

Standard Operating Procedure No. 83 CRUST EVAPORATION RATE EXPERIMENT

REVISION LOG		
Revision Number	Description	Date
SOP 83v1	Original SOP by LMK, LMG	10/16/06
SOP 83v2	Edits by LMG, LMK	10/20/06
SOP 83v3	Edits by VTM, LMG	11/28/06
SOP 83v4	Edits by GWW	01/08/07
SOP 83v5	Edits by VTM, LMG	01/ 23/07
SOP 83v5	Minor edits to recent revisions Finalized by LMK for posting to Molycorp Project website and to send to George Robinson for lab audit	4/4/07
83v6	Editorial by SKA	10/28/08

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure describes the method for determining the evaporation rate of water from rock pile crust material as compared to that of plain (de-ionized) water. The test consists of preparing specimens of rock pile crust material, rock pile material, silica sand, and de-ionized water in identical shallow metal pans with similar water depths and comparing their rates of evaporation. The purpose is to determine what effect, if any, the presence of rock pile crust material has on the evaporation rate of water.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Team Leader will have the overall responsibility for implementing this SOP. He/she will be responsible for assigning appropriate staff to implement this SOP and for ensuring that the procedures are followed accurately.

All personnel performing these procedures are required to have the appropriate health and safety training. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP, and to receive specific training regarding these procedures, if necessary.

All environmental staff and assay laboratory staff are responsible for reporting deviations from this SOP to the Team Leader.

3.0 DATA QUALITY OBJECTIVES

Determine what influence crusts on the surface of the rock piles can have on the evaporation rates of the rock pile material.

4.0 RELATED STANDARD OPERATING PROCEDURES

The procedures set forth in this SOP are intended for use with the following SOPs:

- SOP 1 - Data management (including verification and validation)
- SOP 2 - Sample management (including chain of custody)
- SOP 3- GPS surveying
- SOP 4 - Taking photographs
- SOP 5 - Sampling outcrops, rock piles, and drill core (solid)

5.0 EQUIPMENT LIST

The following materials are required for performing the evaporation rate experiment:

- Samples of typical Molycorp rock pile crust material
- 4 shallow metal pans (~9" X 12" X 1" deep) for each set of samples to be run
- Controlled humidity/temperature room for running experiments, with thermometer and humidity measuring devices in place
- Scales, preferably an electronic balance with 2000 gram capacity
- pH meter
- Permanent marker pen or etching tool to mark pans with sample numbers
- De-ionized water
- Miscellaneous equipment such as spatulas
- Weatherproof bound lab notebook and indelible pens
- Data sheets
- No. 4 sieve (4.76 mm) with pan and cover
- Silica sand of similar grain size as crust material
- Assume a particular density for the material
- Ziploc bags quart size
- Drying oven capable of maintaining ~150° F, large enough to contain all four of the pans at once.
- Digital camera
- GPS unit
- Calipers or ruler accurate to .5mm to measure heights
- Clock or watch to measure time of readings

6.0 COLLECTING SAMPLES

Refer to SOP 5 (Sampling outcrops, rock piles, undisturbed blocks and drill cores)
Samples are collected, labeled, preserved and transported in accordance with SOP 1, 5 and 9. Log the samples into the laboratory following chain of custody procedures (SOP 2). Photographs should be taken before the sample is collected, consistent with SOP 4.

The position of each sample and the coordinate system used for the GPS should be recorded into a bound weatherproof field notebook with indelible ink using procedures in SOP 3 Surveying.

7.0 SAMPLE SELECTION

The sample of crust material used for the evaporation experiment should be enough to fill the evaporative pan you are using to at least 2 mm. Each sample should fill its pan to a similar depth. Each crust sample should be made up entirely of “crust” material from a single rock pile and the “below crust” material should be from just underneath where the crust was collected.

8.0 TEST PROCEDURES

1. Collect crust sample, sample from below crust, and silica sand to be tested (purchased silica sand can be used instead).
2. Sieve all materials through No. 4 sieve separately.
3. Retain the portion of each material passing the No. 4 sieve for the test and return the material caught on the No. 4 sieve to its original sample bag.
4. Write identifying numbers on each pan with permanent markers or etching (such as 1, 2, 3, 4, do not use the sample numbers to mark the pans as you will be re-using them).
5. Weigh each empty pan separately and record its weight in the corresponding field on the data sheet.
6. Spread the “crust” sample in pan 1, the “below crust” sample in pan 2, the silica sand in pan 3, and nothing in pan 4. Weigh out between 500 and 900 grams of sample. Spread the samples to 2-13 mm thickness and record the corresponding thickness for each on the data sheet.
7. Weigh each sample before drying and record weights on data sheet (see Appendix I. for data sheet example).
8. Oven-dry the samples in their pans.
9. Weigh each oven-dried sample/pan and record weights on data sheet.
10. Add enough de-ionized water to saturate each sample to 85% saturation (add .85ml water for each gram of sample) and record the mL of DI added to each sample on the data sheet. Also calculate the amount of water added in grams.
11. Add ONLY de-ionized water to the fourth pan with as much DI water (weight wise) as the other samples.
12. Weigh each pan with samples/water, and record weights on data sheet.
13. Calculate the water content of each sample for each measured weight based on the initial oven dried weight of the sample and the measured total weight of sample at each interval (in accordance with the SOP).
14. Also measure and record: height of sample/water in each pan (take height from the middle of the pan each time), time, date, pH (readings should be taken from the same corner of the pan each reading), and the temperature and humidity of the room.
15. Pans should be placed in a room with relatively constant temperature and humidity on a fairly level surface that is out of direct sunlight.

16. Continue to weigh the pans and take the height, time, pH, temperature, and humidity readings three or four times a day at regular intervals (more readings if wanted).
17. Note at regular intervals how the crust behaves to finger pressure (from soft to hard) once no water is present on the surface. Record if the finger leaves an indentation or “pokes” through the crust, etc.
18. Record all readings on data sheet.
19. Once the weight of the sample is stable, transfer sample/pan to a drying oven (~150° F) and continue to take and record the regular weight, time, temperature, and humidity/readings.
20. When weight is stable in oven, test is complete.
21. Determine the air dried or final water content of the sample at the end of the evaporation test (like #13 above).
22. Take note of the crust sample surfaces and how they look and behave when you touch them with your finger from soft to hard pressure.
23. Return sample to its corresponding original sample bag.

9. DOCUMENTATION - PLOTS AND REPORTING

Data sheets will be stored electronically in the Molycorp database.

The experiment report shall include the following:

- Sample identification numbers and any information about where/when they were collected, project, location and date of the tests, and name of the person(s) completing the test.
- Description of the equipment and samples used in the test.
- Description of sample type, that is, whether the specimen is undisturbed, remolded, compacted, or otherwise prepared.
- Plot of evaporation rate in mm/day versus time for all four pans.
- Plot of evaporation rate in mm/day versus water for the salt crust in Pan one, the below crust material in Pan two, and the silica sand in Pan three.
- Plot the actual evaporation rate “AE” for the crust sample, below crust sample, and silica sand divided by the potential evaporation rate “PE” for the de-ionized water versus both time and water content: note that the units for AE/PE cancel out because they are identical (i.e. mm/day), so no units appear on the y axis of the plots.

10. QUALITY ASSURANCE/QUALITY CONTROL

Duplicates of samples will be included to ensure repeatability of results.

Where feasible, samples should be archived for future studies.

11. REFERENCES

Wilson, G. W., Fredlund, D. G., and Barbour, S. L., 1997, The effects of soil suction on evaporative fluxes from soil surfaces, *Can. Geotech. J.*, Vol. 34, pp. 145-155.

Wilson, G. Ward, 2006, unpublished memo to Modeling Subcommittee, Molycorp
Questa Rock Pile Stability Study, August 29, 2006.

Appendix I. DATA SHEETS

Crust Evaporation Rate Data Sheet

PAN EVAPORATION TEST DATA SHEET

Test Number:	
Field Identification Number:	
Pan Number: (Circle One)	1 2 3 4
Laboratory Number:	NM6
Person who analyzed sample:	
SOP number:	83
Deviation of SOP:	
Sieve Size (mm):	Number 4, 6.3 mm
Weight of empty pan (g):	
Initial sample plus pan weight (g):	
Sample weight only (g) (#10 minus #9):	
Sample height (mm):	
Dried sample plus pan weight (g):	
DI water added (mL or g) (#13 multiplied by 0.85):	
Sample plus water height (mm):	
Total weight of pan/sample/water (g):	
Comments:	

[illegible]
