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**TEST REPORT No. NOV20174.1**

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

**DATE OF TESTING:** 24<sup>TH</sup> & 25<sup>TH</sup> NOVEMBER 2020

**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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## 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 24<sup>th</sup> & 25<sup>th</sup> November 2020.

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 06<sup>th</sup> September 2016).

**Table 1:** Comparison of Test Results with NSW DEHP Limits

Release Point	Parameter	Concentration (mg/m <sup>3</sup> )	NSWEPA Concentration Limit (mg/m <sup>3</sup> )
Mill 1	Total solid particles (TSP)	2.3	20
	Type 1 & 2 Substances	0.010	1.0
Mill 2	Total solid particles (TSP)	2.4	20
	Type 1 & 2 Substances	0.0099	1.0
Mill 3	Total solid particles (TSP)	1.3	20
	Type 1 & 2 Substances	0.0056	1.0

## 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 24<sup>th</sup> & 25<sup>th</sup> November 2020.

## 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 <sup>3</sup>	± 15%	✓	✓
Type 1 & 2 Substances	NSW EPA TM-12, 13 & 14	0.05 mg/m <sup>3</sup>	± 17%	✓	✓ <sup>1</sup>

1. Type 1 & 2 Substances analyses were performed by NMI, with results included in their Report No. RN1297255.

## 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:

- The gas flow is basically in the same direction at all points along each sampling traverse.
- The gas velocity at all sampling points is greater than 3 m/s.
- 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.
- 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.
- 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.
- The gas temperature at the sampling plane should preferably be above the dewpoint.

**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 (< 3D)
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 (< 3D)
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	1.1:1 (< 1.6:1)
Absolute Temperature Difference (K)	< 10%
Minimum Velocity at any Sample Point (m/s)	> 3

**Figure 2:** Cement Mill 2 Exhaust Duct



## 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	3.4D (< 6 D)
Type of Disturbance, Downstream	Duct Exit
Distance to Downstream Disturbance	4.9D (> 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	1.3:1 (< 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<sup>3</sup>' Actual gas volume at stack conditions.
- 'STP' Standard temperature and pressure (0°C and 101.3 kPa).
- '% v/v' Percent, volumetric basis.
- 'm<sup>3</sup>' Normalised gas volume in dry cubic metres at STP.
- 'mg/m<sup>3</sup>' Milligrams (10<sup>-3</sup> grams) of substance per dry cubic meter of gas at STP.
- 'g/sec' Grams of substance discharged per second.

## RESULTS

<b>Company</b>	Morgan Cement International Pty Ltd
<b>Site</b>	Foreshore Rd, Port Kembla
<b>Date of Test</b>	25 <sup>th</sup> November 2020
<b>Source Tested</b>	Cement Mill 1 Exhaust Duct – EPA ID No.4
<b>Sampling Period</b>	14:10 – 15:10
<b>Testing Officers</b>	I Brash
<b>Sampling Position</b>	Two 110 mm flanges in a circular metal duct

**Table 7:** Sampling Conditions for the Cement Mill 1 Exhaust Duct

Sampling Conditions	
Duct dimensions at sampling plane (m)	0.850
Average gas temperature (K)	342 (69°C)
Average gas velocity (m/s)	14.2
Actual gas flow rate (Am <sup>3</sup> /sec)	8.06
Average moisture content (%v/v)	1.17
Barometric pressure (mB)	1016.4
Static pressure (mB)	-25.3
Stack pressure (mB)	991.1
Average gas flow rate at STP, dry (m <sup>3</sup> /sec)	6.36
Average oxygen concentration (%v/v)	20.9
Average carbon dioxide concentration (%v/v)	0.10
Dry gas density of stack gas (kg/m <sup>3</sup> )	1.287
Dry molecular weight of stack gas (g/g mole)	28.85
Wet molecular weight of stack gas (g/g mole)	28.72

**Table 8:** Test Results for Cement Mill 1 Exhaust

Parameter	Concentration (mg/m <sup>3</sup> )	NSWEPA Limit (mg/m <sup>3</sup> )	Emission Rate (g/sec)
Total solid particles (TSP)	2.3	20	0.015
Type 1 & 2 substances <sup>a</sup>	0.010	1.0	0.000064

<sup>a</sup> 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).



## RESULTS – Continued

**Table 9:** Concentration of Type 1 Substances and their Compounds - 25<sup>th</sup> November 2020

<b>Metal/Metal Compound</b>	<b>Concentration (mg/Nm<sup>3</sup>)</b>	<b>Emission Rate (g/sec)</b>
Antimony (Sb) & its compounds	<0.0002	<0.000001
Arsenic (As) & its compounds	<0.0002	<0.000001
Cadmium (Cd) & its compounds	0.000082	0.00000052
Lead (Pb) & its compounds	0.0015	0.000010
Mercury (Hg) & its compounds	0.000018	0.00000011
<b>Total Type 1 substances &amp; their compounds</b>	<b>0.0016</b>	<b>0.000011</b>

**Table 10:** Concentration of Type 2 Substances and their Compounds - 25<sup>th</sup> November 2020

<b>Metal/Metal Compound</b>	<b>Concentration (mg/Nm<sup>3</sup>)</b>	<b>Emission Rate (g/sec)</b>
Beryllium (Be) & its compounds	<0.0002	<0.000001
Chromium (Cr) & its compounds	0.0014	0.0000086
Cobalt (Co) & its compounds	<0.0002	<0.000001
Manganese (Mn) & its compounds	0.0050	0.000032
Nickel (Ni) & its compounds	0.0010	0.0000065
Selenium (Se) & its compounds	0.00026	0.0000017
Tin (Sn) & its compounds	0.00031	0.0000020
Vanadium (V) & its compounds	0.00052	0.0000033
<b>Total Type 2 substances &amp; their compounds</b>	<b>0.0085</b>	<b>0.000054</b>

## RESULTS Continued

<b>Company</b>	Morgan Cement International Pty Ltd
<b>Site</b>	Foreshore Rd, Port Kembla
<b>Date of Test</b>	25 <sup>th</sup> November 2020
<b>Source Tested</b>	Cement Mill 2 Exhaust Duct – EPA ID No.2
<b>Sampling Period</b>	10:22 – 11:22
<b>Testing Officers</b>	I Brash
<b>Sampling Position</b>	Two 110 mm flanges in a circular metal duct

**Table 11:** Sampling Conditions for the Cement Mill 2 Exhaust Duct

Sampling Conditions	
Duct dimensions at sampling plane (m)	0.850
Average gas temperature (K)	335 (62°C)
Average gas velocity (m/s)	12.9
Actual gas flow rate (Am <sup>3</sup> /sec)	7.32
Average moisture content (%v/v)	1.05
Barometric pressure (mB)	1016.4
Static pressure (mB)	- 16.6
Stack pressure (mB)	999.8
Average gas flow rate at STP, dry (m <sup>3</sup> /sec)	5.91
Average oxygen concentration (%v/v)	20.9
Average carbon dioxide concentration (%v/v)	0.10
Dry gas density of stack gas (kg/m <sup>3</sup> )	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 12:** Test Results for the Cement Mill 2 Exhaust Duct

Parameter	Concentration (mg/m <sup>3</sup> )	NSWEPA Limit (mg/m <sup>3</sup> )	Emission Rate (g/sec)
Total solid particles (TSP)	2.4	<b>20</b>	0.014
Type 1 & 2 substances <sup>b</sup>	0.0099	<b>1.0</b>	0.000058

<sup>b</sup> 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).

RESULTS – Continued

**Table 13:** Concentration of Type 1 Substances and their Compounds - 25<sup>th</sup> November 2020

Metal/Metal Compound	Concentration (mg/Nm <sup>3</sup> )	Emission Rate (g/sec)
Antimony (Sb) & its compounds	<0.0001	<0.000001
Arsenic (As) & its compounds	<0.0001	<0.000001
Cadmium (Cd) & its compounds	0.000078	0.00000046
Lead (Pb) & its compounds	0.0014	0.0000085
Mercury (Hg) & its compounds	0.000040	0.00000024
<b>Total Type 1 substances &amp; their compounds</b>	<b>0.0015</b>	<b>0.0000090</b>

**Table 14:** Concentration of Type 2 Substances and their Compounds - 25<sup>th</sup> November 2020

Metal/Metal Compound	Concentration (mg/Nm <sup>3</sup> )	Emission Rate (g/sec)
Beryllium (Be) & its compounds	<0.0001	<0.000001
Chromium (Cr) & its compounds	0.0010	0.0000057
Cobalt (Co) & its compounds	<0.0001	<0.000001
Manganese (Mn) & its compounds	0.0055	0.000032
Nickel (Ni) & its compounds	0.00090	0.0000053
Selenium (Se) & its compounds	0.00016	0.0000010
Tin (Sn) & its compounds	0.00036	0.0000021
Vanadium (V) & its compounds	0.00037	0.0000053
<b>Total Type 2 substances &amp; their compounds</b>	<b>0.0083</b>	<b>0.000049</b>

## RESULTS Continued

<b>Company</b>	Morgan Cement International Pty Ltd
<b>Site</b>	Foreshore Rd, Port Kembla
<b>Date of Test</b>	24 <sup>th</sup> November 2020
<b>Source Tested</b>	Cement Mill 3 Exhaust Duct – EPA ID No.3
<b>Sampling Period</b>	11:07 – 12:07
<b>Testing Officers</b>	I Brash
<b>Sampling Position</b>	Three 4” sockets in a rectangular metal duct

**Table 15:** Sampling Conditions for the Cement Mill 3 Exhaust Duct

Sampling Conditions	
Duct dimensions at sampling plane (m)	1.77 x 0.800
Average stack gas temperature (K)	348 (75°C)
Average gas velocity (m/s)	22.8
Actual gas flow rate (Am <sup>3</sup> /sec)	32.3
Average moisture content (%v/v)	0.43
Barometric pressure (mB)	1013.8
Static pressure (mB)	3.1
Stack pressure (mB)	1016.9
Average gas flow rate at STP, dry (m <sup>3</sup> /sec)	25.3
Average oxygen concentration (%v/v)	20.9
Average carbon dioxide concentration (%v/v)	0.10
Dry gas density of stack gas (kg/m <sup>3</sup> )	1.287
Dry molecular weight of stack gas (g/g mole)	28.85
Wet molecular weight of stack gas (g/g mole)	28.81

**Table 16:** Test Results for the Cement Mill 3 Exhaust Duct

Parameter	Concentration (mg/m <sup>3</sup> )	NSWEPA Limit (mg/m <sup>3</sup> )	Emission Rate (g/sec)
Total solid particles (TSP)	1.3	20	0.033
Type 1 & 2 substances <sup>c</sup>	0.0056	1.0	0.00011

<sup>c</sup> 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).

RESULTS – Continued

**Table 17:** Concentration of Type 1 Substances and their Compounds - 24<sup>th</sup> November 2020

Metal/Metal Compound	Concentration (mg/Nm <sup>3</sup> )	Emission Rate (g/sec)
Antimony (Sb) & its compounds	<0.0001	<0.000004
Arsenic (As) & its compounds	<0.0001	<0.000004
Cadmium (Cd) & its compounds	0.000059	0.0000015
Lead (Pb) & its compounds	0.0011	0.000028
Mercury (Hg) & its compounds	0.000065	0.0000017
<b>Total Type 1 substances &amp; their compounds</b>	<b>0.0012</b>	<b>0.000031</b>

**Table 18:** Concentration of Type 2 Substances and their Compounds - 24<sup>th</sup> November 2020

Metal/Metal Compound	Concentration (mg/Nm <sup>3</sup> )	Emission Rate (g/sec)
Beryllium (Be) & its compounds	<0.0001	<0.000004
Chromium (Cr) & its compounds	0.00091	0.000023
Cobalt (Co) & its compounds	<0.0001	<0.000004
Manganese (Mn) & its compounds	0.0021	0.000052
Nickel (Ni) & its compounds	0.00072	0.000018
Selenium (Se) & its compounds	<0.0001	<0.000004
Tin (Sn) & its compounds	0.00069	0.000017
Vanadium (V) & its compounds	<0.0001	<0.000004
<b>Total Type 2 substances &amp; their compounds</b>	<b>0.0044</b>	<b>0.00011</b>