

STANDARD PROCEDURE INSTRUCTION

Title		SPI
Acid Generating Potential of Broken Rock		35-7
Department	Supersedes SPI Dated	Effective Date
Safety, Health & Environment	NEW	May 10, 2016

1.0 PURPOSE:

1.1 Establish a protocol to manage the risk associated with the storage, use or disposal of potentially acid generating rock on surface.

2.0 DEFINITIONS:

2.1 **Inert or clean rock:** broken rock which will not generate acid or leach metals when left exposed to natural elements.

2.2 **Acid Generating rock:** broken rock which has the potential to generate acid and leach metals if left exposed to natural elements.

3.0 CONTEXT:

3.1 Broken rock, mine waste and overburden is used on site for many applications. Some applications require “inert or clean rock”. Inert or clean rock can be used for:

- applications where effluent water quality or fish habitat may be affected, such as dam construction;
- rehabilitation, re-vegetation or decommissioning projects where a cover or cap calls for clean or inert rock;
- road construction where precipitation runoff may affect water quality;

3.2 Acid generating rock has the potential to create acidity, resulting in metals being released into the environment which may adversely affect water quality and fish habitat. Acid generating rock can be used for:

- underground applications (backfill, rockfill)
- tailings line extensions
- road construction inside of the tailings management area

3.3 The following criteria will be used to determine the acid generating potential of rock and to verify contractor supplied clean rock. If the contractor can supply a federal or provincial operating permit which indicates the source of rock is inert or clean (non acid generating) then the sampling and analytical criteria does not apply.

3.4 The total quantity (weight) of clean or inert rock used, that meets the criteria identified in Section 4.4 below, must be estimated and reported to the Environment Department to ensure compliance with legislated reporting requirements.

3.5 The total quantity (weight) of acid generating rock used, must be estimated and reported to the Environment Department to ensure compliance with legislated reporting requirements

4.0 SCOPE:

All projects requiring clean/inert broken rock must follow the procedure to determine if the proposed rock is non-acid generating or have a contractor supply documented clean/inert rock.

5.0 PROCEDURE

The following sample collection and analysis methodology will be initiated to determine the acid generating potential of rock:

5.1 Plan and design an appropriate sampling campaign.

To collect a representative sample of the rock, refer to MEND Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials Version 0-Dec.2009, Section 8.0 for sampling guidelines, and the Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (April, 1997), Section 6 for sampling requirements.

Basic guidelines:

Sample Size:	Minimum Sample Mass = 500g
<u>Tonnage (metric Tonnes)</u>	<u>Minimum # of Samples</u>
<10,000	3
<100,000	8
<1,000,000	26
<10,000,000	80

- The sampler should be familiar with the local geological rock types and the source of the broken rock to be sampled.
- The sampler shall record/ map pertinent environmental information on the area of interest, including drainage patterns, rock types etc.

Other information, such as age of the pile, (i.e. how long the rocks have been exposed to air and/or water), should be considered when determining where, and how much to sample. For example, when a stockpile has been exposed to rainwater / weathering, the base and interior of the stockpile may require more samples than the top.

- The sampling pattern must be designed to ensure representative sampling of the material, considering lateral and vertical representation as necessary. Heavy equipment may be required. Field safety must be considered.
- The sampler is required to record the location of the area, sampling locations and identifiers on a sketch or map as well as the date/time sampling took place. Pile size and sample size must be estimated and recorded.
- All information shall be provided to the Environment Department.

5.2 Submit samples to the Smelter Sample House for the following sample preparation and analysis:

- air dry
- crush to -100 mesh for Vale Solids lab analysis
- % total Sulphur by LECO

5.3 Once prepared, samples shall be sent to the Vale Solids lab for the following analysis:

- Concentration of Arsenic reported in PPM
- ICP analysis reported in PPM
- Analytical report shall include Cd, Co, Cu, Ni, Pb, Se, Zn in PPM
- Paste pH

5.4 If the sample has a **total Sulphur concentration of $\leq 0.2\%$** , the sample is deemed inert or clean, and may be used for the purposes described above.

However, if the sample **has a total Sulphur concentration of $\leq 0.2\%$, and the concentration of Arsenic is >12 ppm**, the sample is deemed inert or clean, however, the quantity of Arsenic in the rock being used must be accounted for and reported to Environment Department to ensure inclusion in the annual NPRI report.

5.5 If the sample has a **total Sulphur concentration of > 0.2%**, Acid Base Accounting (ABA), an analytical technique which determines the ratio of neutralizing potential (NP) to acid generating potential (AGP), will be applied to determine if the rock is clean or inert.

Consult the Vale lab to request Acid Base Accounting.

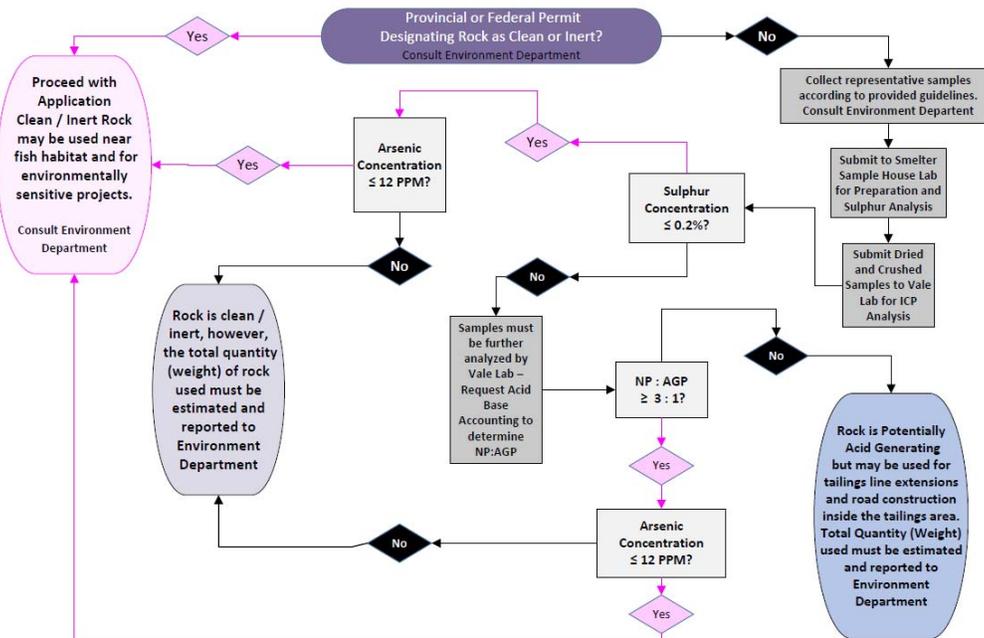
If the ratio of **NP: AGP is \geq 3:1** the sample is deemed inert or clean.

However, **even if the rock is determined to be inert or clean, if the concentration of Arsenic is >12 PPM**, the quantity of Arsenic (kg) in the waste rock being used must be accounted for and reported to the Environment Department to ensure inclusion in the annual NPRI report.

5.6 If the ABA analysis determines the ratio of **NP: AGP is < 3:1, the sample is deemed acid generating** and may only be used for the purposes described above. In that case, the quantity (Kg) of Arsenic, Cadmium, Cobalt, Copper, Nickel, Lead, Sulphur, Selenium and Zinc contained in the rock must be accounted for and reported to the Environment Department to ensure inclusion in the annual NPRI report.

Process Flowchart

6.0



CONTROLS:

- 6.1 Vale Geologists and/or Environmental personnel will collect samples to ensure representative samples are collected safely.
- 6.2 Arrangements for sample preparation and analysis will be made with the supervisor of the Smelter Sample House and the supervisor of the Vale lab prior to delivery.
- 6.3 Analytical results must be reviewed by the senior supervisor of Environment.

7.0 References:

- Metal Mining Effluent Regulation (MMER), a regulation under the [Fisheries Act](#)
- Mine Environment Neutral Drainage (MEND), (MEND Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials Version 0-Dec.2009)
- Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (April, 1997)
- Environment Canada – National Pollutant Release Inventory (NPRI) Reporting Guide, 2010 – Part 3.7-3.11
- Guidelines for Sampling developed by Vale Geology Department.

Approved By	Title
	Vice-President, Manitoba Operations
Date	