, see CERCLA in Section 14.

SECTION 13 TRANSPORTATION INFORMATION

DOT PROPER SHIPPING NAME/HAZARD CODE ~ PRODUCT IS NOT REGULATED DURING TRANSPORTATION

SECTION 14 REGULATORY INFORMATION

The following regulations apply to this product.

FEDERAL REGULATIONS: OSHA's HAZARD COMMUNICATIN RULE, 29 CFR 1910.1200: Based on our hazard evaluation, the following ingredients in this product are hazardous.

CERCIA, 40 cfr 117, 302: Notification of spills of this product is not required

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III)- SECTIONS 302, 311,312 AND 313:

PAGE 3 OF 3 MSDS 5500

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355): This product does not contain ingredients listed in Appendix A and B as an Extremely Hazardous Substance.

SECTIONS 311 AND 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370): Our hazard evaluation has found that this product is not hazardous under 29 CFR 1910.1200. EPA HAZARD CLASSIFICATION CODE: ACUTE......NO FIRE.....NO CHRONIC....NO PRESSURE...NO

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372):

This product does not contain ingredients (at a level of 1% or greater) on the List of Toxic Chemicals.

TOXIC SUBSTANCES CONTROL ACT (TSCA): The chemical ingredients in this product are on the 8(b) Inventory List (40CFR 710).

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA), 40 CFR 261 SUBPART C & D: If this product becomes a waste, it does not meet the criteria of a hazardous waste.

STATE REGULATIONS:

STATE RIGHT TO KNOW LAWS: This product does not contain ingredients listed by State Right To Know Laws.

SECTION 15 ADDITIONAL INFORMATION None

SECTION 16 USER'S RESPONSIBILITY

This product material safety data sheet provides health and safety information. This product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations. Please consult your local sales representative for any further information.

PREPARED BY : W.K. Gustafson DATE CHANGED: 11/3/97

DATE PRINTED: 9/14/2005

Material Safety Data Sheet May be used to comply with OSHA's Hazard Communication Standard 29 CFR 1910.1200. Standard must be consulted for specific requirements.			U.S. Department of Labor Occupational Safety and Health Administration (Non-Mandatory Form) Form Approved OMB No. 1218-0072					
IDENTITY Hydrated Li	me Slurry		Note: Blank spaces a	are not permitted. If any	item is not applicable	ə, or no		
Ca(OH) ₂ (Calcium hydrox	(ide slurry)	and the second	information is a	vailable, the space mu	st be marked to indica	ite that.		
Section I					3. 90000 0.000			
Manufacturer's Name and Add Chemical Lime Company	iress ,		Emergency Telephone Number Chemtrec 800-424-9300					
3724 Hulen Street Fort Worth, Texas 76107	,		Information Phon 817-732-8164	e Number	Date Prepared 11/18/2004			
Section II - Hazardous I	entity Information		979-1					
Hazardous Components	CAS	Common Name	OSHA PEL	ACGIH TLV	Other Limits	% (optional)		
Calcium hydroxide	1305-62-0	Hydrated Lime	5 ma/m3	5 mg/m3	7340 ma/ka	20-55%		
Magnesium hydroxide	1309-42-8	Brucite	NΔ	N A		<5%		
Silicon dioxide	14808 60.7	Quartz		0.1 mg/m2	1 ma/m2	-20%		
	14000-00-7	When persenters of all	see note below		+ mg/ma	-2.70		
Section III Physical/Ch	mis aividea by	toristics	ca in the dust pit	us 2) (respirable)			
Belling Delet	100 °C	Mallar Dalat	dog 580 °C	Develop Oresthe	10 15	<i>alaa</i>		
Vapor Pressure (mm Ha)	NA	Vapor Density	N A	Evaporation Pate	1.2 - 1.5	N A		
Solubility in Water	Material is a s	stable suspension of ca	lcium hydroxide	in water pH=1	2 4@25°C	11.0.		
Appearance and Odor	White low vise	cosity liquid, odorless	in a la l	in materic pro-				
Section IV - Fire and Ex	plosion Hazar	d Data						
Flash Point	LEL/UEL	Flammable Limits	Extinguishing Me	dia				
N.A.	N.A.	N.A.	Not Combustible	Use extinguishing a	gent for surroundi	ng fire		
Special Firefighting Procedure	s/Unusual Fire ar	nd Explosion Hazards				- 34740-00 - 10 - 10		
Avoid skin contact or inha	alation of dust if	f material becomes dry						
Section V - Reactivity D	ata			ā sa sa	1.11.1.1.1.1.Berg			
Stability Conditions to Stable Material is s	Avoid (stability - r table	elated)						
Incompatibility (Materials to A	vold)		t er sinn					
Acids: Reacts vigorously	and produces	heat. Maleic Anhydrid	e: May react ex	plosively. Nitro	Organic			
Compounds: May react t	o form explosiv	e salts. Phosphorous:	May form flam	mable products	when heated.			
Aluminum: May react to	form hydrogen	gas.			enciet defined and			
Hazardous Polymerization/Haz	zardous Decompo	sition of Byproducts		Will not occur (none)			
Section VI - Health Haza	ird Data							
Route(s) of Entry:	Inhalation, Ing	jestion						
Avoid skin and eve conta	ronic) ct as irritation w	vill occur. Contact lense	es should not be	worn when wor	king with lime	products		
Inhalation of mist or dried	dust can caus	e couahina, sneezina,	or breathing prol	blems.	ang marinno j	5100000		
Carcinogenicity:	OSHA?	SiO ₂	NTP/IARC Monog	raphs?	SiO ₂			
Respirable crystalline silic	a from occupa	tional sources is classi	fied by IARC as	a Group I Carci	nogen.			
California Proposition 65:	Silica is on the	e Governor's Propositio	on 65 list. Comp	onents used in	this product ma	ay .		
contain trace amounts of	Innerent natura	ny occurring elements	(such as, but no	t imited to arse	nic, cadmium)			
that are on the Governor:	s Fioposidon o	o not.						

Material Safety Data Sheet May be used to comply with OSHA's Hazard Communication Standard 29 CFR 1910.1200 Standard must be consulted for specific requirements. IDENTITY Hydrated Lime Slurry			U.S. Department of Labor Occupational Safety and Health Administration (Non-Mandatory Form) Form Approved OMB No. 1218-0072 Note: Blank spaces are not permitted. If any item is not applicable, or no					
Ca(OH) ₂ (Calcium hydros	(de slurry)							
Section I								
Manufacturer's Name and Address			Emergency Telephone Number					
Chemical Lime Company			Chemtrec 800-424-9300					
3724 Hulen Street			Information Phone Number Date Prepared					
Section II - Hazardous I	naredients/Ider	tity Information	017-732-0104		11/10/2004			
	angreuteritärider		00114 071	100011711	Other Linelte	N / W W		
Hazardous Components	CAS	Common Name	OSHA PEL ACGIH TL		Other Limits	% (optional)		
Calcium hydroxide	1305-62-0	Hydrated Lime	5 mg/m3	5 mg/m3	7340 mg/kg	20-55%		
Magnesium hydroxide	1309-42-8	Brucite	N.A.	N.A.		<5%		
Silicon dioxide	14808-60-7	Quartz	*see note below	0.1 mg/m3	4 mg/m3	<2%		
*SiO2 OSHA PEL: 10 ma	/m3 divided by ((the percentage of sili	ca in the dust plu	us 2) (respirable)			
Section III - Physical/Ch	emical Charac	teristics						
Bolling Point	100 °C	Melting Point	dec. 580 °C	Specific Gravity	1.2 - 1.5	g/cc		
Vapor Pressure (mm Hg)	N.A.	Vapor Density	N.A.	Evaporation Rate		N.A.		
Solubility in Water	Material is a st	able suspension of ca	lcium hydroxide	in water. pH=1	2.4@25°C			
Appearance and Odor	White low visc	osity liquid, odorless		50 50				
Section IV - Fire and Ex	plosion Hazard	Data				and a second state where		
Flash Point	LEL/UEL	lammable Limits	Extinguishing Me	dia				
N.A.	N.A.	N.A.	Not Combustible -	Use extinguishing a	gent for surroundi	ng fire		
Special Firefighting Procedure	es/Unusual Fire and	d Explosion Hazards						
Avoid skin contact or inha	alation of dust if	material becomes dry	•					
Presting V. Depatholity D			1000 C 10 874		158			
Section V - Reactivity D	ata							
Stability Conditions to	Stability Conditions to Avoid (stability - related)							
Incompatibility (Materials to A	vold)	ining and the second states and the second				singer ergenen estingen inner		
Acids: Reacts vigorously	and produces h	eat. Maleic Anhydrid	e: May react ex	plosively. Nitro	Organic			
Compounds: May react to form explosive salts. Phosphorous: May form flammable products when heated								
Aluminum: May react to form hydrogen gas.								
Hazardous Polymerization/Hazardous Decomposition of Byproducts Will not occur (none)								
Section VI - Health Hazard Data								
Route(s) of Entry:	Inhalation, Inge	estion						
Health Hazards (Acute and Ch	ronic)							
Avoid skin and eye conta	ct as irritation wi	Il occur. Contact lense	es should not be	worn when wor	king with lime	products.		
Inhalation of mist or dried	dust can cause	coughing, sneezing,	or breathing prol	blems.	80			
Carcinogenicity: OSHA? SIO ₂ NTP/IARC Monographs? SIO ₂								
California Proposition 65	Silica is on the	Governor's Propositi	ned by IARC as	a Group I Carcli	this product me	91/		
contain requestion of since is on the dovernor's proposition to its. Components used in this product may								
that are on the Governor's Proposition 65 list.								

Chemical Li	me Company	Hydrated Lime Slur	ry MSDS	page 2/2		
Section VI	- Health Hazard Data (cont	inued)	5 10 - 3 TOURED O DA <u>100 AN NESO</u> RA			
Signs and Syn	nptoms of Exposure					
Skin or eye	irritation; coughing or breath	ing problems.				
Medical Condi	tions Generally Aggravated by E	posure				
Respiratory	problems, asthma, dermatit	is or skin or eye sensiti	vity.			
Emergency an	d First Aid Procedure					
Flush contai	minated area with excess w	ater. If eye contact, rir	ise eye with e	eye wash solution or excess water		
and seek m	edical attention immediately					
Section VII	 Precautions for Safe Har 	ndling and Use				
Steps to be Ta	ken in Case Material Is Released	or Spilled				
Protect skin	and eyes from contact and	avoid inhalation of mist	. Collect by I	mop other suitable method.		
Place in stee	el container.					
Waste Disposa	al Method					
Add water to	o dilute and flush to sewer.	Consult local, state, or	federal regula	ations.		
Precautions to	be Taken in Handling and Stora	je				
Store in tigh	tly closed containers and ke	ep away from acids or	other incomp	atible substances.		
Do not store	or ship in aluminum contail	iers.				
Other Precauti	ons					
Avoid eye co	ontact and breathing dust if	material becomes dry.				
NFPA Rating: HEALTH: 1 FLAMMABIL			: 0	REACTIVITY: 0		
HMIS Rating: HEALTH: 1 FLAMMAE			: 0	REACTIVITY: 0		
WHMIS Rating	: D2A, E			00000000000000000000000000000000000000		
Section VIII	- Control Measures					
Respiratory Pr	otection (Specify Type)					
Dust masks	meeting the NIOSH N95 ra	ing are sufficient for ca	sual exposur	e to mist or dust. (42 CFR)		
Ventilation	Local Exhaust	100 Martin 1	Special	Do not dispose of dust with		
	N.A.			combustible materials.		
	Mechanical (General) N.A.		Other			
Protective Glo	Ves	Other Protective Clothi	ng or Equipmen	ıt		
	bber gloves	Full clothing to cove	Full clothing to cover arms and legs, safety glasses or face shield.			
Clean dry ru		and the second se		the summer is a state of the st		
Clean dry ru Work/Hygienic	Practices					

comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must consult their own technical and legal advisors and/ or exercise their own judgment in determining its appropriateness for a particular purpose. Chemical Lime Company makes no representations or warranties, either express or implied, including without limitation and warranties of merchantability or fitness for a particular purpose with respect to the information set forth herein or the product(s) to which the information refers. Accordingly, Chemical Lime Company will not be responsible or liable for any claims, losses or damages resulting from the use of or reliance upon or failure to use this information.

References: Sax, N.I. & R.J. Lewis Sr. (1989) "Dangerous Properties of Industrial Materials", New York: Van Nostrand Reinhold Co. Ltd. Lewis, R.J. (1997) "Hazardous Chemicals Desk Reference", New York: Van Nostrand Reinhold Co. Ltd. KSA

Chemical Lin	ne Company	Hydrated Lime Slur	ry MSDS	page 2/2		
Section VI -	Health Hazard Data (conti	nued)				
Signs and Sym	ptoms of Exposure					
Skin or eye i	rritation; coughing or breath	ng problems.				
Medical Conditi	lons Generally Aggravated by Ex	posure				
Respiratory p	problems, asthma, dermatiti	s or skin or eye sensiti	vity.			
Emergency and	First Aid Procedure					
Flush contan	ninated area with excess wa	ter. If eye contact, rin	ise eye with e	ye wash solution or excess water		
and seek me	dical attention immediately.			and and a second state of a residue the form of the second state of a second state of the second state of the s		
Section VII -	Precautions for Safe Han	dling and Use				
Steps to be Tak	en in Case Material is Released o	or Spilled				
Protect skin a	and eyes from contact and a	woid inhalation of mist	. Collect by n	nop other suitable method.		
Place in stee	l container.					
Waste Disposal	Method					
Add water to	dilute and flush to sewer. O	Consult local, state, or	federal regula	tions.		
Precautions to	be Taken in Handling and Storag	9				
Store in tight	ly closed containers and kee	ep away from acids or	other incompa	atible substances.		
Do not store	or ship in aluminum contain	ers.				
Other Precautio	ns					
Avoid eye co	ntact and breathing dust if r	naterial becomes dry.				
NFPA Rating: HEALTH: 1 FLAMMABILI			0	REACTIVITY: 0		
HMIS Rating: HEALTH: 1 FLAMMAB			: 0	REACTIVITY: 0		
WHMIS Rating:	D2A, E					
Section VIII	- Control Measures					
Respiratory Pro	tection (Specify Type)					
Dust masks r	meeting the NIOSH N95 rati	ng are sufficient for ca	sual exposure	e to mist or dust. (42 CFR)		
Ventilation	Local Exhaust		Special	Do not dispose of dust with		
	N.A.			combustible materials.		
	Mechanical (General)		Other			
Protective Glov	0.F	Other Protective Clothi	i or Equipment	na an a		
I OLECTIVE CION	ber gloves	Full clothing to cove	Full clothing to cover arms and lags, safety plasses or face shield			
Clean dry rut	Jour Biorea	I an cloaning to cove	and le	go, carety glasses of lass shield.		
Clean dry rub	Practices					
Clean dry rub Work/Hygienic I Eve wash an	Practices d shower station should be	readily available				

comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must consult their own technical and legal advisors and/ or exercise their own judgment in determining its appropriateness for a particular purpose. Chemical Lime Company makes no representations or warranties, either express or implied, including without limitation and warranties of merchantability or fitness for a particular purpose with respect to the information set forth herein or the product(s) to which the information refers. Accordingly, Chemical Lime Company will not be responsible or liable for any claims, losses or damages resulting from the use of or reliance upon or failure to use this information.

References: Sax. N I. & R J. Lewis Sr. (1989) "Dangerous Properties of Industrial Materials", New York: Van Nostrand Reinhold Co. Ltd. Lewis, R J. (1997) "Hazardous Chemicals Desk Reference", New York: Van Nostrand Reinhold Co. Ltd. KSA

Appendix C

Sludge Analysis and Testing



ENERGY LABORATORIES, INC. * 2393 Salt Creek Highway (82601) * PO Box 3258 * Casper, WY 82602

LABORATORY ANALYTICAL REPORT

Client:	Energy Fuels Resources Corporation	Report Date:	04/04/07
Project:	Energy Queen	Collection Date:	03/07/07 13:15
Lab ID:	C07030454-001	DateReceived:	03/09/07
Client Sample ID:	EQ-Pond	Matrix:	Sludge

Analyses	Result	Units	Qualifier	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
Filterable	Yes					SW1311	03/12/07 14:44 / dcj
METALS - TCLP							
Arsenic	ND	mg/L		0.50	5	SW6010B	03/15/07 16:58 / cp
Barium	ND	mg/L		10	100	SW6010B	03/15/07 16:58 / cp
Cadmium	ND	mg/L		0.10	1	SW6010B	03/15/07 16:58 / cp
Chromium	ND	mg/L		0.50	5	SW6010B	03/15/07 16:58 / cp
Lead	ND	mg/L		0.50	5	SW6010B	03/15/07 16:58 / cp
Mercury	ND	mg/L		0.02	0.2	SW7470A	03/21/07 14:35 / kes
Selenium	ND	mg/L		0.10	1	SW6010B	03/15/07 16:58 / cp
Silver	ND	mg/L		0.50	5	SW6010B	03/15/07 16:58 / cp
RADIONUCLIDES - TOTAL							
Radium 226	2.1	pCi/g-dry		0.1		E903.0	04/02/07 06:22 / trs
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	04/02/07 06:22 / trs
Radium 228	ND	pCi/g-dry		0.1		RA-05	03/26/07 13:39 / plj
Uranium	25.2	mg/kg-dry	D	0.03		SW6020	03/16/07 21:40 / bas
Uranium, Activity	17.1	pCi/g-dry	D	0.02		SW6020	03/16/07 21:40 / bas

Report Definitions: RL - Analyte reporting limit. QCL - Quality control limit. D - RL increased due to sample matrix interference. MCL - Maximum contaminant level. ND - Not detected at the reporting limit.