DATE OF REPORT: 6TH OCTOBER 2017

[redacted]

Adelaide Brighton Cement Ltd
PO Box 77
Port Adelaide SA 5015

[redacted]

TEST REPORT NO. JUN17122.2

AIR EMISSIONS MONITORING OF RELEASE POINTS 4A & 4B AT ADELAIDE BRIGHTON CEMENT LTD IN BIRKENHEAD

DATE OF TESTING: 29TH JUNE 2017

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.

AUTHORISATION:

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TECHNICAL MANAGER

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INTRODUCTION

Airlabs Environmental Pty Ltd was commissioned by Adelaide Brighton Cement Ltd to conduct air emissions testing of the Dry Process Kiln 4 Main Stack (Release Point 4A) and the Precalciner Plant Stack (Release Point 4B) at their Birkenhead Plant. The following parameters were monitored on each stack:

- Gas velocity and volume flow rate
- Temperature
- Moisture concentration
- Concentration of oxygen & carbon dioxide
- Dry molecular weight and dry gas density
- Concentration and mass emission rate of:
  - Total solid particulates;
  - PM_{10} (Particulate matter with a nominal aerodynamic diameter $\leq 10\,\mu m$);
  - $PM_{2.5}$ (Particulate matter with a nominal aerodynamic diameter $\leq 2.5\,\mu m$);
  - Carbon monoxide;
  - Nitrogen oxides (NO, NO_2, NO_x);
  - Sulphur dioxide;
  - Antimony and its compounds (as Sb);
  - Arsenic and its compounds (as As);
  - Barium and its compounds (as Ba);
  - Beryllium and its compounds (as Be);
  - Cadmium and its compounds (as Cd);
  - Chromium trivalent and its compounds (as Cr(III));
  - Chromium hexavalent and its compounds (as Cr(VI))
  - Copper Oxide fume (as CuO);
  - Iron oxide fume (as Fe_2O_3);
  - Lead and its compounds (as Pb);
  - Magnesium oxide fume (as MgO);
  - Manganese and its compounds (as Mn);
  - Mercury and its compounds - organic and inorganic (as Hg);
  - Nickel and its compounds (as Ni);
  - Zinc oxide fume (as ZnO);
  - Hydrogen chloride;
  - Fluoride (as HF);
  - Chlorine;
  - PAHs (as BaP toxic equivalent);
  - Polychlorinated Dibenzo-*p*-Dioxins & Polychlorinated Dibenzofurans (Dioxins & Furans);
  - Total Volatile Organic Compounds (TVOCs);
  - Benzene.

Combustion gases (O_2, CO, CO_2, SO_2 and NO_x) were monitored semi-continuously and the average values reported. Average normalised flow rates were used to calculate the mass emission rates. The Dry Process Kiln 4 Main Stack (4A) and the Precalciner Plant Stack (4B) were both tested on 29th June 2017.

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 National Measurement Institute (NATA Accreditation No. 198) and Airlabs Environmental in accordance with our terms of accreditation.

OPERATING CONDITIONS

The Dry Process Kiln 4 Main Stack (4A) and the Precalciner Plant Stack (4B) were tested on 29th June 2017 at 08:16 am – 10:27 pm. The average plant operating conditions are summarised in Table 1 below.

Table 1: Average Plant Operating Conditions on 29th June 2017

The above operating conditions are considered to be representative of typical plant production levels.

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 and the National Measurement Institute (NMI, NATA Accreditation No. 198) 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	AS 4323.1	NA	NA	✓	NA
Gas velocity	US EPA Method 2	3 m/s	± 10%	✓	NA
Temperature	US EPA Method 2	273K (0°C)	± 1%	✓	NA
Moisture content	US EPA Method 4	0.2%	± 5%	✓	✓
Oxygen & carbon dioxide	US EPA Method 3A	0.1%	± 2%	✓	✓
Dry molecular weight & gas density	US EPA Method 3	NA	± 5%	✓	✓
Total solid particulates	AS 4323.2	1 mg/Nm^3	± 15%	✓	✓
PM_{10} & $PM_{2.5}$	US EPA Method 201A	1 mg/Nm^3	± 15%	✓	✓
Sulfur dioxide	US EPA Method 6C	3 mg/Nm^3	± 5%	✓	✓
Carbon monoxide	US EPA Method 10	1 mg/Nm^3	± 5%	✓	✓
Nitrogen oxides (as NO_2)	US EPA Method 7E	2 mg/Nm^3	± 5%	✓	✓
Chlorine, Chloride (as HCl) & Fluoride (as HF)	US EPA Method 26A	0.1 mg/Nm^3	± 17%	✓	✓ [1]
Total VOCs	US EPA Method 25A	0.1 mg/Nm^3	± 10%	✓	✓
Benzene	US EPA Method 18 / NSW EPA TM-34	0.05 mg/Nm^3	± 17%	✓	✓
Multi-Metals	US EPA Method 29	0.05 mg/Nm^3 (total metals)	± 17%	✓	✓ [2]
Chromium VI	US EPA Method 0061	0.0001 mg/Nm^3	± 17%	✓	✓ [3]
PAHs (as BaP-TEQ_{PAH})	US EPA SW-846 Method 0010 & CARB 429	0.000005 mg/Nm^3 (total BaP-TEQ_{PAH})	± 20%	✓	✓ [4]
Dioxins and Furans (PCDD/Fs)	USEPA Method 23	0.0004 ng/Nm^3 as I-TEQ	± 25%	✓	✓ [5]

1. Chloride and fluoride analyses were performed by NMI, with results included in their Report No. RN1170075.
2. Multi-metal analysis was performed on the various sample components by NMI, with results included in their Report No. RN1170075.
3. Hexavalent chromium analysis was performed by NMI, with results included in their Report No. RN1170075.
4. PAH analysis was performed by NMI, with results included in their Analytical Certificate Nos. ORG17_030 and ORG17_045.
5. Dioxin & furan analysis was performed by NMI, with results included in their Analytical Certificate Nos. DAU17_136 and DAU17_174.

DEFINITIONS

'SA EPA'	South Australian Environment Protection Authority.
'US EPA'	United States Environmental Protection Agency.
'NSW EPA'	New South Wales Environment Protection Authority.
'NMI'	National Measurement Institute (Australian Government), North Ryde, NSW.
'K'	Absolute temperature in Kelvin (°C + 273).
'mB'	Pressure in millibars.
'STP'	Standard temperature and pressure (273K and 101.3 kPa).
'm^3'	Actual gas volume in cubic metres at stack conditions.
'Nm^3'	Gas volume in dry cubic metres at STP.
'<'	Less than. The value stated is the limit of detection.
'g'	Grams.
'mg'	Milligrams (10^{-3} grams).
'µg'	Micrograms (10^{-6} grams).
'ng'	Nanograms (10^{-9} grams).
'min'	Minute.
'NA'	Not applicable.
'PM_{10}'	Particulate matter with a nominal aerodynamic diameter ≤ 10 µm.
'$PM_{2.5}$'	Particulate matter with a nominal aerodynamic diameter ≤ 2.5 µm.
'LOD'	Limit of detection.
'FIA'	Flame ionisation analyser.
'VOC'	Volatile organic compound. A VOC is defined as any chemical compound based on carbon chains or rings with a vapour pressure greater than 2 mm of mercury (0.27 kPa) at 25°C. These compounds may contain hydrogen, oxygen, nitrogen and other elements, but specifically excluded are methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
'PAHs'	Polycyclic aromatic hydrocarbons.
'CARB'	California Air Resources Board.
'OEHHA'	Office of Environmental Health Hazard Assessment (US).
'BaP-PEF'	Benzo(a)pyrene Potency Equivalent Factor, as defined in "Benzo(a)pyrene as a Toxic Air Contaminant", CARB/OEHHA Executive Summary, July 1994.
'$BAP\text{-}TEQ_{PAH}$'	Benzo(a)pyrene Toxic Equivalents.
'PCDDs'	Polychlorinated Dibenzo-*p*-Dioxins.
'PCDFs'	Polychlorinated Dibenzofurans.
'TCDF'	Tetrachlorodibenzofuran.
'TCDD'	Tetrachlorodibenzo-*p*-dioxin.
'PeCDF'	Pentachlorodibenzofuran.
'PeCDD'	Pentachlorodibenzo-*p*-dioxin.
'HxCDF'	Hexachlorodibenzofuran.
'HxCDD'	Hexachlorodibenzo-*p*-dioxin.
'HpCDF'	Heptachlorodibenzofuran.
'HpCDD'	Heptachlorodibenzo-*p*-dioxin.
'OCDF'	Octachlorodibenzofuran.
'OCDD'	Octachlorodibenzo-*p*-dioxin.
'NATO'	North Atlantic Treaty Organisation.
'WHO'	World Health Organisation.
'$NATO_{89}$ I-TEF'	International Toxic Equivalency Factor for PCDDs & PCDFs (NATO 1989 basis).
'$NATO_{89}$ I-TEQ'	International Toxic Equivalent for PCDDs & PCDFs, based on the 2,3,7,8-TCDD congener (NATO 1989 basis).
'WHO_{05} TEF'	International Toxic Equivalency Factor for PCDDs & PCDFs (WHO 2005 basis).
'WHO_{05} TEQ'	International Toxic Equivalent for PCDDs & PCDFs, based on the 2,3,7,8-TCDD congener (WHO 2005 basis).

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.

The gas characteristics determined for the Dry Process Kiln 4 Main Stack (Release Point 4A) and the Precalciner Plant Stack (Release Point 4B) satisfied the requirements of AS 4323.1-1995 Section 4.1 (a) - (f), and as such the sampling location is considered to be ideal. The sampling plane details and required number of sampling points are given in Tables 4 and 5 below:

SUITABILITY OF SAMPLING PLANE Continued

Table 4: Sampling Plane Details for the Kiln 4 Main Stack

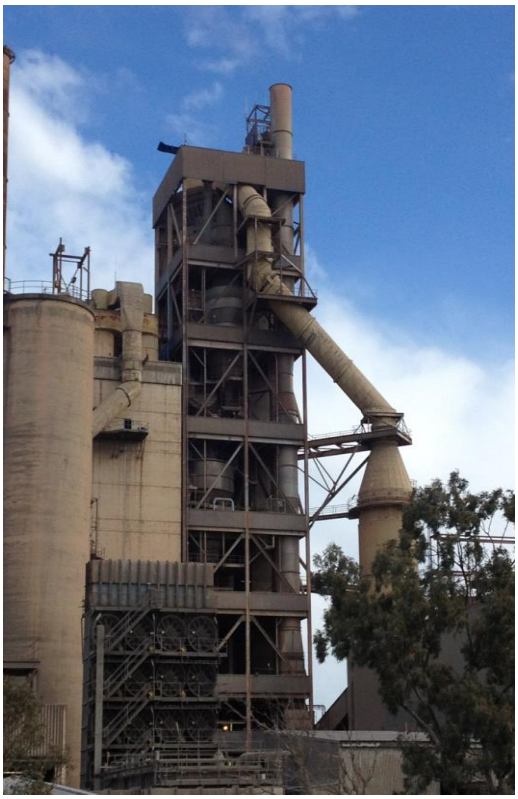
Parameter	
Stack Shape	Circular
Actual Stack Internal Diameter (m)	3.23
Stack Exit Diameter (m)	3.23
Direction of Discharge to Air	Vertical
Type of Disturbance, Upstream	Centrifugal Fan
Distance from Upstream Disturbance	> 6 D
Type of Disturbance, Downstream	Stack Exit
Distance to Downstream Disturbance	> 2 D
Compliance with AS4323.1, Ideal Conditions	Yes
Stack Height Above Ground Level (m)	75.5
Standard No. of Sampling Points per Traverse	12
Number of Traverses	2
Correction Factor	N/A
Corrected No. of Sampling Points per Traverse	N/A
Total No. of Sampling Points	24
Stratified	No
Cyclonic	No (< 15°)
Velocity Difference	1.4:1 (< 1.6:1)
Absolute Temperature Difference (K)	< 10%
Minimum Velocity at any Sample Point (m/s)	> 3

Figure 1: Kiln 4 Main Stack (RP 4A)

Table 5: Sampling Plane Details for the Precalciner Plant Stack

Parameter	
Stack Shape	Circular
Actual Stack Internal Diameter (m)	3.00
Stack Exit Diameter (m)	3.00
Direction of Discharge to Air	Vertical
Type of Disturbance, Upstream	Centrifugal Fan
Distance from Upstream Disturbance	> 6 D
Type of Disturbance, Downstream	Stack Exit
Distance to Downstream Disturbance	> 2 D
Compliance with AS4323.1, Ideal Conditions	Yes
Stack Height Above Ground Level (m)	96
Standard No. of Sampling Points per Traverse	12
Number of Traverses	2
Correction Factor	N/A
Corrected No. of Sampling Points per Traverse	N/A
Total No. of Sampling Points	24
Stratified	No
Cyclonic	No (< 15°)
Velocity Difference	1.5:1 (< 1.6:1)
Absolute Temperature Difference (K)	< 10%
Minimum Velocity at any Sample Point (m/s)	> 3

Figure 2: Precalciner Plant Stack (RP 4B)



RESULTS – RELEASE POINT 4A

Company	Adelaide Brighton Cement
Site	Elder Rd, Birkenhead
Source Tested	Dry Process Kiln 4 Main Stack - Release Point 4A
Date of Tests	29th June 2017
Sampling Period	08:16 – 22:18
Testing Officers	C. Clunies-Ross
Sampling Position	Four 4" BSP sample ports in circular stack

Table 6: Release Point 4A – Gas Flow Conditions

Sampling Conditions	***Start***	***Finish***	***Average***
Stack diameter at sampling plane (m)	3.23	3.23	3.23
Average stack gas temperature (K)	372 (99°C)	374 (101°C)	373 (100°C)
Average barometric pressure (mB)	1021.9	1019.8	1020.9
Average static pressure (mB)	- 1.9 (negative pressure)	- 1.7 (negative pressure)	- 1.8 (negative pressure)
Average stack pressure (mB)	1020.0	1018.1	1019.1
Average velocity at sampling plane (m/s)	20.6	19.8	20.2
Average velocity at sampling plane expressed at STP (m/s)	15.1	14.5	14.8
Actual gas flow rate (m^3/min)	10,100	9,730	9,930
Average moisture content (%v/v)	7.86	8.11	7.99
Gas flow rate at STP, dry (Nm^3/min)	6,850	6,530	6,690
Average carbon dioxide concentration, dry basis (%v/v)	6.12	6.23	6.18
Average oxygen concentration, dry basis (%v/v)	17.0	16.8	16.9
Dry molecular weight of stack gas (g/g mole)	29.66	29.67	29.67
Dry gas density of stack gas (kg/m^3)	1.324	1.324	1.324

RESULTS – RELEASE POINT 4A Continued

Table 7: Release Point 4A – Summary of Test Results

Parameter	Sampling Period	Concentration (mg/Nm³)	Emission Rate (g/min)
Total Solid Particulates	08:16 – 10:19	8.3	56
PM_{10} Particles	10:34 – 12:38	5.8	39
$PM_{2.5}$ Particles		2.7	18
Sulphur Dioxide	12:47 – 13:47	< 3 – 26 (Av. 11)	< 20 – 170 (Av. 74)
Carbon Monoxide		25 – 120 (Av. 64)	170 – 800 (Av. 430)
Oxides of Nitrogen (as NO_2) *Actual at STP*		621 – 779 (Av. 685)	4,150 – 5,210 (Av. 4,580)
Hydrogen Chloride	12:56 – 14:59	3.5	23
Chlorine		3.0	20
Fluoride (as HF)		0.26	1.7
Total Volatile Organic Compounds (by FIA, as n-propane equivalent)	15:13 – 16:13	0.45	3.0
Benzene (by activated carbon adsorption and GC/MS analysis)		< 0.05	< 0.3
Total Multi-Metals [a,b]	15:28 – 17:32	0.57	3.8
Chromium VI and Compounds	17:50 – 19:53	< 0.0005	< 0.003
Polycyclic Aromatic Hydrocarbons *Total BaP-TEQ$_{PAH}$* [c]	20:13 – 22:18	0.0000045	0.000030
Polychlorinated Dioxins and Furans [d] Total tetra to octa PCDD/Fs [e] WHO_{05} TEQ for PCDDs /Fs [f] $NATO_{89}$ I-TEQ for PCDDs /Fs [f]		 0.031 ng/Nm³ 0.00035 ng/Nm³ 0.00038 ng/Nm³	 0.21 µg/min 0.0023 µg/min 0.0025 µg/min

[a] Individual metals and their compounds are given in Table 8.
[b] Quartz filter used to capture particulate phase metals in the USEPA Method 29 sample train was found to contain barium. Results have been adjusted to compensate for this.
[c] Individual BaP-TEQ$_{PAH}$ contributions are given in Table 9, and the total BaP-TEQ$_{PAH}$ in Table 11. This result includes half LOD values.
[d] Tetra-octa chlorinated dioxin & furan congener profile, homologue groups and toxic equivalents are given in Table 12.
[e] Total does not include limit of detection (LOD) values.
[f] Result includes half LOD values.

RESULTS – RELEASE POINT 4A Continued

Table 8: Release Point 4A – Metals and their Compounds

Metal	**Concentration (mg/Nm³)**	**Emission Rate (g/min)**
Antimony and its compounds	< 0.00009	< 0.0006
Arsenic and its compounds	0.000074	0.00049
Barium (soluble compounds)[g]	0.0023	0.015
Beryllium and its compounds	< 0.00009	< 0.0006
Cadmium and its compounds	0.000011	0.000074
Chromium (III) and its compounds	0.0013	0.0087
Copper oxide fume (as CuO)	0.014	0.093
Iron oxide fume (as Fe_2O_3)	0.10	0.69
Lead and its compounds	0.0011	0.0075
Magnesium oxide fume (as MgO)	0.30	2.0
Manganese and its compounds	0.0032	0.022
Mercury and its compounds (as Hg) *Organic:* *Inorganic:* *Total:*	 < 0.000005 0.000025 0.000025	 < 0.00003 0.00017 0.00017
Nickel and its compounds	0.00072	0.0048
Zinc oxide fume (as ZnO)	0.15	0.97
TOTAL METALS *Excluding LOD values* *Including half LOD values*	 **0.57** **0.57**	 **3.8** **3.8**

[g] Quartz filter used to capture particulate phase metals in the USEPA Method 29 sample train was found to contain barium. Results have been adjusted to compensate for this.

RESULTS – RELEASE POINT 4A Continued

Table 9: Release Point 4A – Individual USEPA Priority Pollutant PAHs

Individual USEPA Priority Pollutant PAHs	Concentration of PAHs (µg/Nm³)	BaP-PEF value	BaP-TEQ$_{PAH}$ Contribution	Emission Rate of PAHs (mg/min)
Naphthalene	0.20	0.0	0.0	1.4
2-Methylnaphthalene	0.087	0.0	0.0	0.59
Acenaphthylene	< 0.0050	0.0	0.0	< 0.033
Acenaphthene	< 0.0050	0.0	0.0	< 0.033
Fluorene	< 0.0050	0.0	0.0	< 0.033
Phenanthrene	0.016	0.0	0.0	0.11
Anthracene	< 0.0050	0.0	0.0	< 0.033
Fluoranthene	< 0.0050	0.0	0.0	< 0.033
Pyrene	< 0.0050	0.0	0.0	< 0.033
Benz(a)anthracene	< 0.0050	0.1	0.00025	< 0.033
Chrysene	< 0.0050	0.01	0.000025	< 0.033
Benzo(b)fluoranthene	< 0.0050	0.1	0.00025	< 0.033
Benzo(k)fluoranthene	< 0.0050	0.1	0.00025	< 0.033
Benzo(e)pyrene	< 0.0050	0.0	0.0	< 0.033
Benzo(a)pyrene	< 0.0050	1.0	0.0025	< 0.033
Perylene	< 0.0050	0.0	0.0	< 0.033
Indeno(123-cd)pyrene	< 0.0050	0.1	0.00025	< 0.033
Dibenz(ah)anthracene	< 0.0050	0.4	0.0010	< 0.033
Benzo(ghi)perylene	< 0.0050	0.0	0.0	< 0.033

Table 10: Release Point 4A – Total USEPA Priority Pollutant PAHs

Total USEPA Priority Pollutant PAHs	Concentration (µg/Nm³)	Emission Rate (mg/min)
Excluding LOD values	0.31	2.1
Including half LOD values	0.35	2.3

Table 11: Release Point 4A – Total PAH Toxic Equivalents (BaP-TEQ$_{PAH}$)

Total PAH Toxic Equivalents (BaP-TEQ$_{PAH}$)[h]	Concentration (µg/Nm³)	Emission Rate (mg/min)
Excluding LOD values	0.0	0.0
Including half LOD values	0.0045	0.030

[h] Calculated using benzo(α)pyrene potency equivalency factors (BaP-PEF values).

RESULTS – RELEASE POINT 4A Continued

Table 12: Release Point 4A – PCDD/F Congener Profile

PCDD/F Congeners	Concentration (ng/Nm³)	WHO_{05} TEF	WHO_{05} TEQ contribution (ng/Nm³)	$NATO_{89}$ I-TEF	$NATO_{89}$ I-TEQ contribution (ng/Nm³)
2378 TCDF	0.00018	0.1	0.000018	0.1	0.000018
2378 TCDD	< 0.00010	1	0.000050	1	0.000050
12378 PeCDF	< 0.00025	0.03	0.0000037	0.05	0.0000062
23478 PeCDF	0.00022	0.3	0.000067	0.5	0.00011
12378 PeCDD	< 0.000075	1	0.000037	0.5	0.000019
123478 HxCDF	< 0.00025	0.1	0.000012	0.1	0.000012
123678 HxCDF	0.00037	0.1	0.000037	0.1	0.000037
234678 HxCDF	0.00062	0.1	0.000062	0.1	0.000062
123789 HxCDF	< 0.000075	0.1	0.0000037	0.1	0.0000037
123478 HxCDD	< 0.00015	0.1	0.0000075	0.1	0.0000075
123678 HxCDD	< 0.00012	0.1	0.0000062	0.1	0.0000062
123789 HxCDD	< 0.00010	0.1	0.0000050	0.1	0.0000050
1234678 HpCDF	0.0020	0.01	0.000020	0.01	0.000020
1234789 HpCDF	0.00020	0.01	0.0000020	0.01	0.0000020
1234678 HpCDD	0.0013	0.01	0.000013	0.01	0.000013
OCDF	0.0013	0.0003	0.00000040	0.001	0.0000013
OCDD	0.0070	0.0003	0.0000021	0.001	0.0000070

PCDD/F Homologue Groups	Concentration (ng/Nm³)
Total TCDF isomers	0.0052
Total TCDD isomers	0.00065
Total PeCDF isomers	0.0042
Total PeCDD isomers	0.00095
Total HxCDF isomers	0.0040
Total HxCDD isomers	0.0021
Total HpCDF isomers	0.0030
Total HpCDD isomers	0.0027

Polychlorinated Dioxins & Furans Summary Results	Concentration (ng/Nm³)	Emission Rate (µg/min)
Sum of PCDD/F congeners (Total of all Tetra to Octa congeners)		
Total PCDD/F (Excluding LOD values)	0.031	0.21
WHO_{05} TEQ (Total of WHO_{05} TEQ contribution for 17 toxic congeners)		
WHO_{05} TEQ (Excluding LOD values)	0.00022	0.0015
WHO_{05} TEQ (Including half LOD values)	0.00035	0.0023
$NATO_{89}$ I-TEQ (Total of $NATO_{89}$ I-TEQ contribution for 17 toxic congeners)		
$NATO_{89}$ I-TEQ (Excluding LOD values)	0.00027	0.0018
$NATO_{89}$ I-TEQ (Including half LOD values)	0.00038	0.0025

RESULTS – RELEASE POINT 4B

Company	Adelaide Brighton Cement
Site	Elder Rd, Birkenhead
Source Tested	Precalciner Plant Stack - Release Point 4B
Date of Tests	29th June 2017
Sampling Period	08:41 – 22:27
Testing Officers	D. McDonald
Sampling Position	Four 4" BSP sample ports in circular stack

Table 13: Release Point 4B - Gas Flow Conditions

Sampling Conditions	***Start***	***Finish***	***Average***
Stack diameter at sampling plane (m)	3.00	3.00	3.00
Average stack gas temperature (K)	376 (103°C)	380 (107°C)	378 (105°C)
Average barometric pressure (mB)	1021.7	1019.7	1020.7
Static pressure (mB)	-1.6 (negative pressure)	-1.4 (negative pressure)	-1.5 (negative pressure)
Average stack pressure (mB)	1020.2	1018.4	1019.3
Average velocity at sampling plane (m/s)	18.1	17.6	17.9
Average velocity at sampling plane expressed at STP (m/s)	13.1	12.6	12.9
Actual gas flow rate (m^3/min)	7,680	7,460	7,570
Average moisture content (%v/v)	17.0	16.8	16.9
Gas flow rate at STP, dry (Nm^3/min)	4,630	4,460	4,540
Average carbon dioxide concentration, dry basis (%v/v)	20.9	21.1	21.0
Average oxygen concentration (%v/v), dry basis	10.7	10.3	10.5
Dry molecular weight of stack gas (g/g mole)	31.77	31.79	31.78
Dry gas density of stack gas (kg/m^3)	1.418	1.419	1.419

RESULTS – RELEASE POINT 4B Continued

Table 14: Release Point 4B – Summary of Test Results

Parameter	Sampling Period	Concentration (mg/Nm³)	Emission Rate (g/min)
Total Solid Particulates	08:41 – 10:44	18	82
PM_{10} Particles	10:57 – 13:01	12	54
$PM_{2.5}$ Particles		6.3	29
Sulphur Dioxide	08:33 – 09:33	< 3	< 10
Carbon Monoxide		256 – 533 (Av. 366)	1,160 – 2,420 (Av. 1,660)
Oxides of Nitrogen (as NO_2) *Actual at STP*		401 - 696 (Av. 562)	1,820 – 3,160 (Av. 2,550)
Hydrogen Chloride	13:19 – 15:21	4.4	20
Chlorine		1.8	8.3
Fluoride (as HF)		0.38	1.7
Total Volatile Organic Compounds (by FIA, as n-propane equivalent)	15:38 – 16:38	2.0	9.1
Benzene (by activated carbon adsorption and GC/MS analysis)		0.29	1.3
Total Multi-Metals [i,j]	15:40 – 17:44	1.2	5.6
Chromium VI and Compounds	18:02 – 20:04	< 0.0005	< 0.002
Polycyclic Aromatic Hydrocarbons *Total BaP-TEQ$_{PAH}$* [k]	20:23 – 22:27	0.0000036	0.000016
Polychlorinated Dioxins and Furans [l] Total tetra to octa PCDD/Fs [m] WHO_{05} TEQ for PCDDs /Fs [n] $NATO_{89}$ I-TEQ for PCDDs /Fs [k]		 0.21 ng/Nm³ 0.0014 ng/Nm³ 0.0018 ng/Nm³	 0.95 µg/min 0.0064 µg/min 0.0082 µg/min

[i] Individual metals and their compounds are given in Table 15.
[j] Quartz filter used to capture particulate phase metals in the USEPA Method 29 sample train was found to contain barium. Results have been adjusted to compensate for this.
[k] Individual BaP-TEQ$_{PAH}$ contributions are given in Table 16, and the total BaP-TEQ$_{PAH}$ in Table 18. This result includes half LOD values.
[l] Tetra-octa chlorinated dioxin & furan congener profile, homologue groups and toxic equivalents are given in Table 19.
[m] Total does not include limit of detection (LOD) values.
[n] Result includes half LOD values.

RESULTS – RELEASE POINT 4B Continued

Table 15: Release Point 4B – Metals and their Compounds

Metal	**Concentration (mg/Nm³)**	**Emission Rate (g/min)**
Antimony and its compounds	0.00015	0.00067
Arsenic and its compounds	0.00030	0.0014
Barium (soluble compounds)[o]	0.0022	0.010
Beryllium and its compounds	< 0.0001	< 0.0005
Cadmium and its compounds	0.000020	0.000090
Chromium (III) and its compounds	0.0015	0.0067
Copper oxide fume (as CuO)	0.019	0.085
Iron oxide fume (as Fe_2O_3)	0.33	1.5
Lead and its compounds	0.0016	0.0073
Magnesium oxide fume (as MgO)	0.62	2.8
Manganese and its compounds	0.010	0.047
Mercury and its compounds (as Hg) *Organic:* *Inorganic:* *Total*[p]*:*	 < 0.000007 0.000021 0.000021	 < 0.00003 0.000095 0.000095
Nickel and its compounds	0.00096	0.0044
Zinc oxide fume (as ZnO)	0.24	1.1
TOTAL METALS *Excluding LOD values* *Including half LOD values*	 **1.2** **1.2**	 **5.6** **5.6**

[o] Quartz filter used to capture particulate phase metals in the USEPA Method 29 sample train was found to contain barium. Results have been adjusted to compensate for this.

[p] Total does not include 'less than limit of detection' value for organic mercury.

RESULTS – RELEASE POINT 4B Continued

Table 16: Release Point 4B – Individual USEPA Priority Pollutant PAHs

Individual USEPA Priority Pollutant PAHs	Concentration of PAHs (µg/Nm³)	BaP-PEF value	BaP-TEQ Contribution	Emission Rate of PAHs (mg/min)
Naphthalene	4.6	0.0	0.0	21
2-Methylnaphthalene	3.8	0.0	0.0	17
Acenaphthylene	0.013	0.0	0.0	0.060
Acenaphthene	< 0.0040	0.0	0.0	< 0.018
Fluorene	0.050	0.0	0.0	0.23
Phenanthrene	0.20	0.0	0.0	0.89
Anthracene	< 0.0040	0.0	0.0	< 0.018
Fluoranthene	0.014	0.0	0.0	0.061
Pyrene	0.0093	0.0	0.0	0.042
Benz(a)anthracene	< 0.0040	0.1	0.00020	< 0.018
Chrysene	< 0.0040	0.01	0.000020	< 0.018
Benzo(b)fluoranthene	< 0.0040	0.1	0.00020	< 0.018
Benzo(k)fluoranthene	< 0.0040	0.1	0.00020	< 0.018
Benzo(e)pyrene	< 0.0040	0.0	0.0	< 0.018
Benzo(a)pyrene	< 0.0040	1.0	0.0020	< 0.018
Perylene	< 0.0040	0.0	0.0	< 0.018
Indeno(123-cd)pyrene	< 0.0040	0.1	0.00020	< 0.018
Dibenz(ah)anthracene	< 0.0040	0.4	0.00080	< 0.018
Benzo(ghi)perylene	< 0.0040	0.0	0.0	< 0.018

Table 17: Release Point 4B – Total USEPA Priority Pollutant PAHs

Total USEPA Priority Pollutant PAHs	Concentration (µg/Nm³)	Emission Rate (mg/min)
Excluding LOD values	8.7	39
Including half LOD values	8.7	39

Table 18: Release Point 4B – Total PAH Toxic Equivalents ($BaP\text{-}TEQ_{PAH}$)

Total PAH Toxic Equivalents ($BaP\text{-}TEQ_{PAH}$)[q]	Concentration (µg/Nm³)	Emission Rate (mg/min)
Excluding LOD values	0.0	0.0
Including half LOD values	0.0036	0.016

[q] Calculated using benzo(α)pyrene potency equivalency factors (BaP-PEF values).

RESULTS – RELEASE POINT 4B Continued

Table 19: Release Point 4B – PCDD/F Congener Profile

PCDD/F Congeners	Concentration (ng/Nm³)	WHO_{05} TEF	WHO_{05} TEQ contribution (ng/Nm³)	$NATO_{89}$ I-TEF	$NATO_{89}$ I-TEQ contribution (ng/Nm³)
2378 TCDF	0.0040	0.1	0.00040	0.1	0.00040
2378 TCDD	< 0.00010	1	0.000050	1	0.000050
12378 PeCDF	0.0015	0.03	0.000045	0.05	0.000075
23478 PeCDF	0.0016	0.3	0.00049	0.5	0.00082
12378 PeCDD	< 0.00018	1	0.000090	0.5	0.000045
123478 HxCDF	0.00084	0.1	0.000084	0.1	0.000084
123678 HxCDF	0.00086	0.1	0.000086	0.1	0.000086
234678 HxCDF	0.00054	0.1	0.000054	0.1	0.000054
123789 HxCDF	< 0.000060	0.1	0.0000030	0.1	0.0000030
123478 HxCDD	0.00014	0.1	0.000014	0.1	0.000014
123678 HxCDD	0.00026	0.1	0.000026	0.1	0.000026
123789 HxCDD	0.00024	0.1	0.000024	0.1	0.000024
1234678 HpCDF	0.0011	0.01	0.000011	0.01	0.000011
1234789 HpCDF	< 0.00010	0.01	0.00000050	0.01	0.00000050
1234678 HpCDD	0.0046	0.01	0.000046	0.01	0.000046
OCDF	0.00019	0.0003	0.000000058	0.001	0.00000019
OCDD	0.044	0.0003	0.000013	0.001	0.000044

PCDD/F Homologue Groups	Concentration (ng/Nm³)
Total TCDF isomers	0.12
Total TCDD isomers	0.0058
Total PeCDF isomers	0.015
Total PeCDD isomers	< 0.0010
Total HxCDF isomers	0.0066
Total HxCDD isomers	0.0030
Total HpCDF isomers	0.0014
Total HpCDD isomers	0.010

Polychlorinated Dioxins & Furans Summary Results	Concentration (ng/Nm³)	Emission Rate (µg/min)
Sum of PCDD/F congeners (Total of all Tetra to Octa congeners)		
Total PCDD/F (Excluding LOD values)	0.21	0.95
WHO_{05} TEQ (Total of WHO_{05} TEQ contribution for 17 toxic congeners)		
WHO_{05} TEQ (Excluding LOD values)	0.0013	0.0059
WHO_{05} TEQ (Including half LOD values)	0.0014	0.0064
$NATO_{89}$ I-TEQ (Total of $NATO_{89}$ I-TEQ contribution for 17 toxic congeners)		
$NATO_{89}$ I-TEQ (Excluding LOD values)	0.0017	0.0077
$NATO_{89}$ I-TEQ (Including half LOD values)	0.0018	0.0082