DATE OF REPORT: 19TH DECEMBER 2019

Paul Bollen
NSW Operations Manager
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P.O. Box 230
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TEST REPORT NO. NOV19206.1

AIR EMISSION TESTING CONDUCTED ON CEMENT MILL EXHAUST STACKS 1, 2 & 3 AT MORGAN CEMENT INTERNATIONAL IN PORT KEMBLA

DATE OF TESTING: 26TH & 27TH NOVEMBER 2019

ACCREDITATION:

This laboratory is accredited by the National Association of Testing Authorities (NATA).
NATA Accredited Laboratory No. 15463.
Accredited for compliance with ISO/IEC 17025:2005.
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AUTHORISATION:

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EXECUTIVE SUMMARY

AirLabs Environmental Pty Ltd was commissioned by Morgan Cement International Pty Ltd to monitor stack emissions from Mills 1, 2 & 3 Exhaust Stacks. All sampling was conducted by Airlabs Environmental on the 26th & 27th November 2019.

Analysis was undertaken by Airlabs Environmental and the National Measurement Institute (NMI) in accordance with our terms of NATA accreditation. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

The following results comparison table shows that the concentrations of all analytes were below the limits set by the NSW DEHP (refer to Licence No. –12643, issued on 06th September 2016).

Table 1: Comparison of Test Results with NSW DEHP Limits

Release Point	Parameter	Concentration (mg/m^3)	NSWEPA Concentration Limit (mg/m^3)
Mill 1	Total solid particles (TSP)	2.2	20
	Type 1 & 2 Substances	0.0065	1.0
Mill 2	Total solid particles (TSP)	1.7	20
	Type 1 & 2 Substances	0.0051	1.0
Mill 3	Total solid particles (TSP)	1.4	20
	Type 1 & 2 Substances	0.0043	1.0

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INTRODUCTION

Airlabs Environmental Pty Ltd was commissioned by Morgan Cement International Pty Ltd to conduct air emissions monitoring of the exhaust ducts leaving Cement Mills 1, 2 and 3 for the following parameters:

- Gas velocity and volume flow rate
- Temperature
- Concentration of water vapour (moisture content)
- Concentration of oxygen and carbon dioxide
- Dry molecular weight & density of gases
- Concentration and mass emission rate of:
  - total solid particles
  - type 1 & 2 substances.

All sampling was conducted on 26th & 27th November 2019.

TEST METHODS

All sampling was undertaken by Airlabs Environmental. Airlabs Environmental is NATA accredited for all sampling undertaken for this project (NATA Accredited Laboratory No. 15463). Analysis was undertaken by Airlabs Environmental in accordance with our terms of accreditation. Specific details of the test methods used are available upon request.

Table 2: Summary of Test Methods

Test Parameter	Test Method	Method Detection Limit	Estimated Measurement Uncertainty	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSWEPA TM-1	NA	NA	✓	NA
Gas velocity	NSWEPA TM-2	3 m/s	± 10%	✓	NA
Temperature	NSWEPA TM-2	273K (0°C)	± 1%	✓	NA
Moisture content	NSWEPA TM-22	0.2% v/v	± 5%	✓	✓
Oxygen & carbon dioxide	NSWEPA TM-24 & TM-25	0.1% v/v	± 2%	✓	✓
Total solid particulates	NSWEPA TM-15	0.5 mg/m^3	± 15%	✓	✓
Type 1 & 2 Substances	NSW EPA TM-12, 13 & 14	0.05 mg/m3	± 17%	✓	✓[1]

1. Type 1 & 2 Substances analyses were performed by NMI, with results included in their Report No. RN1256564.

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QUALITY STATEMENT

AirLabs Environmental is committed to providing the highest quality data to all our clients, as reflected in our ISO 17025 (NATA) accreditation. This requires strict adherence to and continuous improvement of all our processes and test work. Our goal is to exceed the QA/QC requirements as set by our clients and appropriate governmental entities and to ensure that all data generated is scientifically valid and defensible.

Airlabs Environmental is NATA accredited for all sampling undertaken for this project. Analysis was undertaken by the Airlabs Environmental in accordance with our terms of accreditation.

SUITABILITY OF SAMPLING PLANE

The criteria for sampling planes as specified in AS4323.1-1995 'Stationary Source Emissions, Method 1: Selection of Sampling Provisions' states that, in the absence of cyclonic flow activity, ideal sampling plane conditions are found to exist at the positions given in Table 3 below:

Table 3: Criteria for the Selection of Sampling Planes

Type of flow disturbance	**Minimum distance upstream from disturbance, diameters (*D*)**	**Minimum distance downstream from disturbance, diameters (*D*)**
Bend, connection, junction, direction change	>2D	>6D
Louvre, butterfly damper (partially closed or closed)	>3D	>6D
Axial fan	>3D	>8D (see Note)
Centrifugal fan	>3D	>6D

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

Section 4.1 of AS 4323.1-1995 (Ideal Sampling Positions) states that the location of the sampling plane shall be such that it meets the following criteria:

(a) The gas flow is basically in the same direction at all points along each sampling traverse.

(b) The gas velocity at all sampling points is greater than 3 m/s.

(c) The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane.

(d) The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.

(e) The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1.

(f) The gas temperature at the sampling plane should preferably be above the dewpoint.

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SUITABILITY OF SAMPLING PLANE Continued

When the criteria in Table 3 cannot be met, a greater number of sampling points is used in order to retain as much accuracy as is practicable, as outlined in Section 4.2 of AS 4323.1-1995 (Non-Ideal Sampling Positions). The sampling plane details and required number of sampling points for Cement Mills 1, 2 and 3 are given in Tables 4, 5 and 6 below:

Table 4: Sampling Plane Details for the Cement Mill 1 Exhaust Duct

Parameter	
Stack Shape	Circular
Actual Stack Internal Diameter (m)	0.850
Direction of Air Flow	Vertical
Type of Disturbance, Upstream	Bend
Distance from Upstream Disturbance	4 D (< 6D)
Type of Disturbance, Downstream	Butterfly damper
Distance to Downstream Disturbance	1 D (< 3 D)
Compliance with AS 4323.1, Ideal Conditions	No
Standard No. of Sampling Points per Traverse	6
Number of Traverses	2
Correction Factor	1.265
Corrected No. of Sampling Points per Traverse	8
Total No. of Sampling Points	16
Stratified	No
Cyclonic	No (< 15°)
Velocity Difference	1.2:1 (< 1.6:1)
Absolute Temperature Difference (K)	< 10%
Minimum Velocity at any Sample Point (m/s)	> 3

Figure 1: Cement Mill 1 Exhaust Duct

Table 5: Sampling Plane Details for the Cement Mill 2 Exhaust Duct

Parameter	
Stack Shape	Circular
Actual Stack Internal Diameter (m)	0.850
Direction of Air Flow	Vertical
Type of Disturbance, Upstream	Bend
Distance from Upstream Disturbance	4 D (< 6D)
Type of Disturbance, Downstream	Butterfly damper
Distance to Downstream Disturbance	1 D (< 3 D)
Compliance with AS 4323.1, Ideal Conditions	No
Standard No. of Sampling Points per Traverse	6
Number of Traverses	2
Correction Factor	1.265
Corrected No. of Sampling Points per Traverse	8
Total No. of Sampling Points	16
Stratified	No
Cyclonic	No (< 15°)
Velocity Difference	1.3:1 (< 1.6:1)
Absolute Temperature Difference (K)	< 10%
Minimum Velocity at any Sample Point (m/s)	> 3

Figure 2: Cement Mill 2 Exhaust Duct

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SUITABILITY OF SAMPLING PLANE Continued

Table 6: Sampling Plane Details for the Cement Mill 3 Exhaust Duct

Parameter	
Stack Shape	Rectangular
Actual Duct Internal Diameter (m)	1.77 * 0.800
Direction of Discharge to Air	Horizontal
Type of Disturbance, Upstream	Centrifugal Fan
Distance from Upstream Disturbance	3.4 D (< 6 D)
Type of Disturbance, Downstream	Duct Exit
Distance to Downstream Disturbance	4.9 D (> 2 D)
Compliance with AS 4323.1, Ideal Conditions	No
Standard No. of Sampling Points per Traverse	2
Number of Traverses	3
Correction Factor	1.15
Corrected No. of Sampling Points per Traverse	3
Total No. of Sampling Points	9
Stratified	No
Cyclonic	No (< 15°)
Velocity Difference	1.1:1 (< 1.6:1)
Absolute Temperature Difference (K)	< 10%
Minimum Velocity at any Sample Point (m/s)	> 3

Figure 3: Cement Mill 3 Exhaust Duct

DEFINITIONS

'NSWEPA' New South Wales Environment Protection Authority.
'USEPA' United States Environmental Protection Agency.
'NA' Not applicable.
'Am^3' Actual gas volume at stack conditions.
'STP' Standard temperature and pressure (0°C and 101.3 kPa).
'% v/v' Percent, volumetric basis.
'm^3' Normalised gas volume in dry cubic metres at STP.
'mg/m^3' Milligrams (10^{-3} grams) of substance per dry cubic meter of gas at STP.
'g/sec' Grams of substance discharged per second.

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RESULTS

Company	Morgan Cement International Pty Ltd
Site	Foreshore Rd, Port Kembla
Date of Test	27th November 2019
Source Tested	Cement Mill 1 Exhaust Duct – EPA ID No.4
Sampling Period	10:18 – 11:18
Testing Officers	I Brash
Sampling Position	Two 110 mm flanges in a circular metal duct

Table 7: Sampling Conditions for the Cement Mill 1 Exhaust Duct on 27th November 2019

Sampling Conditions	
Duct dimensions at sampling plane (m)	0.850
Average gas temperature (K)	336 (63°C)
Average gas velocity (m/s)	16.2
Actual gas flow rate (Am^3/sec)	9.21
Average moisture content (%v/v)	0.28
Barometric pressure (mB)	1014.9
Static pressure (mB)	-24.5
Stack pressure (mB)	990.4
Average gas flow rate at STP, dry (m^3/sec)	7.46
Average oxygen concentration (%v/v)	20.9
Average carbon dioxide concentration (%v/v)	0.10
Dry gas density of stack gas (kg/m^3)	1.287
Dry molecular weight of stack gas (g/g mole)	28.85
Wet molecular weight of stack gas (g/g mole)	28.82

Table 8: Test Results for Cement Mill 1 Exhaust Duct on 27th November 2019

Parameter	**Concentration (mg/m^3)**	**NSWEPA Limit (mg/m^3)**	**Emission Rate (g/sec)**
Total solid particles (TSP)	2.2	**20**	0.016
Type 1 & 2 substances[a]	0.0065	**1.0**	0.000049

[a] Type 1 & 2 substances include As, Be, Cd, Cr, Co, Hg, Mn, Ni, Pb, Sb, Se, Sn, V & their compounds (refer to Table 9 & 10).

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RESULTS – Continued

Table 9: Concentration of Type 1 Substances and their Compounds - 27th November 2019

Metal/Metal Compound	Concentration (mg/Nm³)	Emission Rate (g/sec)
Antinomy (Sb) & its compounds	<0.0001	<0.000001
Arsenic (As) & its compounds	<0.0001	<0.000001
Cadmium (Cd) & its compounds	<0.00003	<0.0000002
Lead (Pb) & its compounds	0.00062	0.0000046
Mercury (Hg) & its compounds	<0.00003	<0.0000002
Total Type 1 substances & their compounds	**0.00062**	**0.0000046**

Table 10: Concentration of Type 2 Substances and their Compounds - 27th November 2019

Metal/Metal Compound	Concentration (mg/Nm³)	Emission Rate (g/sec)
Beryllium (Be) & its compounds	<0.0001	<0.000001
Chromium (Cr) & its compounds	0.00076	0.0000057
Cobalt (Co) & its compounds	<0.0001	<0.000001
Manganese (Mn) & its compounds	0.0035	0.000026
Nickel (Ni) & its compounds	0.00065	0.0000048
Selenium (Se) & its compounds	0.00076	0.0000057
Tin (Sn) & its compounds	0.00014	0.0000011
Vanadium (V) & its compounds	0.000080	0.00000059
Total Type 2 substances & their compounds	**0.0059**	**0.000044**

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RESULTS Continued

Company	Morgan Cement International Pty Ltd
Site	Foreshore Rd, Port Kembla
Date of Test	26th November 2019
Source Tested	Cement Mill 2 Exhaust Duct – EPA ID No.2
Sampling Period	14:24 – 15:24
Testing Officers	I Brash
Sampling Position	Two 110 mm flanges in a circular metal duct

Table 11: Sampling Conditions for the Cement Mill 2 Exhaust Duct on 26th November 2019

Sampling Conditions	
Duct dimensions at sampling plane (m)	0.850
Average gas temperature (K)	351 (78°C)
Average gas velocity (m/s)	13.7
Actual gas flow rate (Am^3/sec)	7.75
Average moisture content (%v/v)	0.51
Barometric pressure (mB)	994.8
Static pressure (mB)	- 16.2
Stack pressure (mB)	978.6
Average gas flow rate at STP, dry (m^3/sec)	6.00
Average oxygen concentration (%v/v)	20.9
Average carbon dioxide concentration (%v/v)	0.10
Dry gas density of stack gas (kg/m^3)	1.287
Dry molecular weight of stack gas (g/g mole)	28.85
Wet molecular weight of stack gas (g/g mole)	28.80

Table 12: Test Results for the Cement Mill 2 Exhaust Duct on 26th November 2019

Parameter	**Concentration (mg/m^3)**	**NSWEPA Limit (mg/m^3)**	**Emission Rate (g/sec)**
Total solid particles (TSP)	1.7	**20**	0.010
Type 1 & 2 substances[b]	0.0051	**1.0**	0.000031

[b] Type 1 & 2 substances include As, Be, Cd, Cr, Co, Hg, Mn, Ni, Pb, Sb, Se, Sn, V & their compounds (refer to Table 13 & 14).

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RESULTS – Continued

Table 13: Concentration of Type 1 Substances and their Compounds - 26th November 2019

Metal/Metal Compound	**Concentration (mg/Nm³)**	**Emission Rate (g/sec)**
Antinomy (Sb) & its compounds	<0.0001	<0.0000006
Arsenic (As) & its compounds	0.000077	0.00000046
Cadmium (Cd) & its compounds	0.000011	0.00000063
Lead (Pb) & its compounds	0.00050	0.0000030
Mercury (Hg) & its compounds	<0.00002	<0.0000001
Total Type 1 substances & their compounds	**0.00059**	**0.0000035**

Table 14: Concentration of Type 2 Substances and their Compounds - 26th November 2019

Metal/Metal Compound	**Concentration (mg/Nm³)**	**Emission Rate (g/sec)**
Beryllium (Be) & its compounds	<0.0001	<0.0000006
Chromium (Cr) & its compounds	0.00050	0.0000030
Cobalt (Co) & its compounds	<0.0001	<0.0000006
Manganese (Mn) & its compounds	0.0025	0.000015
Nickel (Ni) & its compounds	0.00056	0.0000033
Selenium (Se) & its compounds	0.00093	0.0000056
Tin (Sn) & its compounds	<0.0001	<0.0000006
Vanadium (V) & its compounds	<0.0001	<0.0000006
Total Type 2 substances & their compounds	**0.0045**	**0.000027**

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RESULTS Continued

Company	Morgan Cement International Pty Ltd
Site	Foreshore Rd, Port Kembla
Date of Test	26th November 2019
Source Tested	Cement Mill 3 Exhaust Duct – EPA ID No.3
Sampling Period	10:56 – 11:56
Testing Officers	I Brash
Sampling Position	Three 4" sockets in a rectangular metal duct

Table 15: Sampling Conditions for the Cement Mill 3 Exhaust Duct on 26th November 2019

Sampling Conditions	
Duct dimensions at sampling plane (m)	1.77 x 0.800
Average stack gas temperature (K)	354 (81°C)
Average gas velocity (m/s)	21.6
Actual gas flow rate (Am^3/sec)	30.6
Average moisture content (%v/v)	1.04
Barometric pressure (mB)	1000.0
Static pressure (mB)	1.8
Stack pressure (mB)	1001.8
Average gas flow rate at STP, dry (m^3/sec)	23.3
Average oxygen concentration (%v/v)	20.9
Average carbon dioxide concentration (%v/v)	0.10
Dry gas density of stack gas (kg/m3)	1.287
Dry molecular weight of stack gas (g/g mole)	28.85
Wet molecular weight of stack gas (g/g mole)	28.74

Table 16: Test Results for the Cement Mill 3 Exhaust Duct on 26th November 2019

Parameter	**Concentration (mg/m^3)**	**NSWEPA Limit (mg/m^3)**	**Emission Rate (g/sec)**
Total solid particles (TSP)	1.4	**20**	0.033
Type 1 & 2 substancesc	0.0043	**1.0**	0.00010

[c] Type 1 & 2 substances include As, Be, Cd, Cr, Co, Hg, Mn, Ni, Pb, Sb, Se, Sn, V & their compounds (refer to Table 17 & 18).

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RESULTS – Continued

Table 17: Concentration of Type 1 Substances and their Compounds - 26th November 2019

Metal/Metal Compound	Concentration (mg/Nm³)	Emission Rate (g/sec)
Antinomy (Sb) & its compounds	<0.0001	<0.000002
Arsenic (As) & its compounds	<0.0001	<0.00002
Cadmium (Cd) & its compounds	0.000011	0.00000025
Lead (Pb) & its compounds	0.00053	0.000012
Mercury (Hg) & its compounds	<0.00002	<0.000001
Total Type 1 substances & their compounds	**0.00054**	**0.000013**

Table 18: Concentration of Type 2 Substances and their Compounds - 26th November 2019

Metal/Metal Compound	Concentration (mg/Nm³)	Emission Rate (g/sec)
Beryllium (Be) & its compounds	<0.0001	<0.000002
Chromium (Cr) & its compounds	0.00073	0.000017
Cobalt (Co) & its compounds	<0.0001	<0.000002
Manganese (Mn) & its compounds	0.0010	0.000024
Nickel (Ni) & its compounds	0.00067	0.000016
Selenium (Se) & its compounds	0.0013	0.000030
Tin (Sn) & its compounds	<0.0001	<0.000002
Vanadium (V) & its compounds	0.00011	0.0000027
Total Type 2 substances & their compounds	**0.0038**	**0.000089**

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