

Boral Cement Ltd, Berrima
Kiln Emission Testing Report – Tyre Fuel Trial
Report Number R012341

Document Information

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Client Name: Boral Cement Ltd
Report Number: R012341
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Attention: Gabriel Paicu
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Report Authorisation



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NATA Accredited Laboratory
No. 14601

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1 Executive Summary

1.1 Background

Ektimo was engaged by Boral Cement Ltd to perform emission monitoring at their Berrima plant, as requested.

1.2 Project Objective

The objective of the project was to conduct a monitoring programme to quantify emissions from one discharge point to determine compliance with Boral Cement Ltd's Environment Protection Licence, 1698.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA 2 – No. 6 Kiln Stack	27 January 2022	Solid particles Coarse particulates Fine particulates (PM ₁₀) by particle size analysis (PSA) Fine particulates (PM _{2.5}) by particle size analysis (PSA) Sulfuric acid mist and sulfur trioxide as (SO ₃), sulfur dioxide Metals - type 1 & 2 substances in aggregate (Sb, As, Cd, Pb, Hg, Be, Cr, Co, Mn, Ni, Se, Sn, V), copper, thallium, zinc
	28 January 2022	Dioxins and furans (PCDDs & PCDFs) Polycyclic aromatic hydrocarbons (PAHs) Hexavalent chromium (Cr ⁶⁺) Nitrogen oxides (as NO _x), carbon monoxide (CO) Carbon dioxide (CO ₂), Oxygen (O ₂) Speciated volatile organic compounds (VOCs) Total fluoride (as HF), hydrogen chloride (as HCl), chlorine (Cl ₂)

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP.

PM₁₀ and PM_{2.5} results determined as sample fractions from particle size analysis (PSA), are calculated based on the assumption that the density of the sample material is 1 g/cm³, i.e., no corrections have been made for sample density.

Plant operating conditions have been noted in the report.

1.3 Licence Comparison

The following licence comparison table shows that all analytes highlighted in green are within the licence set by the NSW EPA as per licence 1698 (last amended on 18 December 2019).

EPA	Parameter	Units	Licence limit	Detected values	Detected values (corrected to 10% O ₂)
EPA 2 - Kiln Stack No. 6	Mercury	mg/m ³	0.05	0.0086	0.0093
	Type 1 and Type 2 substances in aggregate	mg/m ³	0.5	≤0.044	≤0.047
	Solid particles	mg/m ³	50	18	18
	Nitrogen oxides	mg/m ³	1250	1000	1100
	Cadmium + Thallium	mg/m ³	0.05	≤0.00053	≤0.00057
	Chlorine	mg/m ³	50	<0.01	<0.01
	Dioxins & furans (I-TEQ middle bound)	ng/m ³	0.1	0.0007	0.00072
	Hydrogen chloride	mg/m ³	10	0.4	0.42
	Hydrogen fluoride	mg/m ³	1	0.06	0.063
	Sulfur dioxide	mg/m ³	50	<0.02	<0.02
	Sulfuric acid mist and sulfur trioxide (as SO ₃)	mg/m ³	50	1.9	1.9
	Volatile organic compounds	mg/m ³	40	1.2	1.2

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2 Results

2.1 EPA 2 – No.6 Kiln Stack

Date	27/01/2022	Client	Boral Cement Ltd
Report	R012341	Stack ID	EPA 2: No. 6 Kiln Stack
Licence No.	1698	Location	New Berrima
Ektimo Staff	Zoe Parker & Harrison Handicott	State	NSW
Process Conditions	Please refer to client records.		

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Sampling Plane Details	
Sampling plane dimensions	3000 mm
Sampling plane area	7.07 m ²
Sampling port size, number	3" BSP and 4" Flange
Access & height of ports	Elevator 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 8 D
Upstream disturbance	Junction 8 D
No. traverses & points sampled	2 24
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	30.1 (wet)	31.8 (dry)
Gas density at STP, kg/m³	1.34 (wet)	1.42 (dry)
Gas density at discharge conditions, kg/m³	0.85	
% Oxygen correction & Factor	10 %	0.99
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1245 & 1503	
Temperature, °C	121	
Temperature, K	394	
Velocity at sampling plane, m/s	29	
Volumetric flow rate, actual, m³/s	210	
Volumetric flow rate (wet STP), m³/s	130	
Volumetric flow rate (dry STP), m³/s	120	
Mass flow rate (wet basis), kg/hour	640000	

Isokinetic Results		Average			Test 1 1256-1500			Test 2 1256-1500		
		Concentration mg/m ³	Corrected to 10% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	Corrected to 10% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	Corrected to 10% O ₂ mg/m ³	Mass Rate g/min
Solid Particles		18	18	130	15	15	110	21	21	140
Fine particulates (PM10) (PSA)		11	11	74	9	8.9	64	13	12	84
Fine particulates (PM2.5) (PSA)		4.7	4.6	32	3.9	3.9	28	5.4	5.3	36
Coarse Particulates		7.5	7.5	52	6.2	6.2	44	8.9	8.8	59
Sulfur dioxide		<0.02	<0.02	<0.1	<0.01	<0.01	<0.1	<0.02	<0.02	<0.1
Sulfur trioxide and/or Sulfuric acid (as SO ₃)		1.9	1.9	13	2	2	14	1.8	1.8	12
Isokinetic Sampling Parameters										
Sampling time, min					120			120		
Isokinetic rate, %					100			101		
Gravimetric analysis date (total particulate)					04-02-2022			04-02-2022		

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Process Conditions	Please refer to client records.		

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Sampling Plane Details	
Sampling plane dimensions	3000 mm
Sampling plane area	7.07 m ²
Sampling port size, number	3" BSP and 4" Flange
Access & height of ports	Elevator 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 8 D
Upstream disturbance	Junction 8 D
No. traverses & points sampled	2 24
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	29.8 (wet)	31.6 (dry)
Gas density at STP, kg/m³	1.33 (wet)	1.41 (dry)
Gas density at discharge conditions, kg/m³	0.85	
% Oxygen correction & Factor	10 %	1.08
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1503 & 1730	
Temperature, °C	118	
Temperature, K	392	
Velocity at sampling plane, m/s	31	
Volumetric flow rate, actual, m³/s	220	
Volumetric flow rate (wet STP), m³/s	140	
Volumetric flow rate (dry STP), m³/s	120	
Mass flow rate (wet basis), kg/hour	670000	

Isokinetic Results	Sampling time	Average			Test 1 1523-1726			Test 2 1523-1726		
		Corrected			Corrected			Corrected		
		Concentration mg/m ³	to 10% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	to 10% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	to 10% O ₂ mg/m ³	Mass Rate g/min
Antimony		<0.003	<0.003	<0.02	<0.003	<0.003	<0.02	<0.003	<0.003	<0.02
Arsenic		<0.001	<0.001	<0.008	<0.001	<0.001	<0.008	<0.001	<0.001	<0.009
Beryllium		<0.0003	<0.0004	<0.002	<0.0003	<0.0004	<0.002	<0.0003	<0.0004	<0.003
Cadmium		≤0.00053	≤0.00057	≤0.0039	<0.0003	<0.0003	<0.002	0.00074	0.0008	0.0055
Chromium		0.00093	0.001	0.0067	0.0014	0.0015	0.0099	0.00047	0.00051	0.0035
Cobalt		<0.0004	<0.0005	<0.003	<0.0004	<0.0005	<0.003	<0.0004	<0.0005	<0.003
Copper		0.0014	0.0015	0.0099	0.0014	0.0015	0.0099	0.0013	0.0014	0.0099
Lead		≤0.011	≤0.012	≤0.079	<0.001	<0.001	<0.008	0.02	0.022	0.15
Manganese		0.012	0.013	0.086	0.013	0.014	0.092	0.011	0.012	0.08
Mercury		0.0086	0.0093	0.063	0.0087	0.0093	0.062	0.0086	0.0093	0.064
Nickel		≤0.0011	≤0.0012	≤0.0079	0.0015	0.0016	0.011	<0.0007	<0.0007	<0.005
Selenium		<0.004	<0.004	<0.03	<0.003	<0.003	<0.02	<0.004	<0.005	<0.03
Thallium		<0.001	<0.001	<0.008	<0.001	<0.001	<0.008	<0.001	<0.001	<0.009
Tin		<0.001	<0.001	<0.008	<0.001	<0.001	<0.008	<0.001	<0.001	<0.009
Vanadium		0.00093	0.001	0.0068	0.00092	0.00099	0.0066	0.00094	0.001	0.007
Zinc		0.0046	0.005	0.034	0.0056	0.006	0.04	0.0036	0.0039	0.027
Type 1 & 2 Substances										
Upper Bound										
Total Type 1 Substances		≤0.024	≤0.025	≤0.17	≤0.014	≤0.015	≤0.099	≤0.033	≤0.036	≤0.25
Total Type 2 Substances		≤0.02	≤0.022	≤0.15	≤0.021	≤0.023	≤0.15	≤0.019	≤0.021	≤0.14
Total Type 1 & 2 Substances		≤0.044	≤0.047	≤0.32	≤0.035	≤0.038	≤0.25	≤0.053	≤0.057	≤0.39
Isokinetic Sampling Parameters										
Sampling time, min					120			120		
Isokinetic rate, %					99			100		

Date	28/01/2022	Client	Boral Cement Ltd
Report	R012341	Stack ID	EPA 2: No. 6 Kiln Stack
Licence No.	1698	Location	New Berrima
Ektimo Staff	Steven Cooper & Harrison Handicott	State	NSW
Process Conditions	Please refer to client records.		

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Sampling Plane Details	
Sampling plane dimensions	3000 mm
Sampling plane area	7.07 m ²
Sampling port size, number	3" BSP and 4" Flange
Access & height of ports	Elevator 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 8 D
Upstream disturbance	Junction 8 D
No. traverses & points sampled	2 24
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	29.8 (wet)	31.7 (dry)
Gas density at STP, kg/m³	1.33 (wet)	1.41 (dry)
Gas density at discharge conditions, kg/m³	0.88	
% Oxygen correction & Factor	10 %	1.02
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1115 & 1728	
Temperature, °C	105	
Temperature, K	378	
Velocity at sampling plane, m/s	29	
Volumetric flow rate, actual, m³/s	200	
Volumetric flow rate (wet STP), m³/s	140	
Volumetric flow rate (dry STP), m³/s	120	
Mass flow rate (wet basis), kg/hour	650000	

Gas Analyser Results	Sampling time	Average			Minimum			Maximum		
		1422 - 1525			1422 - 1525			1422 - 1525		
		Corrected to			Corrected to			Corrected to		
		Concentration	10% O ₂	Mass Rate	Concentration	10% O ₂	Mass Rate	Concentration	10% O ₂	Mass Rate
		mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min
Combustion Gases										
Nitrogen oxides (as NO ₂)		1000	1100	7300	1000	1000	7100	1100	1100	7500
Carbon monoxide		290	300	2100	250	260	1800	320	330	2300
		Concentration			Concentration			Concentration		
		% v/v			% v/v			% v/v		
Carbon dioxide		19.6			19.2			20.1		
Oxygen		10.2			10			10.4		

Total VOCs (as n-Propane)	Average			Test 1			Test 2		
	Corrected to			Corrected to			Corrected to		
	Concentration	10% O ₂	Mass Rate	Concentration	10% O ₂	Mass Rate	Concentration	10% O ₂	Mass Rate
	mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min
Total	1.2	1.2	8.2	1	1.1	7.3	1.3	1.3	9

VOC (speciated)	Sampling time	Average			Test 1			Test 2		
		Corrected to			Corrected to			Corrected to		
		Concentration	10% O ₂	Mass Rate	Concentration	10% O ₂	Mass Rate	Concentration	10% O ₂	Mass Rate
		mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min
Detection limit ⁽¹⁾		<0.1	<0.1	<0.8	<0.1	<0.1	<0.8	<0.1	<0.1	<0.8
Benzene		1.4	1.5	10	1.2	1.2	8.4	1.7	1.7	12
Toluene		0.17	0.17	1.2	0.17	0.17	1.2	0.17	0.17	1.2
Acetone		0.35	0.36	2.5	0.37	0.37	2.6	0.34	0.34	2.4

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

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Process Conditions	Please refer to client records.		

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Dioxins & Furans (PCDDs & PCDFs)	Average			Test 1			Test 2		
	Sampling time			1122 - 1725			1122 - 1725		
	Concentration ng/m ³	Corrected to 10% O ₂ ng/m ³	Mass Rate ng/min	Concentration ng/m ³	Corrected to 10% O ₂ ng/m ³	Mass Rate ng/min	Concentration ng/m ³	Corrected to 10% O ₂ ng/m ³	Mass Rate ng/min
2,3,7,8-TCDF	0.00013	0.00014	0.94	0.00015	0.00015	1	0.00012	0.00012	0.85
2,3,7,8-TCDD	<0.0002	<0.0002	<1	<0.0002	<0.0002	<1	<0.0002	<0.0002	<1
1,2,3,7,8-PeCDF	0.000028	0.000028	0.2	0.000032	0.000032	0.22	0.000024	0.000024	0.17
2,3,4,7,8-PeCDF	0.0003	0.00031	2.1	0.00024	0.00025	1.7	0.00037	0.00037	2.6
1,2,3,7,8-PeCDD	<0.00007	<0.00007	<0.5	<0.00008	<0.00008	<0.5	<0.00007	<0.00007	<0.5
1,2,3,4,7,8-HxCDF	0.000032	0.000033	0.23	0.000024	0.000025	0.17	0.00004	0.000041	0.28
1,2,3,6,7,8-HxCDF	0.000029	0.000029	0.2	0.000026	0.000026	0.18	0.000031	0.000032	0.22
2,3,4,6,7,8-HxCDF	0.00002	0.000021	0.14	0.000015	0.000015	0.1	0.000026	0.000027	0.18
1,2,3,7,8,9-HxCDF	<0.000007	<0.000007	<0.05	<0.000006	<0.000006	<0.04	<0.000007	<0.000007	<0.05
1,2,3,4,7,8-HxCDD	<0.000009	<0.000009	<0.06	<0.000009	<0.000009	<0.06	<0.000009	<0.000009	<0.06
1,2,3,6,7,8-HxCDD	≤0.0000098	≤0.0000099	≤0.069	<0.000009	<0.000009	<0.06	0.00001	0.000011	0.074
1,2,3,7,8,9-HxCDD	≤0.0000092	≤0.0000094	≤0.065	0.0000097	0.0000099	0.068	<0.000009	<0.000009	<0.06
1,2,3,4,6,7,8-HpCDF	0.0000037	0.0000038	0.026	0.0000024	0.0000025	0.017	0.000005	0.0000051	0.036
1,2,3,4,7,8,9-HpCDF	<0.0000008	<0.0000008	<0.006	<0.0000009	<0.0000009	<0.006	<0.0000007	<0.0000007	<0.005
1,2,3,4,6,7,8-HpCDD	0.0000041	0.0000042	0.029	0.0000032	0.0000032	0.022	0.000005	0.0000051	0.036
OCDF	≤0.000000089	≤0.00000009	≤0.00063	<0.00000009	<0.00000009	<0.0006	0.000000087	0.000000089	0.00061
OCDD	0.0000085	0.0000087	0.06	0.000005	0.0000051	0.035	0.000012	0.000012	0.085
Total TCDF isomers	0.032	0.033	230	0.035	0.036	250	0.03	0.03	210
Total TCDD isomers	0.0024	0.0024	17	0.002	0.002	14	0.0028	0.0028	20
Total PeCDF isomers	0.0068	0.0069	48	0.0064	0.0065	45	0.0071	0.0073	50
Total PeCDD isomers	0.0011	0.0011	7.5	0.00076	0.00077	5.3	0.0014	0.0014	9.7
Total HxCDF isomers	0.0019	0.0019	13	0.0015	0.0015	11	0.0023	0.0023	16
Total HxCDD isomers	0.0012	0.0012	8.2	0.0008	0.00082	5.7	0.0015	0.0016	11
Total HpCDF isomers	0.00046	0.00047	3.2	0.00027	0.00028	1.9	0.00064	0.00066	4.5
Total HpCDD isomers	0.00092	0.00094	6.5	0.00074	0.00076	5.2	0.0011	0.0011	7.7
Total PCDDs + PCDFs	0.055	0.056	390	0.052	0.053	370	0.059	0.06	410
I-TEQ									
Lower Bound	0.00057	0.00058	4	0.00051	0.00051	3.6	0.00064	0.00065	4.5
Middle Bound	0.0007	0.00072	5	0.00063	0.00064	4.5	0.00077	0.00079	5.5
Upper Bound	0.00083	0.00085	5.9	0.00076	0.00077	5.3	0.00091	0.00092	6.4

Abbreviations and definitions	
I-TEQ	International toxic equivalents for dioxins and furans
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Test 1	Test 2
PAHs, Dioxins & Furans		
Sampling time, min	360	360
Isokinetic rate, %	95	98

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Process Conditions	Please refer to client records.		

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Polycyclic Aromatic Hydrocarbons (PAHs)	Average			Test 1			Test 2		
	Sampling time			1122 - 1725			1122 - 1725		
	Concentration ng/m ³	Corrected to 10% O ₂ ng/m ³	Mass Rate ng/min	Concentration ng/m ³	Corrected to 10% O ₂ ng/m ³	Mass Rate ng/min	Concentration ng/m ³	Corrected to 10% O ₂ ng/m ³	Mass Rate ng/min
Naphthalene	120000	120000	860000000	120000	120000	820000000	130000	130000	900000000
2-Methylnaphthalene	55000	56000	390000000	39000	40000	280000000	71000	73000	500000000
Acenaphthylene	670	680	4700000	680	690	4800000	660	670	4700000
Acenaphthene	≤110	≤110	≤750000	<3	<3	<20000	210	210	1500000
Fluorene	41	42	290000	41	42	290000	42	43	290000
Phenanthrene	490	500	3500000	530	540	3700000	450	460	3200000
Anthracene	8.8	9	62000	7	7.1	49000	11	11	75000
Fluoranthene	22	22	160000	20	20	140000	24	25	170000
Pyrene	17	18	120000	14	14	96000	21	21	150000
Benz(a)anthracene	<20	<20	<100000	<20	<20	<100000	<20	<20	<100000
Chrysene	15	15	110000	13	14	95000	16	17	120000
Benzo(b)fluoranthene	<8	<8	<60000	<8	<8	<50000	<9	<9	<60000
Benzo(k)fluoranthene	<8	<8	<60000	<8	<8	<50000	<9	<9	<60000
Benzo(e)pyrene	<3	<3	<20000	<3	<3	<20000	<3	<4	<20000
Benzo(a)pyrene	<3	<3	<20000	<3	<3	<20000	<3	<4	<20000
Perylene	<3	<3	<20000	<3	<3	<20000	<3	<4	<20000
Indeno(1,2,3-cd)pyrene	<7	<7	<50000	<7	<7	<50000	<8	<8	<60000
Dibenz(ah)anthracene	<3	<3	<20000	<3	<3	<20000	<3	<4	<20000
Benzo(ghi)perylene	<7	<7	<50000	<6	<6	<40000	<7	<7	<50000
Total 16 PAHs	160000	160000	1100000000	120000	120000	830000000	200000	200000	1400000000
Total 19 PAHs	180000	180000	1300000000	160000	160000	1100000000	200000	200000	1400000000
BaP-TEQ									
Lower Bound	0.15	0.15	1100	0.13	0.14	950	0.16	0.17	1200
Middle Bound	4.6	4.7	32000	4.3	4.3	30000	4.9	5	35000
Upper Bound	9	9.2	64000	8.4	8.6	59000	9.7	9.8	68000

Abbreviations and definitions	
BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Test 1	Test 2
PAHs, Dioxins & Furans		
Sampling time, min	360	360
Isokinetic rate, %	95	98

Date	28/01/2022	Client	Boral Cement Ltd
Report	R012341	Stack ID	EPA 2: No. 6 Kiln Stack
Licence No.	1698	Location	New Berrima
Ektimo Staff	Steven Cooper & Harrison Handicott	State	NSW
Process Conditions	Please refer to client records.		

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Sampling Plane Details

Sampling plane dimensions	3000 mm
Sampling plane area	7.07 m ²
Sampling port size, number	3" BSP and 4" Flange
Access & height of ports	Elevator 30 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 8 D
Upstream disturbance	Junction 8 D
No. traverses & points sampled	2 24
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters

Moisture content, %v/v	14	
Gas molecular weight, g/g mole	29.7 (wet)	31.6 (dry)
Gas density at STP, kg/m ³	1.33 (wet)	1.41 (dry)
Gas density at discharge conditions, kg/m ³	0.88	
% Oxygen correction & Factor	10 %	1.06

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0905 & 1115
Temperature, °C	106
Temperature, K	379
Velocity at sampling plane, m/s	29
Volumetric flow rate, actual, m ³ /s	200
Volumetric flow rate (wet STP), m ³ /s	140
Volumetric flow rate (dry STP), m ³ /s	120
Mass flow rate (wet basis), kg/hour	650000

Isokinetic Results	Sampling time	Average			Test 1 0910-1112			Test 2 0910-1112		
		Corrected to			Corrected to			Corrected to		
		Concentration mg/m ³	10% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	10% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	10% O ₂ mg/m ³	Mass Rate g/min
Chloride (as HCl)		0.4	0.42	2.8	0.33	0.35	2.3	0.46	0.49	3.3
Chlorine		<0.01	<0.01	<0.07	<0.009	<0.009	<0.06	<0.01	<0.01	<0.07
Total Fluoride (as HF)		0.06	0.063	0.42	0.039	0.042	0.28	0.08	0.085	0.56
Isokinetic Sampling Parameters										
Sampling time, min						120			120	
Isokinetic rate, %						100			101	

Date	28/01/2022	Client	Boral Cement Ltd
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Sampling Plane Details	
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Access & height of ports	Elevator 30 m
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Downstream disturbance	Exit 8 D
Upstream disturbance	Junction 8 D
No. traverses & points sampled	2 24
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	29.7 (wet)	31.5 (dry)
Gas density at STP, kg/m³	1.32 (wet)	1.41 (dry)
Gas density at discharge conditions, kg/m³	0.87	
% Oxygen correction & Factor	10 %	1.11
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1728 & 1935	
Temperature, °C	109	
Temperature, K	382	
Velocity at sampling plane, m/s	31	
Volumetric flow rate, actual, m³/s	220	
Volumetric flow rate (wet STP), m³/s	140	
Volumetric flow rate (dry STP), m³/s	120	
Mass flow rate (wet basis), kg/hour	680000	

Isokinetic Results	Sampling time	Average			Test 1			Test 2		
		Concentration	Corrected to	Mass Rate	Concentration	Corrected to	Mass Rate	Concentration	Corrected to	Mass Rate
		mg/m ³	10% O ₂ mg/m ³	g/min	mg/m ³	10% O ₂ mg/m ³	g/min	mg/m ³	10% O ₂ mg/m ³	g/min
Hexavalent chromium		<0.003	<0.003	<0.02	<0.003	<0.003	<0.02	<0.003	<0.003	<0.02
Isokinetic Sampling Parameters										
Sampling time, min						120			120	
Isokinetic rate, %						96			92	

3 Test Methods

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	NSW EPA TM-1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23	not specified	NA	✓
Carbon dioxide	NSW EPA TM-24	NSW EPA TM-24	13%	✓	✓
Carbon monoxide	NSW EPA TM-32	NSW EPA TM-32	12%	✓	✓
Nitrogen oxides	NSW EPA TM-11	NSW EPA TM-11	12%	✓	✓
Sulfur dioxide	NSW EPA TM-4	NSW EPA TM-4	12%	✓	✓ [†]
Speciated volatile organic compounds (VOCs)	NSW EPA TM-34 ^d	Ektimo 344	19%	✓	✓ [†]
Coarse particulates	NSW EPA OM-9	NSW EPA OM-9	not specified	✓	✓ ^{††}
Particulate matter (PM ₁₀ and PM _{2.5}) by particle size analysis	AS 4323.2	HRL in-house method using Malvern Mastersizer 2000	-	-	✗ ^{**}
Solid particles (total)	NSW EPA TM-15	NSW EPA TM-15	3%	✓	✓ ^{††}
Total (gaseous and particulate) metals and metallic compounds	NSW EPA TM-12, NSW EPA TM-13, NSW EPA TM-14	EnviroLab in-house methods Metals-006, Metals-022 & Metals-021	15%	✓	✓ [‡]
Type 1 substances (As, Cd, Hg, Pb, Sb)	NSW EPA TM-12	EnviroLab in-house methods Metals-006, Metals-022 & Metals-021	15%	✓	✓ [‡]
Type 2 substances (Be, Cr, Co, Mn, Ni, Se, Sn, V)	NSW EPA TM-13	EnviroLab in-house methods Metals-006, Metals-022 & Metals-021	15%	✓	✓ [‡]
Total and hexavalent chromium	NSW EPA OM-4	EnviroLab in-house method Metals-006 & Inorg-024	16%	✓	✓ [‡]
Dioxins and furans (PCDDs and PCDFs)	NSW EPA TM-18	NMI in-house method AUTL_MET_02	16%	✓	✓ [¶]
Fluorine & fluorine compounds	NSW EPA TM-9	ALS in-house method EA144C & Ektimo 240	25%	✓	✓ ^{#,†}
Hydrogen chloride	NSW EPA TM-8	Ektimo 235	14%	✓	✓ [†]
Chlorine	NSW EPA TM-7	Ektimo 235	14%	✓	✓ [†]
Polycyclic aromatic hydrocarbons (PAHs)	NSW EPA OM-6	NMI in-house method NGCMS 11.27	21%	✓	✓ [¶]
Sulfuric acid mist and/or sulfur trioxide	NSW EPA TM-3	Ektimo 235	16%	✓	✓ [†]

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- * Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).
- † Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601. Results were reported on:
10 February 2022 in report LV-002400.
10 February 2022 in report LV-002403.
16 February 2022 in report LV-002413.
22 February 2022 in report R012341-F.
- †† Gravimetric analysis conducted at the Ektimo Unanderra, NSW laboratory, NATA accreditation number 14601.
- ‡ Analysis performed by EnviroLab, NATA accreditation number 2901. Results were reported to Ektimo on 8 February 2022 in report 288290.
- ¶ Analysis performed by Australian Government National Measurement Institute, NATA accreditation number 198. Results were reported to Ektimo on:
23 February 2022 in report # DAU22_041.
2 March in report # ORG22_006.
- ** Analysis performed by HRL Technology using a laser-diffraction particle size analyser. NATA accreditation does not cover the performance of this service. Results were reported to Ektimo on 9 February 2022 in report 220177.
- # Analysis (solid fluoride only) performed by Australian Laboratory Services Pty Ltd, NATA accreditation number 825. Results were reported to Ektimo on 21 February 2022 in report EN2201250.
- d Excludes recovery study as specified in section 8.4.3 of USEPA Test Method 18

4 Plant Operating Conditions

See Boral Cement Ltd's records for complete process conditions.

5 Quality Assurance/Quality Control Information

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

6 Definitions

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM/CEMS	Continuous Emission Monitoring/Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D ₅₀	'Cut size' of a cyclone is defined as the particle diameter at which the cyclone achieves a 50% collection efficiency i.e. half of the particles are retained by the cyclone and half pass through it. The D ₅₀ method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D ₅₀ of that cyclone and less than the D ₅₀ of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
PM ₁₀	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
PM _{2.5}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test method
USEPA	United States Environmental Protection Agency
Velocity difference	The percentage difference between the average of initial flows and after flows.
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

7 Appendix 1: Site Location Photo



EPA 2 – No. 6 Kiln Stack

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