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EMISSION TEST REPORT

Report Title	EMISSION TEST REPORT FOR PM EMISSIONS AND VISUAL OPACITY
Test Date(s)	February 4-6, 2015

Facility Information	
Name	Eagle Mine, LLC Humboldt Mill
Street Address	4547 County Road 601
City, County	Champion, Marquette
Phone	(906) 204-9867

Facility Permit Information			
State Registration Number:	N0934	PTI No.	405-08A

Testing Contractor	
Company Mailing Address	Derenzo and Associates, Inc. 39395 Schoolcraft Road Livonia, Michigan 48150
Phone	(517) 324-1880
Project No.	1412001

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EMISION TEST REPORT
FOR
PM EMISSIONS AND VISUAL OPACITY

EAGLE MINE – HUMBOLDT MILL
CHAMPION, MICHIGAN

Test Date(s): February 4-6, 2015

1.0 INTRODUCTION

Eagle Mine, LLC (Eagle Mine) operates the Humboldt Mill in Champion, Marquette County (State Registration No. N0934), which is a copper and nickel ore crushing and concentrate production facility. Coarse ore is received at the site by haul trucks where it is crushed, screened and processed to concentrate copper and nickel. Material processing is performed within enclosures and covered conveyors are used to transfer material between process enclosures. The copper and nickel concentrate is shipped from the facility in railcars.

The Humboldt Mill operations have been issued Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) Permit to Install (PTI) No. 405-08A. The PTI specifies particulate matter (PM) mass emission limits for two processes that are controlled by dust collectors and visible emission opacity limits for all ore processing equipment. Conditions of the PTI and the federal New Source Performance Standard (NSPS) for metallic mineral processing plants (40 CFR Part 60 Subpart LL) require initial testing to demonstrate compliance with the applicable PM and visible emission opacity standards.

The compliance testing consisted of:

1. Particulate matter mass emission testing for two dust collector exhaust stacks using isokinetic testing procedures.

2. Visible emission opacity measurements for the two dust collector exhausts that were performed simultaneous with the PM emission testing.

3. Visible emission opacity measurements for various process enclosures that contain material processing operations.

The compliance testing was performed by Derenzo and Associates, Inc., an environmental consulting and testing company based in Livonia, Michigan. A test protocol was submitted to and reviewed by the MDEQ-AQD prior to the test event. The MDEQ-AQD test protocol approval letter is provided in Appendix 1.

The following items provide information required in MDEQ-AQD "*Format for Submittal of Source Emission Test Plans and Reports*," dated December 2013.

3.0 SUMMARY OF TEST RESULTS

The Eagle Mine Humboldt Mill operations are subject to the emission control requirements of MDEQ-AQD PTI No. 405-08A and NSPS Subpart LL for metallic mineral processing plants.

Exhaust stack PM mass emissions from the:

- Crushers and screens of the FGSECONDCRUSH process (dust collector stack DC-001) are limited to 0.009 lbs/1000 lbs of exhaust gases and 0.5 pounds per hour (pph).

- Bins and drop points of the EUFINEORESTORAGE process (dust collector stack DC-002) are limited to 0.0035 lbs/1000 lbs of exhaust gases and 0.1 pounds per hour (pph).

USEPA Method 17 was used to measure filterable PM emissions to demonstrate compliance with the PM emission limits specified in the permit.

Table 3.1 presents a summary of measured exhaust gas flowrate and particulate matter emission rates for the two processes that are controlled by dust collectors. The data presented in Table 3.1 is the average of three test periods. Data for individual test periods are presented at the end of this report in Tables 6.1 and 6.2.

Exhaust stack visible emissions from the:

- Crushers and screens of the FGSECONDCRUSH process (dust collector) shall not exceed a six-minute average of 5% opacity.

- Bins and drop points of the EUFINEORESTORAGE process (dust collector) shall not exceed a six-minute average of 5% opacity.

Fugitive emissions from:

- The Hopper, Grizzly Feeder, Primary Crusher and Rock Breaker of the FGCOSA process shall not exceed a six-minute average of 10% opacity.

- Railcar loading of the EULOAD process shall not exceed a six-minute average of 10% opacity.

- All processes associated with the concentration plant (FGCONPLANT) including crushing, screening, conveyor belt transfer points, storage bins, enclosed storage areas and truck unloading stations shall not exceed a six-minute average of 10% opacity

Process opacity emissions were determined by a certified observer of visible emissions in accordance with USEPA Method 9 and are presented in Table 3.2.

The measured PM and opacity emission rates from each of the aforementioned regulated processes or process equipment are less than the allowable emission limits specified in PTI No. 405-08A.

Table 3.1 Summary of measured exhaust gas flowrate and particulate matter emission rates

Emission Unit	Exhaust Rate (dscfm)	PM Emission Rate† (lb/hr)	PM Permit Limit (lb/hr)	PM Emission Rate† (lb/1000 lb gas)	PM Permit Limit (lb/1000 lb gas)
FGSECONDCRUSH DC-001	13,302	0.10	0.5	0.0018	0.0090
EUFINEORESTORAGE DC-002	5,407	0.02	0.1	0.0010	0.0035

† Average measured rate for three (3) one-hour test periods

Table 3.2 Summary of measured process opacity emissions

Emission Unit	Release Type	Opacity (%)	Opacity Permit Limit (%)
FGSECONDCRUSH	DC001 stack (point)	0%	5%
EUFINEORESTORAGE	DC002 stack (point)	0%	5%
FGCOSA	Fugitive	0%	10%
EULOAD	Fugitive	0%	10%
EUCONPLANT	Fugitive	0%	10%

4.0 SOURCE DESCRIPTION

4.1 General Process Descriptions

Copper and nickel ore is trucked to the Humboldt Mill for crushing and copper and nickel concentrating. The Humboldt Mill generally consists of the following processes:

1. Coarse Ore Storage Area (FGCOSA) where coarse ore material that is received at the site is temporarily stored before processing. The stored material is subsequently transferred to a dump hopper/grizzly feeder via front-end loader, at which point the larger sized material is crushed in a primary crusher. All processes are operated within a single enclosure (the COSA building) and water suppression is used as needed to control fugitive emissions.

2. Secondary Crushing Process (FGSECONDCRUSH) that receives material from FGCOSA (via a covered transfer conveyor), screens the material to segregate by size, and performs secondary and tertiary crushing. The screens and crushers are located within a single enclosure (the Secondary Crusher Building) and connected to a dust collector (stack DC-001).

3. Enclosed Transfer Station that receives material from the Secondary Crushing Process (via covered transfer conveyors) and conveys it to the Mill Building via a covered transfer conveyor. The associated conveyors are part of emission group FGTRANSFERCONVYS.

4. Mill Building that contains three fine ore storage bins (EUFINEORESTORAGE). All processes are operated within a single enclosure (the Mill Building) and particulate emissions from the bins and drop points are controlled by a dust collector (stack DC-002).

5. Concentrate Loadout Building (EULOAD) that receives material from the Mill Building via a shuttle conveyor. Railcars are loaded with copper and nickel bearing concentrate using front end loaders. All processes are operated within a single enclosure (the Concentrate Loadout Building).

4.2 Emission Control System Description

As presented in Section 4.1, the processes are performed within enclosures and covered conveyors are used to transfer material between process enclosures. Particulate (dust) emissions associated with the:

1. Coarse Ore Storage Area (FGCOSA) are minimized by the COSA enclosure and, as needed, with water suppression.

2. Secondary Crushing Process (FGSEONDCRUSH) are controlled by the Secondary Crushing Building enclosure and a dust collector.

3. Transfer conveyors (FGTRANSFERCONVYS) are minimized by using covered conveyors and by enclosing the transfer drop points within the Enclosed Transfer Station.

4. Bins and drop points of EUFINEORESTORAGE are controlled by the Mill Building enclosure and a dust collector.

5. Loading of railcars (EULOAD) are minimized by limiting loading operations to within the enclosed Concentrate Loadout Building.

4.3 Rated Capacity of the Process

The equipment is allowed to process up to 407 tons per hour of ore as specified in PTI 405-08A. However, the maximum allowable throughput rate cannot be maintained on a regular, continuous basis. Coarse material from storage piles is loaded into the FGCOSA dump hopper using front end loaders. Some of the material passes into the primary crusher, which has an interlock programmed into the system that limits crusher throughput to 350 tons per hour. The downstream processes are generally continuous and dependent on the rate of material passing through the dump hopper.

The exhaust from the Secondary Crushing Building (FGSECONDCRUSH) is filtered using a dust collector identified as DC-001, which has a design exhaust rate of 14,000 actual cubic feet per minute (acfm). The dust collector contains a cyclone precleaner and baghouse filtering section capable of removing greater than 99% of particles greater than 5 microns. Filtered air is discharged to the ambient air through a 37.5-inch diameter vertical exhaust stack (diameter measured at the sampling location).

The exhaust from the Mill Building (EUFINEORESTORAGE) is filtered using a dust collector identified as DC-002, which has a design exhaust rate of 6,200 acfm. The specifications are similar to those of DC-001. Filtered air is discharged to the ambient air through a 36-inch diameter vertical exhaust stack (diameter measured at the sampling location).

Drawings for the dust collector stacks are provided in Appendix 3.

5.0 SAMPLING AND ANALYSIS PROCEDURES

Testing was performed to verify opacity from all emission units with permit-allowable limits and filterable PM emission rates from each of the two dust collector exhaust stacks (DC-001 and DC-002). The exhaust gas from each dust collector exhaust was sampled using isokinetic sampling methods. Filterable PM emissions were determined based on the amount of filterable PM catch in the sample train.

The following USEPA reference test methods and sampling trains were used to perform the emission compliance testing.

USEPA Method 1	Velocity and sampling locations were selected based on physical stack measurements in accordance with USEPA Method 1.
USEPA Method 2	Exhaust gas velocity pressure and temperature using a Type-S Pitot tube connected to a red oil incline manometer and K-type thermocouple.
USEPA Method 3	Exhaust gas O_2 and CO_2 content determined by Fyrite® combustion gas analyzer.
USEPA Method 4	Exhaust gas moisture determined using the chilled impinger method (as part of the particulate sampling train).
USEPA Method 17	Filterable PM determined using isokinetic sampling procedures and analysis of the filter and acetone rinse.
USEPA Method 9	Exhaust gas or fugitive emission opacity during each sampling period was determined by a certified observer of visible emissions.

5.1 Sampling Location and Velocity Measurements (USEPA Methods 1 and 2)

Prior to commencing the exhaust emission test field measurements, velocity pressure measurement locations were determined in accordance with procedures specified in USEPA Method 1.

Exhaust gas velocity was measured using USEPA Method 2 throughout each test period as part of the isokinetic sampling procedures. Velocity pressure measurements were performed at each stack traverse point using an S-type Pitot tube and red-oil manometer. Temperature measurements were performed at each traverse point using a K-type thermocouple and a calibrated digital thermometer. The velocity / sampling traverse points are indicated in Appendix 3.

5.2 Diluent Gas Sampling Procedures (USEPA Method 3)

Dust collector exhaust gas CO_2 and O_2 content was comparable to that of ambient air (20.9% O_2 and no detectable CO_2) and measured using a Fyrite® gas analyzer that contains scrubbing solutions to selectively remove O_2 and CO_2 from the gas sample. Samples were withdrawn from each air stream during the test periods using a sample probe and hand-held aspirator and introduced to the Fyrite® solutions through the scrubbing tube inlet valve. The sampled gas was passed through the appropriate scrubbing solution several times and the gas concentration (O_2 or CO_2) is determined by the solution volume change as indicated by the calibrated scale on the Fyrite® scrubber chamber.

5.3 Moisture Determination (USEPA Method 4)

Exhaust gas moisture content was measured concurrently with the particulate matter sampling trains and determined in accordance with USEPA Method 4. Moisture from the gas sample was removed by the chilled impingers of the isokinetic sampling train. The net moisture gain from the gas sample was determined by the initial and final impinger weights. Percent moisture was calculated based on the measured net gain from the impingers and the metered gas sample volume of dry air.

5.4 Particulate Matter Sampling Procedures

USEPA Method 17 was used to determine PM content in the dust collector exhaust gas. Exhaust gas was withdrawn from the dust collector stacks at an isokinetic sampling rate using an appropriately-sized stainless steel sample nozzle. The collected exhaust gas passed through an in-stack filter placed just after the "goose-neck" nozzle. PM in the sampled gas stream was collected onto a pre-tared glass fiber filter. The stainless steel in-stack filter holder was connected to a sample probe and the sample probe was connected to an impinger train (for moisture removal) via a Teflon line.

At the end of each one-hour test period, the train was leak checked, the filter was recovered, and the nozzle and front half of the filter holder were brushed and rinsed with acetone. The recovered filter and acetone rinses were sent to a qualified third-party laboratory for gravimetric measurements.

Appendix 4 provides sample train drawings and detailed sampling procedures for USEPA Method 17.

Appendix 5 provides field sampling data sheets and particulate matter emission calculations.

Appendix 6 provides the PM laboratory analytical report.

5.5 Opacity Observations (USEPA Method 9)

The NSPS Subpart LL emission standards (§60.382) specify that … *no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from an affected facility any process fugitive emissions that exhibit greater than 10 percent opacity.*

'Process fugitive emissions' are defined as particulate matter emissions from an affected facility that are not collected by a capture system.

The processes within the Secondary Crushing Building and Mill Building are connected to a capture and emission control system (dust collectors DC-001 and 002). Dust collector exhaust gas (stack emission) opacity was measured during the particulate emission test periods.

The two enclosures connected to a capture and emission control system (Secondary Crushing Building and Mill Building) were not included in the fugitive emission evaluation. All affected processes within the Mill Building are connected to the capture system and the Secondary Crushing Building operates at a pressure that is less than the surrounding environment such that all emissions within the enclosure are collected by the capture system (i.e., the collection system creates a vacuum within the enclosure). This was demonstrated using smoke tubes positioned at each enclosure opening.

For the remaining processes, all affected operations take place within the COSA enclosure, enclosed Transfer Station, or Concentrate Loadout Building. Because it would not meet the necessary line of site and background criteria specified under Method 9, visible emission observations of the individual affected operations within the three buildings were not conducted within the buildings. Rather, openings in the building exterior walls (air exhaust vents, man doors and bay doors) were observed for visible emissions. Each exterior building wall for FGCOSA, EULOAD, and FGCONPLANT that contained an opening was evaluated as a single source and was observed for a total of 3 hours according to the requirements of Method 9. No more than two walls were observed simultaneously.

Due to the low arc of the winter sun in the sky at the southern end of the facility, and the limited daylight hours available for the 3-hour observations, the sun was not always within a 140° sector to the back of the observer during the entire observation period. The sun position is noted on each VE observation sheet.

Appendix 7 provides visible emission field data sheets and USEPA Method 9 certificates for each qualified observer.

5.6 Number and Length of Sampling Runs

The dust collector exhaust stacks (DC-001 and DC-002) were sampled for three (3), 60-minute test periods. Exhaust stack gas opacity observations were performed for a total of three (3) hours during the PM test periods.

Fugitive emission opacity observations were performed for three (3) hours for each source (exterior building wall containing openings).

5.7 Quality Assurance/Quality Control Procedures

Appendix 8 provides sampling equipment quality assurance and calibration data. A summary of these procedures is provided in this section.

5.7.1 Sample Location and Velocity Measurements

The representative sample locations were determined in accordance with USEPA Method 1 based on the measured distance to upstream and downstream disturbances. The sampling location was determined to be acceptable based on the absence of significant cyclonic flow, which was measured and recorded on field data sheets.

Prior to performing the initial velocity traverse, and periodically throughout the test program, the S-type Pitot tube and manometer lines were leak-checked. These checks were made by blowing into the impact opening of the Pitot tube until 3 or more inches of water were recorded on the manometer, then capping the impact opening and holding it closed for 15 seconds to ensure that it was leak free. The static pressure side of the Pitot tube was leak-checked using the same procedure.

5.7.2 Meter Box Calibration and Isokinetic Sampling

The Nutech Model 2010 sampling console was calibrated prior to and after the test event using the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5. The digital pyrometer in the gas metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

The isokinetic variation was calculated for each one hour test period and determined to be within the method allowance, +/-10% of the isokinetic sampling rate, as required by USEPA Method 5 and 17.

5.7.3 Particulate Matter Recovery and Analysis

All recovered particulate matter samples were stored and shipped in glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with a permanent marker prior to shipment and the caps were secured closed with tape. A sample of the acetone that was used for the rinses was sent to the laboratory for analysis to verify that it contained low particulate matter residue.

The nozzle and filter holder used to sample PM were washed and rinsed prior to use in accordance with the procedures of USEPA Method 5 and 17.

5.7.4 Laboratory QA/QC Procedures

The particulate matter analyses were conducted by a qualified third-party laboratory according to the appropriate QA/QC procedures specified in the associated USEPA test methods and are included in the final report provided by Bureau Veritas N.A. (Novi, Michigan), in Appendix 6.

6.0 TEST RESULTS AND DISCUSSION

6.1 Particulate Matter Emission Test Results

The filterable particulate matter emission rate (lb/hr PM) for each dust collector stack was calculated based on the amount of dry stack gas metered through the sampling system, the laboratory results for PM recovered from the sampling train (filter and nozzle/filter holder housing rinses) and the measured stack gas volumetric flowrate.

Tables 6.1 and 6.2 present particulate matter and opacity test results for the two dust collector exhaust stacks that were tested on February 4-5, 2015. The measured PM emission rates are less than the emission limits specified in PTI No. 405-08A.

6.2 Visible Emission Test Results

The observed exhaust gas opacity for all point sources (dust collector exhaust stacks) and fugitive sources (process enclosures) was 0%. Opacity limits for each process are presented in Table 3.2.

6.3 Operating Conditions During the Compliance Test

The emission testing was performed during normal material processing and crushing operations. Copper and nickel ore and material crushing rates were relatively constant and no process interruptions occurred during the test periods. Eagle Mine-Humboldt Mill personnel recorded the material throughput data for each test period. The average material throughput (crushing rate) during the test periods for:

- FGSECONDCRUSH / DC-001 was 294 tons per hour.
- EUFINEORESTORAGE / DC-002 was 279 tons per hour.

The pressure drop across the dust collector filter media was also recorded once per test. The recorded pressure drop for:

- DC-001 ranged from 4.8 to 5.4 inches of water.
- DC-002 ranged from 1.9 to 2.2 inches of water.

Appendix 2 provides process operating and baghouse pressure drop records.

6.4 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed as described in the submitted test protocol, MDEQ-AQD approval letter dated January 13, 2015, and specified USEPA test methods except as noted below. During the test event the processes operated normally, at or near normal maximum achievable capacity.

The testing requirements of NSPS Subpart LL (§60.386) specify that the sample volume for each Method 5/17 run shall be at least 1.70 dry standard cubic meters (60 dscf). It was later determined that the sample volumes for the DC-001 and DC-002 test periods were slightly less than 60 dscf, which is typical for a one-hour test period. The average corrected (standard) sample volume was 53.4 dscf for DC-001 and 48.3 dscf for DC-002. Each one-hour test period was performed according to Method 17, satisfied the isokinetic variation requirements, and resulted in acceptable method detection limits with measured PM emission rates that were well below the allowable NSPS and permit limits (no more than 30% of the emission limit). Pulling additional sample volume (i.e., extending the test periods beyond one hour to obtain 60 dscf) would not have affected the measured PM emission rates.

Table 6.1 Measured particulate matter emission rates and opacity for exhaust stack DC-001 that is associated with FGSECONDCRUSH

Test No. Test Date: Test Times:	**1** 2/4/2015 8:43-9:45	**2** 2/4/2015 10:13-11:17	**3** 2/4/2015 11:40-12:44	**Avg**
Exhaust Gas Properties				
Exhaust gas flow (dscfm)	13,256	13,480	13,171	13,302
Temperature (°F)	52	49	50	50
Moisture (% H_2O)	0.15	0.08	0.10	0.11
Filterable Emissions				
Sample volume (dscf)	51.1	54.4	54.6	53.4
PM filterable catch (mg)	<0.5	<0.5	<0.5	<0.5
PM catch acetone rinse (mg)	2.5	2.1	3.5	2.7
PM Emission Rate (lb/hr)	0.100	0.085	0.129	0.105
PM Permit Limit (lb/hr)	--	--	--	*0.50*
PM Emission Factor (lb/1000 lb gas)	0.0017	0.0014	0.0022	0.0018
PM Permit Limit (lb/1000 lb gas)	--	--	--	*0.009*
Observed Opacity	0%	0%	0%	0%

Table 6.2 Measured particulate matter emission rates and opacity for exhaust stack DC-002 that is associated with EUFINEORESTORAGE

Test No. Test Date: Test Times:	**1** 2/5/2015 15:32-16:34	**2** 2/5/2015 16:50-17:52	**3** 2/5/2015 18:30-19:35	**Avg**
Exhaust Gas Properties				
Exhaust gas flow (dscfm)	5,350	5,466	5,405	5,407
Temperature (°F)	56	53	55	54
Moisture (%H_2O)	0.54	0.43	0.49	0.49
Filterable Emissions				
Sample volume (dscf)	48.0	48.8	48.1	48.3
PM filterable catch (mg)	<0.5	<0.5	<0.5	<0.5
PM catch acetone rinse (mg)	2.4	0.5	0.5	1.13
PM Emission Rate (lb/hr)	0.043	0.015	0.015	0.024
PM Permit Limit (lb/hr)	--	--	--	*0.10*
PM Emission Factor (lb/1000 lb gas)	0.0018	0.0006	0.0006	0.0010
PM Permit Limit (lb/1000 lb gas)	--	--	--	*0.0035*
Observed Opacity	0%	0%	0%	0%