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SCRUBBER
MALFUNCTION ABATEMENT PLAN (MAP)

BREMBO NORTH AMERICA FOUNDRY
HOMER, MICHIGAN

PREPARED BY

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1.0 INTRODUCTION

The Brembo North America, Inc. foundry, located in Homer, Michigan (Homer Foundry), will operate and maintain the facility, including air pollution control and monitoring equipment, in a manner consistent with good air pollution control practices for minimizing emissions as presented in this plan.

The Michigan Department of Environmental, Great Lakes, and Energy (EGLE) regulations and the facility's Permit to Install (PTI No. 199-45C) require the owner or operator responsible for the operation of a source of an air contaminant to prepare a malfunction abatement plan (MAP) in accordance with EGLE Rule 336.1911.

1.1 Applicability

[PTI Condition III and EGLE Rule 336.1911(1)]

The standard requires the owner / operator responsible for the operation of a source of an air contaminant to prepare this MAP to prevent, detect, and correct malfunctions or equipment failures resulting in emissions exceeding any applicable emission limit.

The following table, Table 1, presents a listing of applicable regulations and MAP sections.

Table 1: Regulatory Applicability and Plan Location

Citation	Regulations	Plan Location	
MDEQ R336.1911	Malfunction Abatement Plans	Section	Appendix
R336.1910	Control system installed, maintained, and operated in satisfactory manner and in accordance with rules	All	-
R336.1911(1)	MAP prepared to prevent, detect, correct malfunctions or equipment failures	All	-
R336.1911(2)(a)	PMP prepared and updated Inspection performed List of replacement parts maintained and inventory	3	B C
R336.1911(2)(b)	Operating variables to be monitored to detect malfunctions; normal range; monitoring program	4.0, 6.0	A
R336.1911(2)(c)	Description of corrective action or operation changes in event of malfunction or failure to achieve compliance	5.0	-
R336.1912	Excess Emissions Reporting requirements; record of event	7.0	D

2.0 SOURCE DESCRIPTION

The emission sources, air pollution control equipment, and affected emissions from the facility are detailed within the PTI and include:

Table 2: Emission Unit, Control Device, and Pollutants

Emission Unit (EU) IDs	Description and Control System	PTI Limits
EUCOREMAKING	Core making includes curing the formed core sand mixture using dimethylisopropylamine (DMIPA), a non-HAP amine catalyst. There are three core making machines, emissions from which are controlled by an acid scrubber.	N/A*

* N/A = not applicable (no emission limit was assigned in PTI No. 199-14C).

2.1 Emission Unit, Control System, and Monitor Description

This emission unit is associated with the making of sand cores. Core making consists of curing the formed core sand mixture using dimethylisopropylamine (DMIPA), a non-HAP amine catalyst. The unit is a packed-bed wet scrubber countercurrent unit with a designed airflow rates of 12,600 CFM. Process devices associated with this emission unit include three sand core lines. The lines vent to the packed bed wet scrubber which is vented to the atmosphere. Scrubber water pH will be adjusted using of sulfuric acid. Instruments that monitor pH, water flow rate, and differential pressure are integrated into the system. Appendix A provides a summary of operating ranges for the system.

3.0 PREVENTATIVE MAINTENANCE PROGRAM

This preventative maintenance program identifies the personnel responsible for the program elements; proper equipment operations; and equipment inspection and maintenance schedule.

3.1 Responsible Personnel

[R336.1911(2)(a)]

The personnel responsible for this integrated plan are expected to be as follows.

Table 3: Personnel Responsible for Integrated Plan

Position*	Responsibility
Plant Manager	Overall Operations and Maintenance
Maintenance / Engineering Manager	Training, maintaining plan
Environmental Manager	Reporting to EGLE, verifying requirements
Maintenance technician	Preventative maintenance inspections, repairs, and spare parts inventory

Notes: * Or equivalent.

3.2 Equipment Operations

Proper equipment operation must be verified and maintained on a regular basis in an effort to not only meet emission requirements, but to also minimize corrosive fumes from passing through the scrubbers. Additionally, corrosive condensate in the ductwork and exhaust stacks can be discharged from the stack if operational conditions are not met. Equipment shall not be operated without meeting the following criteria:

- Fan shall not be operated without scrubber recirculation system on.
- Fan or scrubber shall not operate if spray nozzles are plugged.
- Fan shall not operate if scrubber recirculation liquor is concentrated. Proper fresh water make up and blowdown rates must be maintained.
- Equipment shall not operate above rated temperatures (130 degrees F).
- If the fan and scrubber have been shut down for any period of time, the scrubber recirculation system should be operated while fan is off to clean scrubber internals.
- Fan shall not be operated unless pH is below 4.0 standard units (S.U.).

The equipment presents a high health and safety hazard to personnel and precautions must be observed during maintenance and servicing operations. The following provisions must be observed prior to accessing or servicing the emission equipment:

- All system motors should be locked out. This must be completed through the installation of specific lockout/tagout hardware onto the electrical service disconnect. Removal of said hardware shall not be conducted until installation or maintenance is complete.
- The scrubber housing should be inspected for debris or any loose parts.
- All guards should be in place and secured. Never remove or replace any guards unless pump is shut down and locked out as per above instructions.
- All dampers within in duct system should be locked in open position.
- Inspect ductwork for leakage of harmful or corrosive fumes.

3.3 Equipment Inspections and Maintenance

[R336.1911(2)(a)]

Preventative maintenance is a key component to ensuring the reliability, availability, efficiency and production at the facility. Routine maintenance and inspection of the equipment will be conducted in accordance with the manufacturer's written maintenance instructions and maintenance schedule, as detailed below. All maintenance work performed will be documented in either hard copy or electronic format and kept for a minimum of five (5) years from the date of the maintenance activity. Maintenance includes equipment inspections, scheduled replacement of parts, and maintaining an inventory of critical spare parts.

Equipment inspections generally fall under two categories: inspections that take place while the facility is operating and less frequent inspections that take place while the facility is not operating. Inspections that take place during facility operation typically occur on a daily, weekly, monthly or quarterly basis. The frequency and scope of these inspections depend on manufacturer recommendations and operator experience and are detailed below. As is the case with most facilities, the facility will have 'major maintenance' outages that will involve more-in depth inspections of equipment internals. These major maintenance outages will be scheduled in advance and the timing of such outages will be dependent on actual facility operation and good management practices.

The following is an equipment inspection and maintenance schedule for critical equipment relating to the emission control units:

Table 4: Equipment Inspection and Maintenance Schedule

Item	Inspection/Maintenance Action	Daily	Monthly	Qrtly	Bi-Annual
1	pH reading (< 4.0)	x			
2	Pump (water) flow rate reading (Q > 150 gpm)	x			
3	Differential pressure (ΔP = 2.48 - 4.08 in H20)	x			
4	Tank level (~30 inches)	x			
5	Absence of alarms displayed	x			
6	Leaks/abnormal noises	x			
7	Confirm HMI data is trending well (pH, Q, ΔP)	x			
8	Inspect mist eliminator for contamination or damage		x		
9	Inspect/verify proper spray pattern		x		
10	Inspect packed bed for proper drainage		x		
11	Inspect external physical integrity of scrubber/ductwork		x		
12	Test the interlocking system to ensure functionality (pH, Q, ΔP)		x		
13	pH meter/monitor calibration		x		
14	Inspect fan wheel for dirt/debris; corrosion			x	
15	Inspect motor/bearing lubrication; replace as necessary			x	
16	Inspect belt for wear and tension; replace as necessary			x	
17	Inspect packed bed for signs of deformation/cracking			x	
18	Visually inspect all associated duct work			x	
19	Inspect blower bearings for signs of failure (leakage, damage, etc); inspect auto-lubers and replace as necessary			x	
20	Verify pad mist eliminators in place and clean; replace as necessary				x
21	Packing material integrity testing	**Annual**			
22	Calibration of flow sensor	**Annual**			
23	Replacement of differential pressure sensor	**Annual**			

The excerpts from manufacturer's literature included in Appendix E constitute a quality assurance plan which describes the methods to calibrate/audit the pH, Q and ΔP monitors, per manufacturer recommendations, in order to verify that the monitoring equipment has been installed and is operating properly.

3.4 Equipment Spare Parts

[R336.1911 (2)(a)]

The ability to quickly replace components which malfunction during operations largely depends on three factors:

- the availability of off-site sources for replacement parts,
- the willingness of the source to shut down while waiting for such parts, and
- the ability to replace parts without the necessity of a shutdown.

In an effort to minimize potential equipment downtime, an inventory of spare parts for the scrubber system are maintained onsite and includes the part, specific make / model or part number as detailed in Appendix B.

4.0 OPERATING VARIABLES TO BE MONITORED

Routine monitoring and collection of operating data is an integral part of equipment operation and necessary to maintaining the equipment operation as per the requirements of the PTI. Often it is the data collected during routine observation of equipment operation that necessitates large-scale equipment servicing or repairs. During normal operations, personnel are required to collect specific operating parameters and data from the scrubber daily basis, including:

- pH
- Water flow rate (Q)
- Differential pressure (ΔP)
- Tank level
- Absence of alarms displayed
- Leaks/abnormal noises
- Confirm HMI data is trending pH, Q, ΔP

Generally, the systems will be monitored in a centralized Distributed Control System (DCS) and thus the data will be available at all times to the operators. The list of information to be monitored should be considered as a minimum and is subject to expansion at a later date.

5.0 CORRECTIVE ACTION PROCEDURES

Troubleshooting procedures shall be well-documented prior to equipment activation to increase the likelihood of timely and effective repairs. Thorough completion of the troubleshooting procedures also reduces the risks of adverse operating conditions which can lead to the discharge of excess emissions. In addition, training of personnel in the typical operations and troubleshooting/repair of the equipment is essential to minimize emissions and maximize operational time.

5.1 Corrective Action Procedures

[R336.1911(2)(c)]

This section presents the actions to be taken to correct (for example, repair) the malfunctioning process, air pollution control, and air pollution monitoring equipment as soon as practical after the malfunctions happens to minimize emissions. Corrective action procedures for the listed malfunction scenarios are presented below. Refer to equipment manuals for specific step-by-step instructions as needed.

Table 5: Malfunctions and Corrective Actions

Malfunction	Corrective Procedures
Poor Spray Pattern	Spray Nozzles plugged up Spray Headers plugged up Pump suction blocked Pump discharge piping too small Insufficient water in sump Pump running backwards Total head exceeds that of pump
Unit will not drain	Drain line to remote tank is not submerged or trapped Drain line is not sloped towards tank Drain line plugged Drain line too small
Moisture after unit	Re-Entrainment due to liquid loading Gap or void in mist eliminator Mist Eliminator damaged Velocity too high through scrubber Droplet size too small Packing has settled (horizontal units) Mesh pad mist eliminator plugged or saturated—liquid loading too high—throttle back nozzle spray pattern—clean mesh pad

Malfunction	Corrective Procedures
Low removal efficiency	Insufficient or no water to spray nozzles Mist Eliminator (if present) plugged or shifted Velocity too high or too low Improper pH of scrubbing liquor—inlet concentration too high Packing plugged or settled
Decreased exhaust volume	Exhaust system not venting properly Check fan RPM, belts, rotation and fuses Packing plugged Chevron mist eliminator and or mesh pad plugged Dampers closed or broken in closed position Ductwork plugged with solids High negative pressure in building Leaks in ductwork
Poor ventilation	Riser dampers closed or broken Hood slot plugged up Control devise such as scrubber plugged up No air make-up in building Improper duct design Fan belts slipping or broken, inspect fan Fan wheel deteriorated, inspect fan Wrong fan motor Wrong fan RPM
Ductwork Collapsing	Duct material thickness inadequate Duct not adequately reinforced Duct plugged with solids or liquid Poor duct hanger design Hanger spacing not according to S.M.C.N.A.
Ductwork Deteriorating	Wrong material for application, chemical attack Dark color used outside, use white or UV stable material Duct plugged Poor job of installing
Excessive Vibration	Material build-up on fan impeller Worn or corroded impeller Impeller out of balance De-lamination of balancing weight Sheaves eccentric or out of balance Bearing or drive misalignment Defective bearing Belts too tight Mismatched belts Motor out of balance Foundation not flat or level, weak or resonant foundation Bent shaft Impeller or sheaves loose on shaft Static pressure too low

Malfunction	Corrective Procedures
High Bearing Temperature	Over-lubrication Under-lubrication Wrong lubricant Defective bearing
High Motor Temperature	Check input power Check fan rotation Check for obstructions around motor shroud Check system static pressure Check for excessive head pressure[1] Motor cooling fan damaged[1]
Air Flow too High	Static pressure too low (less resistance to flow than expected) Fan RPM higher than design Dampers not installed or need to be adjusted
Air Flow too Low	**S**tatic pressure too high (more resistance to flow than expected) Impeller rotation wrong Fan RPM lower than de-sign Obstructions or leaks in duct-work Sharp elbows at fan inlet or outlet No straight duct prior to fan inlet Clogged filters
Fan Does Not Operate	Electricity is turned off or improperly wired Blown fuses Broken belts Loose sheaves Improper voltage Overload protector has broken circuit Fan motor failure[1]
Excessive Noise	Material build-up on fan impeller Defective bearing RPM too high Impeller out of balance Vibrating parts not isolated from building Fan operating in a stall condition (DANGER) Loose mounting bolts Vibrating ductwork Belts too loose or tight Ductwork too small
pH Out of Spec	Damaged pH cables Faulty Transmitted pH probe out of calibration pH probe failure Scrubber solution too saturated with amine – needs regeneration Low level in acid supply Add too much water

Malfunction	Corrective Procedures
Poor Flow Rate	Pump Failure Defective flow meter Low liquid level Plugged spray nozzles Leaks in piping or clogged piping Blocked pump inlet Pump rotation backwards Faulty electrical connection
Differential Pressure out of Spec	Plugged duct Mist eliminator plugged Improper fan speed Faulty differential pressure sensor Plugged or damaged sensor tubing Dirty or plugged media

6.0 STARTUP PROCEDURE

It is critical that the components be activated by following specific procedures, and that specific conditions are verified throughout the process. Startup of process equipment shall proceed as follows:

- Fill scrubber sump or remote tank with freshwater and sulfuric acid until pH is below 3.0 S.U. and water at proper level.
- Set freshwater make-up valve to the proper gallon per minute (GPM) .
- Activate recirculation pump.
- Adjust spray pattern to minimize spray hitting sidewall of scrubber.
- Immediately check stack discharge. If excessive misting is observed shutdown system immediately and consult manufacturer.

7.0 PLAN MAINTENANCE, RECORDKEEPING AND REPORTING

7.1 Initial Plan Requirements

[PTI Condition III]

- The MAP must be developed and submitted within 60 days of installation, and implemented and maintained.

7.2 Plan Revisions

[PTI Condition III and EGLE Rule 336.1911(3) and (4)]

- If at any time the MAP fails to address or inadequately addresses an event that meets the characteristics of the malfunction, the permittee shall amend the MAP within 45 days after such an event occurs.
- The MAP must be revised within 45 days, if new equipment is installed.
- The MAP must be revised upon request from the District Supervisor.
- The permittee shall submit the MAP and any amendments to the MAP to the AQD District Supervisor for review and approval. If the AQD does not notify the permittee within 90 days of the submittal, the MAP or amended MAP shall be considered approved. Until amended plan is approved, the permittee shall implement corrective procedures or operational changes to achieve compliance with all applicable emission limits.

7.3 Record Keeping

[PTI Condition VI, unless otherwise noted]

- The permittee shall monitor and record the acid scrubber liquid flow rate, pressure drop, and pH once per shift, and no less frequently than twice in each 24-hour period while the core making process is operating, and keep records of the monitor calibrations as required by PTI SC IV.2. The permittee shall keep all records on file at the facility and make them available to the Department upon [VI.4].
- The permittee shall maintain inspection records for the scrubber. The permittee shall keep all records on file at the facility and make them available to the Department upon request [VI.5].
- The permittee shall maintain records of the monthly calibrations of the interlock system and keep annual testing and certification records of the interlock system to show compliance with PTI SC V.1. All records shall be kept on file and made available to the Department upon request [VI.5].
- All current plans and superseded plans will be maintained for the life of the affected source [R 336.1915(c)(i)].
- All other information necessary to demonstrate compliance with each plan requirement must be kept on-site for a period of at least 5 years.

7.4 Malfunction Reporting Requirements

[PTI General Condition 7 and EGLE Rules 336.1912 and 336.1213]

Malfunction reporting requirements include any emission exceedance or deviation from operating requirements on semi-annual monitoring and deviation report and annual report. [EGLE Rule 336.1213].

Excess emissions reporting requirements under EGLE Rule 336.1912(3) do not apply, as there is no hourly emissions limit in the PTI, and no other short-term emissions standard associated with the scrubber.

Appendix A
Summary of Operating Ranges

Scrubber Summary of Operating Ranges					
Operating Parameter	**Unit of Measure**	**Normal**	**Max**	**Low / High Alarms**	**Sensors**
pH	S.I.	< 3.0	< 4.0	0.0 / 4.5	Memosens pH Sensor
Q	gpm	> 200	350	150 / 350	Proline Promag 50P, 53P Electromagnetic Flow Measuring System
ΔP	in H2O	2.48 - 4.08	5.08	1.84 / 5.08	DH3 Digihelic Differential Pressure Controller

Appendix B
Equipment Spare Parts

Scrubber		
Spare Parts List		
Quantity	**Description**	**Part Number**
1	Serfilco EFP 3x2-3 SC D15.0-MPH Scrubber pump	291PUM000030
2	SPB3150V Belt Acid Scrubber IMF	289BEL000101
1	Core Shop Scrubber Calibration GRA-7Y379 Buffer Kit	283G EN 000211
1	Exhaust Fan Motor Siemens 480 VAC 68A 1782RPM NEMA MGI 1MB3/IP55	290MOT000118
1	Series DH3 Digihelic Differential Pressure Controller	DH3—OO9
1	Proline Promag Flow Meter 286ELE001611	Promag 50
2	Orbisint CPS11D pH probe 286ELE001537	CPSIID
1	Drive Sheave	285BEA000081
1	Drive Sheave	285BEA000080
1	Tapered Bushing - Drive	BEA000068
1	Tapered Bushing - Drive	BEA000069

Appendix C
Plan Revisions

Scrubber MAP Revisions

Revision Date	Revision No.	Reviewer	Summary of Changes
Dec-18	1	J. Conard	Table 1: Revise References Section Table 5: Additions to Malfunctions / Corrective Actions Appendices: Addition to Spare Parts, Remove Inspection Logs, and add Malfunction Record
Sep-20	2	J. Conard	General revisions to reflects new PTI Addition of Appx E Type and regulatory reference and citation corrections. Changes to Tables 4 and 5, and Appx. A and B.

Appendix D
Malfunction Record

Homer Foundry
Appendix D
Malfunction Records

Information	Description
Date	
Type of Malfunction	
Provide detailed explanation of the circumstances of event	
Provide description of corrective actions taken	
Describe the reasons the MAP was not followed.	
Describe any proposed revisions to the MAP and list revisions in table in Appendix C.	
Name	
Title	

Appendix E
Quality Assurance Plan

Appendix E-1

Manufacturer's Recommended Methods to Calibrate/Audit
pH Monitor

CM442 SCREEN SHOTS FOR CALIBRATING A pH SENSOR

1. Press the CAL button on the main screen, highlighting the sensor you wish to calibrate.

2. Select the two point calibration

3. Select ‘OK” to start the calibration

4. Immerse the sensor in the 1st buffer solution (usually 7pH), and press “OK”


Menu/...on/pH/2-point calibration
C
Buffer 1: 7.00 pH
-10 mV 6.95 pH 50.2 °C
Please clean sensor before
immersing in buffer 1.
ESC
OK

5. 

6. Once finished with the 1st buffer, place the sensor in the 2nd (usually 4pH), then press “OK”

7. Once that is done, select “OK” to save the calibration.


Menu/...on/pH/2-point calibration
C
Buffer 1: 7.00 pH -10 mV
Buffer 2: 4.00 pH 181 mV
Slope: 59.54 mV/pH
Zeropoint: 6.79 pH
Do you want to take over the calibration data for adjustment?
ESC
OK


Menu/Calibration/pH
C
Calibration is finished.
Please clean the sensor before
immersing in process medium.
(Hold will be disabled)
OK

Appendix E-2

Manufacturer's Recommended Methods to Calibrate/Audit
Water Flow Monitor

Appendix E-3

Manufacturer's Recommended Methods to Calibrate/Audit
Differential Pressure Monitor