



May 27th, 2019

Ms. Tracey Braun
Director - Environmental Approvals Branch
123 Main Street, Suite 160
Winnipeg, Manitoba R3C 1A5

Ms. Braun,

Re: Notice of Minor Alteration to Environment Act License 1881

Vale Canada Ltd. (Vale) proposes to alter the process for treating eluate from the Birchtree Mine Effluent Treatment Plant.

A description of the current process is detailed in the Public Registry 557.10 Vale Canada Limited, Manitoba Operations; Appendix 6.1 Comprehensive Report of Vale Canada Limited August 3, 2015 Final, 2.4 Birchtree Mine.

Vale proposes to treat eluate from the Birchtree Mine Effluent Treatment Plant (BTETP) directly in the Tailings Management Area. The proposed change will be permanent.

The current process of treating eluate from the BTETP is to deposit eluate, which is trucked from the BTETP by truck (90,000 – 120,000 Liters) into Copper Pond #5 (See Map1) where it mixes with copper residue solids and supernatant. The copper ponds are periodically dewatered, to maintain freeboard to more than 1 foot. The supernatant is collected by vacuum truck and transported to the mill where it is treated with lime in a treatment sump and released to the 48" sewer which reports to the Tailings Management Area (TMA).

The alteration proposed is the deposition of eluate directly into the Tailings Management Area, bypassing the Copper Ponds, and the Mill, where the pH would be modified with the application of lime to precipitate metals. The location proposed is at the outflow of the 48" sewer (See Map1). For each truck load of eluate deposited into the 48" sewer outflow stream, an appropriate quantity of lime will be deposited at the Cell B lime deposition location, the quantity required is calculated based on eluate chemistry (pH, H⁺, Ni²⁺) and lime strength. Eluate chemistry, based on samples of eluate collected from each production batch, will be monitored to concentrations of H⁺ and Ni²⁺ are within acceptable margins to ensure effective treatment. Should the eluate chemistry test results, fall outside the acceptable range, lime demand shall be adjusted accordingly.

No changes in the quality of water discharged from the final discharge point of the Tailings Management Area (TMA), the "Weir" is expected. The proposed deposit would occur at the 48" sewer outflow, where retention and treatment through the Tailings Management Area is expected to attenuate 96% of the Nickel and 90% of the Copper.



Fig. 1 Proposed and Current Eluate Deposition Locations

The efficiency of the Tailings Management Area at attenuating metals by precipitation and water chemistry control is shown by the soluble nickel analysis for 48-inch Sewer (outflow into tailings area) and Weir (licensed discharge point) from 2017 to January 2019.

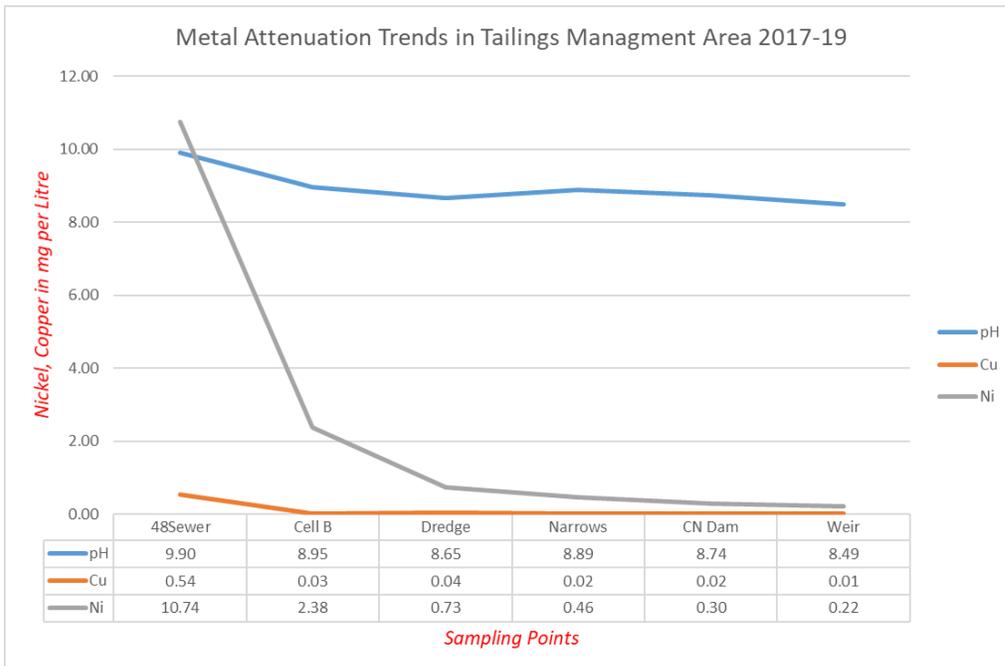


Fig. 2 Metal Attenuation in the TMA

This proposed change has been reviewed by consultants with EcoMetrix Inc, who provided a review of eluate characteristics, and a description of the requirements to maintain appropriate water quality and compliance with the Metal and Diamond Mining Effluent Regulations and Manitoba water quality standards, in the Tailings Management Area. A memo from EcoMetrix Inc., is attached.

A permanent alteration is proposed to ensure long term capability to treat eluate given that the life of the Birchtree Effluent Treatment Plant exceeds the current life of the Copper Residue Ponds. In addition, a period of increased ion exchange regeneration intervals has resulted in an increase in Copper Pond supernatant recovery and treatment events for the Mill, this process has the potential to result in off-gassing in the confined space of the sump, which can result in employee exposure to toxic gas. Processing the eluate in the Tailings Management Area provides the benefit of reducing loadings to the Copper Pond, which is expected to reduce the frequency of the supernatant treatment events in the Mill (and chemical transfer steps) thereby reducing the overall risk of this process.

The Health, Safety and Environmental risks associated with this process are not expected to change significantly; however a reduction in risk is anticipated due to reduction in the frequency of supernatant collection and treatment due to the reduced Copper Pond loadings as described above. Resulting from a risk analysis of this change to the eluate treatment process, the following controls have been planned:

1. The operator hauling eluate from the BTETP to the Tailings Management Area shall receive additional training to ensure he is familiarized with the change in the process, new deposition location and associated hazards and controls relevant to the Tailings Management Area.
2. The proposed eluate deposition location at the outflow of the 48" sewer has been equipped with an air cannon to prevent wildlife interactions, consistent with Vale's existing operational procedures for Copper Ponds #5 & 6 where eluate is currently deposited.

The existing monitoring program for the Tailings Management Area (TMA), which includes daily observations, bi-weekly inspections and weekly water chemistry monitoring will be adequate to ensure water quality is maintained at the outfall of the Final Discharge Point (FDP) known as the 'Weir'. Water chemistry through the TMA is monitored weekly at the outfall of the 48" sewer, Cell B, the Dredge, the Narrows, and finally the CN Dam as it flows North to the Weir FDP, where it then passes through a wetland before it reaches the Burntwood River. Water quality at the FDP is monitored weekly to assess compliance with 960 V.C requirements, Manitoba Water Quality Guidelines Limits and Standards and the Schedule 4 Limits of Deleterious Substances under the Metal and Diamond Mining Effluent Regulations.

In addition to water quality monitoring, the toxicity of effluent from the Weir is tested quarterly to determine its acute lethality to test species, Rainbow Trout and Daphnia Magna, and annually to determine sublethal effects on the growth, survival and reproduction of alga, water flea, aquatic plant and minnow species. (Selenastrum Capicornatum, Lemna Minor, Pimephales Promelas and Ceriodaphnia Dubia)

The effluent from the Weir has not been found to be acutely toxic, and this proposed change is not expected to result in any changes to the toxicity of effluents from the Weir or the sublethal effects on the ecosystem.

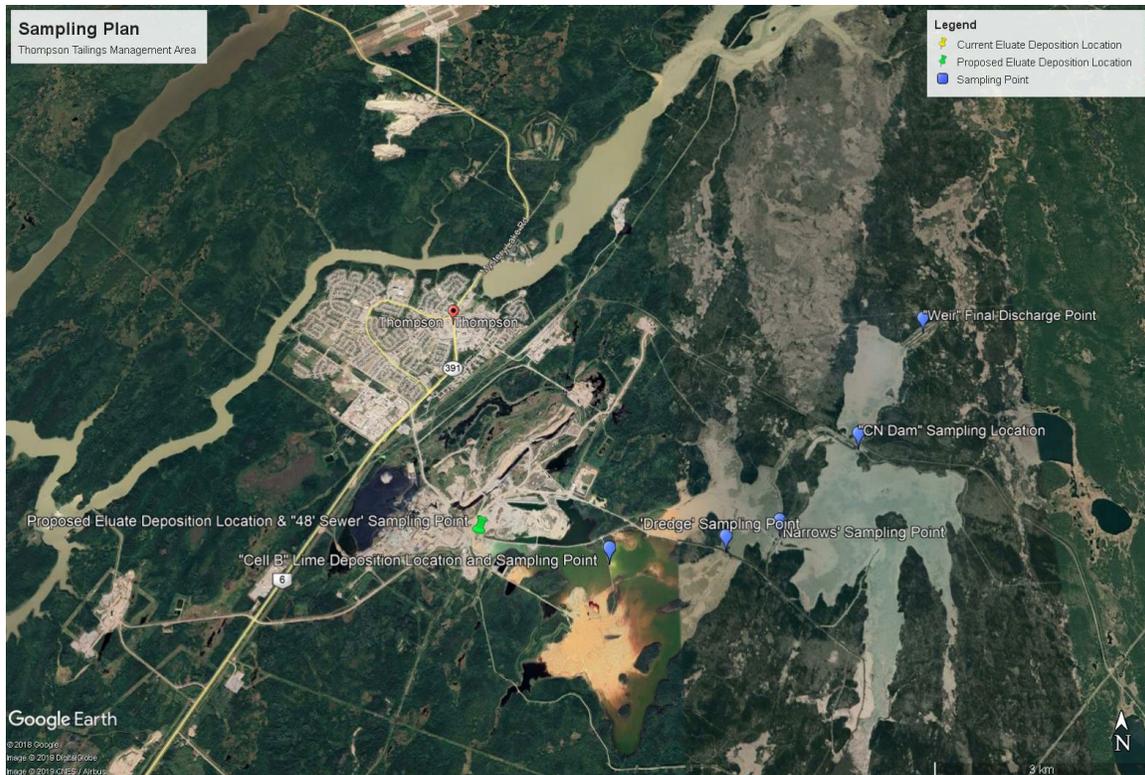


Fig. 3 Tailings Management Area Sampling Points

This proposed change in our process would commence upon your notice of approval. Please feel free to contact me for any additional information or clarifications.

Thank You,

Sarah Paterson
 Superintendent, Health & Environment
 Safety, Health and Environment

Vale
 Manitoba Operations
 Box 5000, Thompson, MB, R8N 1P3
 P: 204-778-2115
 C: 204-939-1204
sarah.paterson@vale.com

cc. Jennifer Windsor, Jeff Fountain

Attachments:

1. EcoMetrix Memo
2. SDS Eluate

MEMO

To: Rachelle Angott, Vale Thompson

From: Ron Nicholson
Sarah Barabash

**Ref: Management of the Birchtree Water
Treatment Eluate in the Thompson
Tailings Basin**

Date: 28 May 2019

The Birchtree Effluent Treatment Plant (BTETP) is based on ion exchange and treats influent, containing nickel, for release to the environment. The treatment system requires regeneration of the ion exchange resin periodically by the addition of sulphuric acid to remove metals. The resulting eluate contains the metals from the resin and is characterized by a low pH value. The eluate has, in the past, been managed in the copper ponds at the Thompson tailings basin. At this time, the management and treatment of the copper pond water can no longer occur in the refinery/smelter complex. As a result, alternative management procedures are required for the BTETP eluate.

The management of the eluate is currently considered under “Public Registry 557.10 Vale Canada Limited, Manitoba Operations; Appendix 6.1 Comprehensive Report of Vale Canada Limited August 3, 2015 Final, 2.4 Birchtree Mine”. It is understood that Vale Thompson wishes to submit a Notice of Minor Alteration, in order to manage the eluate in Thompson tailings basin. This memorandum was prepared in support of the Temporary Authorization and provides both a summary of the eluate characteristics, as well as a description of the requirements for management in order to maintain appropriate water quality in the tailings basin.

Eluate Characteristics

The eluate is a dilute sulphuric acid solution containing some metals. A summary of the metals concentrations and pH is provided in **Table 1**, as well as the equivalent acidity values for the metals and pH. The data presented in this table represent average values from a subset of 30 samples, collected over the period 03 January 2018, to 05 February 2019.

Reference: Management of the Birchtree Water Treatment Eluate in the Thompson Tailings Basin

Table 1: Summary of eluate concentrations and equivalent acidity values.

Parameter	Average mg/L	Acidity mg-CaCO ₃ /L
Al	27	149
Cd	0.01	0.01
Co	1.5	2.5
Cr	0.9	1.7
Cu	1.3	2.0
Fe	29	77
Mn	5.8	11
Ni	416	709
Pb	0.1	0.06
Zn	3.3	5.0
pH	0.52	15,263
Total		16,220

The eluate from the BTETP has a volume of approximately 100,000 L for each regeneration event. The lime that is required to neutralize all acidity and remove metals was calculated and the results are summarized in **Table 2**. Each 100,000 L of eluate requires 2.4 tonnes of lime as Ca(OH)₂. The application of lime includes the consideration of reaction efficiency of 50% when it is added to the basin prior to, or following discharge of, the eluate.

The lime trucks that are routinely used to add lime the tailings basin have the capacity of 10,000 L. The lime concentration that is prepared at the slaker is approximately 150 g/L. Therefore, each lime truck has the capacity to carry approximately 1.5 tonnes of lime. Each 100,000 L of eluate will therefore require approximately 1.6 trucks of lime to effectively neutralize the acidity and remove metals.

Reference: Management of the Birchtree Water Treatment Eluate in the Thompson Tailings Basin

Table 2: Summary of the Eluate Acidity and Lime Requirements.

Items	Units	Values
Acidity	mg-CaCO ₃ /L	16,220
Lime Equivalent	mg-Ca(OH) ₂ /L	12,003
Eluate Volume	L	100,000
Lime Reaction Efficiency	fraction	0.5
Lime Required	tonnes	2.4
Lime Truck	L	10,200
Lime Concentration	g-Ca(OH) ₂ /L	150
Lime per truck	tonnes	1.53
Lime Trucks Required	#	1.6

The eluate will be discharged near the outlet of the 48-inch sewer outfall that historically carried waste water from the refinery to the tailings basin. The lime will then be added to the basin at the Cell B culverts. This will provide ample opportunity for mixing and neutralization of the lime with the eluate.

The addition of lime following discharge of the eluate will ensure that all of the acid is neutralized and metals are removed to levels that will maintain appropriate water quality in the tailings basin. The eluate represents a very small proportion of acid and metals that enter the basin from other sources. These sources include the temporarily beached tailings that have acidified at surface and leach into the tailings basin during the non-frozen season.

The tailings basin is currently managed, and has been for many years, by adding lime regularly to the basin when acidic inputs are occurring. From the spring melt to the fall freeze up, between 6 and 9 from loads of lime are typically added to the basin each day. Therefore, there will be very little lime required to manage the eluate relative to the liming that occurs for water quality management in the Thompson tailings basin.

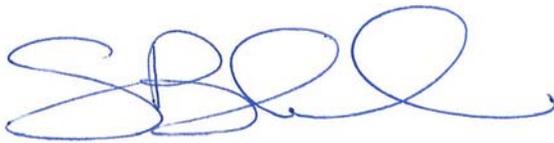
Reference: Management of the Birchtree Water Treatment Eluate in the Thompson Tailings Basin

Closure

We trust this memorandum serves your needs at this time. Should you have any questions please contact the undersigned at your convenience.



Ronald V. Nicholson, PhD, PGeo (ON)



Sarah Barabash, PhD

SAFETY DATA SHEET



MB - Eluate Acid

Section 1. Identification

Product identifier : MB - Eluate Acid
Product type : Liquid.

Relevant identified uses of the substance or mixture and uses advised against

Identified uses
Waste
Uses advised against

Supplier's details : Vale Canada Limited - Manitoba Operations
Thompson, Manitoba
R8N 1P3

Emergency telephone number (with hours of operation) : (204) 778-2276 - Surface First Aid, 24 hr. contact

Section 2. Hazard identification

Classification of the substance or mixture : ACUTE TOXICITY (inhalation) - Category 3
SKIN CORROSION - Category 1
SERIOUS EYE DAMAGE - Category 1
RESPIRATORY SENSITIZATION - Category 1
SKIN SENSITIZATION - Category 1
CARCINOGENICITY - Category 1
TOXIC TO REPRODUCTION (Fertility) - Category 1
TOXIC TO REPRODUCTION (Unborn child) - Category 1

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Toxic if inhaled.
Causes severe skin burns and eye damage.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause cancer.
May damage fertility or the unborn child.

Precautionary statements

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear protective clothing. Wear eye or face protection. Wear respiratory protection. Use only outdoors or in a well-ventilated area. Avoid breathing vapor. Wash hands thoroughly after handling. Contaminated work clothing should not be allowed out of the workplace.

Section 2. Hazard identification

- Response** : IF exposed or concerned: Get medical attention. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or physician. If experiencing respiratory symptoms: Call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water. Wash contaminated clothing before reuse. Immediately call a POISON CENTER or physician. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash it before reuse. If skin irritation or rash occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or physician.
- Storage** : Store locked up.
- Disposal** : Dispose of contents and container in accordance with all local, regional, national and international regulations.
- Supplemental label elements** : Percentage of the mixture consisting of ingredient(s) of unknown oral toxicity: 49.3%
Percentage of the mixture consisting of ingredient(s) of unknown dermal toxicity: 53.8%
Percentage of the mixture consisting of ingredient(s) of unknown inhalation toxicity: 49.3%

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Ingredient name	% (w/w)	CAS number
water	4 - 88	7732-18-5
Sulfuric acid	0.1 - 9	7664-93-9
sodium hydroxide	1.5 - 2	1310-73-2
Sodium ion	0.01 - 3	17341-25-2
Nickel sulfate	0.02 - 1	7786-81-4
calcium sulfate	0.02 - 0.4	7778-18-9
magnesium sulphate	0.01 - 0.15	7487-88-9

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First-aid measures

Description of necessary first aid measures

- Eye contact** : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician.
- Inhalation** : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In the event of any complaints or symptoms, avoid further exposure.

Section 4. First-aid measures

- Skin contact** : Get medical attention immediately. Call a poison center or physician. Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. In the event of any complaints or symptoms, avoid further exposure. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : Causes serious eye damage.
- Inhalation** : Toxic if inhaled. May cause allergy or asthma symptoms or breathing difficulties if inhaled.
- Skin contact** : Causes severe burns. May cause an allergic skin reaction.
- Ingestion** : No known significant effects or critical hazards.

Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:
pain
watering
redness
- Inhalation** : Adverse symptoms may include the following:
wheezing and breathing difficulties
asthma
reduced fetal weight
increase in fetal deaths
skeletal malformations
- Skin contact** : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur
reduced fetal weight
increase in fetal deaths
skeletal malformations
- Ingestion** : Adverse symptoms may include the following:
stomach pains
reduced fetal weight
increase in fetal deaths
skeletal malformations

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

Section 4. First-aid measures

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : In a fire or if heated, a pressure increase will occur and the container may burst.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
sulfur oxides
metal oxide/oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Do not breathe vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Note : **At Vale sites where applicable, direct all spills to the assigned drains for metal recovery.**

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Persons with a history of skin sensitization problems or asthma, allergies or chronic or recurrent respiratory disease should not be employed in any process in which this product is used. Avoid exposure - obtain special instructions before use. Avoid exposure during pregnancy. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Keep away from acids. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Separate from acids. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
water	-
Sulfuric acid	<p>CA Alberta Provincial (Canada, 4/2009). 15 min OEL: 3 mg/m³ 15 minutes. 8 hrs OEL: 1 mg/m³ 8 hours.</p> <p>CA Ontario Provincial (Canada, 1/2018). TWA: 0.2 mg/m³ 8 hours.</p> <p>CA Quebec Provincial (Canada, 1/2014). TWA: 0.2 mg/m³ 8 hours. STE: 3 mg/m³ 15 minutes.</p> <p>CA British Columbia Provincial (Canada, 6/2017). TWA: 0.2 mg/m³ 8 hours. Form: thoracic</p> <p>CA Saskatchewan Provincial (Canada, 7/2013). STEL: 0.6 mg/m³ 15 minutes. TWA: 0.2 mg/m³ 8 hours.</p>
sodium hydroxide	<p>CA Alberta Provincial (Canada, 4/2009). C: 2 mg/m³</p> <p>CA British Columbia Provincial (Canada, 7/2016). C: 2 mg/m³</p> <p>CA Ontario Provincial (Canada, 7/2015). C: 2 mg/m³</p> <p>CA Quebec Provincial (Canada, 1/2014). STE: 2 mg/m³ 15 minutes.</p> <p>CA Saskatchewan Provincial (Canada, 7/2013). CEIL: 2 mg/m³</p>
Sodium ion	-
Nickel sulfate	<p>CA Saskatchewan Provincial (Canada, 7/2013). STEL: 0.3 mg/m³, (measured as Ni) 15 minutes. Form: Inhalable fraction</p>

Section 8. Exposure controls/personal protection

calcium sulfate	<p>TWA: 0.1 mg/m³, (measured as Ni) 8 hours. Form: Inhalable fraction</p> <p>CA Ontario Provincial (Canada, 1/2018). TWA: 0.1 mg/m³, (as Ni) 8 hours. Form: Inhalable fraction.</p> <p>CA Alberta Provincial (Canada, 4/2009). 8 hrs OEL: 0.1 mg/m³, (as Ni) 8 hours.</p> <p>CA British Columbia Provincial (Canada, 6/2017). TWA: 0.05 mg/m³, (as Ni) 8 hours.</p> <p>CA Quebec Provincial (Canada, 1/2014). TWAEV: 0.1 mg/m³, (as Ni) 8 hours.</p> <p>CA British Columbia Provincial (Canada, 6/2017). TWA: 10 mg/m³ 8 hours. Form: Inhalable</p> <p>CA Ontario Provincial (Canada, 1/2018). TWA: 10 mg/m³ 8 hours. Form: Inhalable fraction.</p> <p>CA Quebec Provincial (Canada, 1/2014). TWAEV: 5 mg/m³ 8 hours. Form: Respirable dust. TWAEV: 10 mg/m³ 8 hours. Form: Total dust.</p> <p>CA Alberta Provincial (Canada, 4/2009). 8 hrs OEL: 10 mg/m³ 8 hours.</p> <p>CA Saskatchewan Provincial (Canada, 7/2013). STEL: 20 mg/m³ 15 minutes. TWA: 10 mg/m³ 8 hours.</p>
magnesium sulphate	-

ACGIH

Ingredient name	Exposure limits
water	None.
sulphuric acid	ACGIH TLV (United States, 3/2017). TWA: 0.2 mg/m ³ 8 hours. Form: Thoracic fraction
sodium hydroxide	ACGIH TLV (United States, 3/2017). C: 2 mg/m ³
Sodium ion	None.
nickel sulfate	ACGIH TLV (United States, 3/2017). TWA: 0.1 mg/m ³ , (as Ni) 8 hours. Form: Inhalable fraction
calcium sulfate	ACGIH TLV (United States, 3/2017). TWA: 10 mg/m ³ 8 hours. Form: Inhalable fraction
magnesium sulphate	None.

Appropriate engineering controls

- : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Environmental exposure controls

- : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

- : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Contaminated work clothing should not be allowed out of the workplace. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

- : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Section 8. Exposure controls/personal protection

Skin protection

- Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

- Physical state** : Liquid. [Liquid.]
- Color** : Clear. Green.
- Odor** : Repulsive.
- Odor threshold** : Not available.
- pH** : 13.9
- Melting point** : Not available.
- Boiling point** : Not available.
- Flash point** : Not available.
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Not available.
- Vapor pressure** : Not available.
- Vapor density** : Not available.
- Relative density** : Not available.
- Solubility** : Not available.
- Solubility in water** : Not available.
- Partition coefficient: n-octanol/water** : Not available.
- Auto-ignition temperature** : Not available.
- Decomposition temperature** : Not available.
- Viscosity** : Not available.
- Flow time (ISO 2431)** : Not available.

Section 10. Stability and reactivity

- Reactivity** : No specific test data related to reactivity available for this product or its ingredients.
- Chemical stability** : The product is stable.
- Possibility of hazardous reactions** : Hazardous reactions or instability may occur under certain conditions of storage or use.

Section 10. Stability and reactivity

Conditions to avoid : No specific data.

Incompatible materials : Reactive or incompatible with the following materials:
acids

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Sulfuric acid	LD50 Oral	Rat	2140 mg/kg	-
Nickel sulfate	LC50 Inhalation Vapor	Rat - Female	2.48 mg/l	4 hours
	LD50 Oral	Rat - Female	361 mg/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Sulfuric acid	Eyes - Severe irritant	Rabbit	-	250 Micrograms	-
	Eyes - Severe irritant	Rabbit	-	0.5 minutes	-
sodium hydroxide	Eyes - Severe irritant	Monkey	-	5 milligrams	-
	Eyes - Mild irritant	Rabbit	-	24 hours 1 Percent	-
	Eyes - Severe irritant	Rabbit	-	400 Micrograms	-
	Eyes - Severe irritant	Rabbit	-	24 hours 50 Micrograms	-
	Eyes - Severe irritant	Rabbit	-	1 Percent	-
	Eyes - Severe irritant	Rabbit	-	0.5 minutes	-
	Skin - Mild irritant	Human	-	1 milligrams	-
	Skin - Severe irritant	Rabbit	-	24 hours 2 Percent	-
Nickel sulfate	Skin - Mild irritant	Woman	-	24 hours 500 milligrams	-
				48 hours 5 Percent	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
sulphuric acid	-	1	Known to be a human carcinogen.
nickel sulfate	-	1	Reasonably anticipated to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Section 11. Toxicological information

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Nickel sulfate	Category 1	Inhalation	lungs

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

- Eye contact** : Causes serious eye damage.
- Inhalation** : Toxic if inhaled. May cause allergy or asthma symptoms or breathing difficulties if inhaled.
- Skin contact** : Causes severe burns. May cause an allergic skin reaction.
- Ingestion** : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : Adverse symptoms may include the following:
pain
watering
redness
- Inhalation** : Adverse symptoms may include the following:
wheezing and breathing difficulties
asthma
reduced fetal weight
increase in fetal deaths
skeletal malformations
- Skin contact** : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur
reduced fetal weight
increase in fetal deaths
skeletal malformations
- Ingestion** : Adverse symptoms may include the following:
stomach pains
reduced fetal weight
increase in fetal deaths
skeletal malformations

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Long term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Potential chronic health effects

Section 11. Toxicological information

Not available.

General	: Once sensitized, a severe allergic reaction may occur when subsequently exposed to very low levels.
Carcinogenicity	: May cause cancer. Risk of cancer depends on duration and level of exposure.
Mutagenicity	: No known significant effects or critical hazards.
Teratogenicity	: May damage the unborn child.
Developmental effects	: No known significant effects or critical hazards.
Fertility effects	: May damage fertility.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Oral	23866.9 mg/kg
Inhalation (dusts and mists)	0.5576 mg/l

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Sulfuric acid	Acute LC50 42500 µg/l Marine water	Crustaceans - Pandalus montagui - Adult	48 hours
sodium hydroxide	Acute LC50 36 ul/L Marine water	Fish - Agonus cataphractus	96 hours
	Acute EC50 40.38 mg/l Fresh water	Crustaceans - Ceriodaphnia dubia - Neonate	48 hours
Nickel sulfate	Acute LC50 125 ppm Fresh water	Fish - Gambusia affinis - Adult	96 hours
	Acute IC50 7.28 mg/l Marine water	Algae - Phaeodactylum tricornutum - Exponential growth phase	72 hours
	Acute IC50 4.59 mg/l Marine water	Algae - Phaeodactylum tricornutum - Exponential growth phase	96 hours
	Acute LC50 39177.81 µg/l Fresh water	Crustaceans - Stenocypris major - Adult	48 hours
	Acute LC50 180 µg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 589.9 µg/l Fresh water	Fish - Danio rerio - Larvae	96 hours

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogP _{ow}	BCF	Potential
Nickel sulfate	-	5613	high

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	TDG Classification	DOT Classification	ADR/RID	IMDG	IATA
UN number	UN 1760	UN 1760	UN 1760	UN 1760	UN 1760
UN proper shipping name	Corrosive liquids, n.o.s. (sulphuric acid)	Corrosive liquids, n.o.s. (sulphuric acid)			
Transport hazard class(es)	8 	8 	8 	8 	8 
Packing group	III	III	III	III	III
Environmental hazards	No.	No.	No.	No.	No.

Additional information

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.40-2.42 (Class 8).

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

Canadian lists

Canadian NPRI : The following components are listed: Sulphuric acid

CEPA Toxic substances : The following components are listed: Oxidic, sulphidic and soluble inorganic nickel compounds

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Section 15. Regulatory information

Not listed.

[Rotterdam Convention on Prior Informed Consent \(PIC\)](#)

Not listed.

[UNECE Aarhus Protocol on POPs and Heavy Metals](#)

Not listed.

[Inventory list](#)

Australia	: Not determined.
Canada	: Not determined.
China	: Not determined.
Europe	: Not determined.
Japan	: Japan inventory (ENCS) : Not determined. Japan inventory (ISHL) : Not determined.
Malaysia	: Not determined.
New Zealand	: Not determined.
Philippines	: Not determined.
Republic of Korea	: Not determined.
Taiwan	: Not determined.
Thailand	: Not determined.
Turkey	: Not determined.
United States	: Not determined.
Viet Nam	: Not determined.

Section 16. Other information

[History](#)

Date of printing	: 11/1/2018
Date of issue/Date of revision	: 11/1/2018
Date of previous issue	: No previous validation
Version	: 1

[Key to abbreviations](#)

: ATE = Acute Toxicity Estimate
: BCF = Bioconcentration Factor
: GHS = Globally Harmonized System of Classification and Labelling of Chemicals
: IATA = International Air Transport Association
: IBC = Intermediate Bulk Container
: IMDG = International Maritime Dangerous Goods
: LogPow = logarithm of the octanol/water partition coefficient
: MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
: UN = United Nations
: HPR = Hazardous Products Regulations

[Procedure used to derive the classification](#)

Classification	Justification
ACUTE TOXICITY (inhalation) - Category 3	Calculation method
SKIN CORROSION - Category 1	On basis of test data
SERIOUS EYE DAMAGE - Category 1	On basis of test data
RESPIRATORY SENSITIZATION - Category 1	Calculation method
SKIN SENSITIZATION - Category 1	Calculation method
CARCINOGENICITY - Category 1	Calculation method
TOXIC TO REPRODUCTION (Fertility) - Category 1	Calculation method
TOXIC TO REPRODUCTION (Unborn child) - Category 1	Calculation method

References : Not available.

Section 16. Other information

✔ Indicates information that has changed from previously issued version.

Notice to reader

Vale Canada believes that the information in this Safety Data Sheet is accurate. However, Vale Canada makes no express or implied warranty as to the accuracy of such information and expressly disclaims any liability resulting from reliance on such information.