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Stack Emissions Testing Report Commissioned by
Irish Cement Ltd

Installation Name & Address
Irish Cement Ltd
Limerick Works
Castlemungret
County Limerick

Industrial Emissions Licence: P0029-06

Stack Reference
A2-01 Kiln 6

Dates of the Monitoring Campaign
13th - 21st September 2023

Job Reference Number
EMT06515

Report Written by
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Report Approved by
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Report Date
17th October 2023

Version
Version 1

Signature of Report Approver


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Opinions and interpretations expressed herein are outside the scope of Element Ireland's ISO 17025 accreditation.

The testing performed fully meets the technical requirements in Irish EPA Guidance Note, AG2.

MONITORING OBJECTIVES

Irish Cement Ltd, Limerick
A2-01 Kiln 6
13th - 21st September 2023

Overall Aim of the Monitoring Campaign

Element Ireland were commissioned by Irish Cement Ltd to carry out stack emissions testing on the A2-01 Kiln 6 at Limerick.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Licence.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Sulphur Dioxide, Cadmium & Thallium, Heavy Metals, Mercury, Dioxins & Furans, PCBs, Hydrogen Chloride, Hydrogen Fluoride, Ammonia, Total VOCs (as Carbon), Oxides of Nitrogen (as NO_2), Carbon Monoxide, Ammonia, Hydrogen Chloride, Sulphur Dioxide, Oxides of Nitrogen (as NO_2), Carbon Monoxide

MONITORING RESULTS

Irish Cement Ltd, Limerick
A2-01 Kiln 6
13th - 21st September 2023

where MU = Measurement Uncertainty associated with the Result

		Concentration				Mass Emission			
Parameter	**Units**	**Result**		**MU +/-**	**Limit**	**Units**	**Result**	**MU +/-**	**Limit**
Cadmium & Thallium [1]	mg/m³	0.001		0.0002	0.05	g/hr	0.29	0.05	-
Heavy Metals [1]	mg/m³	0.011		0.002	0.5	g/hr	2.9	0.60	-
Mercury	mg/m³	0.008		0.002	0.05	g/hr	2.0	0.48	-
Dioxins & Furans Upper Limit (worst case where <LOD = LOD)									
Dioxins & Furans (NATO I-TEQ) [1]	ng/m³	0.0038		0.0008	0.1	µg/hr	0.99	0.21	-
Dioxins & Furans (WHO TEQ Humans / Mammals) [1]	ng/m³	0.0046		0.0010	-	µg/hr	1.20	0.26	-
Dioxins & Furans (WHO TEQ Fish) [1]	ng/m³	0.0049		0.0010	-	µg/hr	1.26	0.27	-
Dioxins & Furans (WHO TEQ Birds) [1]	ng/m³	0.0065		0.0013	-	µg/hr	1.68	0.36	-
Dioxins & Furans Lower Limit (best case where <LOD = 0)									
Dioxins & Furans (NATO I-TEQ) [1]	ng/m³	0.0022		0.0005	-	µg/hr	0.58	0.12	-
Dioxins & Furans (WHO TEQ Humans / Mammals) [1]	ng/m³	0.0028		0.0006	-	µg/hr	0.73	0.16	-
Dioxins & Furans (WHO TEQ Fish) [1]	ng/m³	0.0028		0.0006	-	µg/hr	0.72	0.15	-
Dioxins & Furans (WHO TEQ Birds) [1]	ng/m³	0.0040		0.0008	-	µg/hr	1.03	0.22	-
PCBs Upper Limit (worst case where <LOD = LOD)									
PCBs (WHO TEQ Humans / Mammals) [1]	ng/m³	0.000227		0.000047	-	µg/hr	0.06	0.013	-
PCBs (WHO TEQ Fish) [1]	ng/m³	0.000013		0.000003	-	µg/hr	0.003	0.001	-
PCBs (WHO TEQ Birds) [1]	ng/m³	0.001021		0.000213	-	µg/hr	0.26	0.056	-
PCBs Lower Limit (best case where <LOD = 0)									
PCBs (WHO TEQ Humans / Mammals) [1]	ng/m³	0.000127		0.000026	-	µg/hr	0.03	0.007	-
PCBs (WHO TEQ Fish) [1]	ng/m³	0.000009		0.000002	-	µg/hr	0.002	0.0005	-
PCBs (WHO TEQ Birds) [1]	ng/m³	0.000941		0.000196	-	µg/hr	0.24	0.05	-
Ammonia [1]	mg/m³	5.6		1.0	50	g/hr	1463	280	-
Total VOCs (as Carbon) [1]	mg/m³	11.3		0.64	25	g/hr	2939	214	-
Oxides of Nitrogen (as NO_2) [1]	mg/m³	479		17.5	500	g/hr	124274	7299	-
Carbon Monoxide [1]	mg/m³	280		10.3	1500	g/hr	72603	4273	-
Oxygen	% v/v	Dry	10.4	0.25					
Stack Gas Temperature	°C		146.6						
Stack Gas Velocity	m/s		24.2	0.19					
Volumetric Flow Rate (ACTUAL)	m³/hr		462645	21265					
Volumetric Flow Rate (REF) [1]	m³/hr		259215	11914					

NOTE: VOLUMETRIC FLOW RATE & VELOCITY DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

[1] Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 10% oxygen.

Executive Summary

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MONITORING DATE(S) & TIMES

Irish Cement Ltd, Limerick

A2-01 Kiln 6

13th - 21st September 2023

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Cadmium & Thallium	R1	mg/m³	0.001	g/hr	0.29	13/09/2023	18:05 - 19:05	60
Cadmium & Thallium	R2	mg/m³	< 0.001	g/hr	< 0.28	14/09/2023	08:15 - 09:15	60
Cadmium & Thallium	R3	mg/m³	< 0.001	g/hr	< 0.29	14/09/2023	17:07 - 18:07	60
Heavy Metals	R1	mg/m³	0.016	g/hr	4.1	13/09/2023	18:05 - 19:05	60
Oxygen (Metals Run 1)	R1	% v/v	10.2			13/09/2023	18:05 - 19:05	60
Water Vapour (Metals Run 2)	R1	% v/v	11.3			13/09/2023	18:05 - 19:05	60
Heavy Metals	R2	mg/m³	0.006	g/hr	1.5	14/09/2023	08:15 - 09:15	60
Oxygen (Metals Run 2)	R2	% v/v	10.1			14/09/2023	08:15 - 09:15	60
Water Vapour (Metals Run 2)	R2	% v/v	10.7			14/09/2023	08:15 - 09:15	60
Heavy Metals	R3	mg/m³	0.012	g/hr	3.1	14/09/2023	17:07 - 18:07	60
Oxygen (Metals Run 3)	R2	% v/v	10.6			14/09/2023	17:07 - 18:07	60
Water Vapour (Metals Run 3)	R2	% v/v	10.2			14/09/2023	17:07 - 18:07	60
Mercury	R1	mg/m³	0.006	g/hr	1.5	13/09/2023	18:05 - 19:05	60
Oxygen (Mercury Run 1)	R1	% v/v	10.2			13/09/2023	18:05 - 19:05	60
Water Vapour (Mercury Run 1)	R1	% v/v	11.8			13/09/2023	18:05 - 19:05	60
Mercury	R2	mg/m³	0.007	g/hr	1.7	14/09/2023	08:15 - 09:15	60
Oxygen (Mercury Run 2)	R2	% v/v	10.1			14/09/2023	08:15 - 09:15	60
Water Vapour (Mercury Run 2)	R2	% v/v	11.0			14/09/2023	08:15 - 09:15	60
Mercury	R3	mg/m³	0.011	g/hr	2.8	14/09/2023	17:07 - 18:07	60
Oxygen (Mercury Run 3)	R3	% v/v	10.6			14/09/2023	17:07 - 18:07	60
Water Vapour (Mercury Run 3)	R3	% v/v	10.1			14/09/2023	17:07 - 18:07	60
Dioxins & Furans (NATO)	R1	ng/m³	0.0020	µg/hr	0.53	13/09/2023	12:00 - 18:00	360
Oxygen (Dioxins Run 1)	R1	% v/v	10.5			13/09/2023	12:00 - 18:00	360
Water Vapour (Dioxins Run 1)	R1	% v/v	12.1			13/09/2023	12:00 - 18:00	360
Dioxins & Furans (NATO)	R2	ng/m³	0.0066	µg/hr	1.7	14/09/2023	09:30 - 13:36, 14:50 - 16:44	360
Oxygen (Dioxins Run 2)	R2	% v/v	10.5			14/09/2023	09:30 - 13:36, 14:50 - 16:44	360
Water Vapour (Dioxins Run 2)	R2	% v/v	9.0			14/09/2023	09:30 - 13:36, 14:50 - 16:44	360
Dioxins & Furans (NATO)	R3	ng/m³	0.0029	µg/hr	0.745	15/09/2023	09:20 - 15:20	360
Oxygen (Dioxins Run 3)	R3	% v/v	10.8			15/09/2023	09:20 - 15:20	360
Water Vapour (Dioxins Run 3)	R3	% v/v	13.6			15/09/2023	09:20 - 15:20	360
PCBs	R1	ng/m³	0.0001	µg/hr	0.032	13/09/2023	12:00 - 18:00	360
PCBs	R2	ng/m³	0.0004	µg/hr	0.105	14/09/2023	09:30 - 13:36, 14:50 - 16:44	360
PCBs	R3	ng/m³	0.0002	µg/hr	0.039	15/09/2023	09:20 - 15:20	360
Ammonia	R1	mg/m³	0.36	g/hr	93.9	15/09/2023	10:15 - 10:45	30
Oxygen (NH3 Run 1)	R1	% v/v	10.7			15/09/2023	10:15 - 10:45	30
Water Vapour (NH3 Run 1)	R1	% v/v	9.6			15/09/2023	10:15 - 10:45	30
Ammonia	R2	mg/m³	6.0	g/hr	1567	15/09/2023	10:55 - 11:25	30
Oxygen (NH3 Run 2)	R2	% v/v	10.7			15/09/2023	10:55 - 11:25	30
Water Vapour (NH3 Run 2)	R2	% v/v	8.4			15/09/2023	10:55 - 11:25	30
Ammonia	R3	mg/m³	10.5	g/hr	2728	15/09/2023	11:35 - 12:05	30
Oxygen (NH3 Run 3)	R3	% v/v	10.7			15/09/2023	11:35 - 12:05	30
Water Vapour (NH3 Run 3)	R3	% v/v	7.6			15/09/2023	11:35 - 12:05	30
Total VOCs (as Carbon)	R1	mg/m³	11.3	g/hr	2939	14/09/2023	18:30 - 02:30	480
Oxides of Nitrogen (as NO_2)	R1	mg/m³	479	g/hr	124274	14/09/2023	18:30 - 02:30	480
Carbon Monoxide	R1	mg/m³	280	g/hr	72603	14/09/2023	18:30 - 02:30	480
Carbon Dioxide	R1	% v/v	18.9			14/09/2023	18:30 - 02:30	480
Oxygen	R1	% v/v	10.1			14/09/2023	18:30 - 02:30	480
Velocity Traverse	R1					13/09/2023	11:00 - 11:25	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Irish Cement Ltd, Limerick
A2-01 Kiln 6
13th - 21st September 2023

Standard Operating Conditions

Parameter	Value
Process Status	Cement Kiln
Capacity (of 100%) and Tonnes / Hour	180 Tonnes / Hour
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Raw Meal
Abatement System	Bag Filter & SNCR
Abatement System Running Status	Normal Operating Conditions
Fuel	Petcoke and SRF
Plume Appearance	Visible

MONITORING & ANALYTICAL METHODS

Irish Cement Ltd, Limerick
A2-01 Kiln 6
13th - 21st September 2023

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**Sampling Status**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**Analysis Status**	**Analysis Lab**	**Overall Status**	**LOD (Average)**
Cadmium & Thallium	EN 14385	MD 006	MCERTS	EET	CAT-AP-07	ICP-MS	MCERTS	EET	MCERTS	0.001 mg/m³
Heavy Metals	EN 14385	MD 006	MCERTS	EET	CAT-AP-07	ICP-MS	MCERTS	EET	MCERTS	0.006 mg/m³
Mercury	EN 13211	MD 006	MCERTS	EET	CAT-AP-08	CV-AFS	MCERTS	EET	MCERTS	0.00027 mg/m³
Dioxins & Furans	EN 1948	MD 007	MCERTS	EET	PM137, TM201	GC-HRMS	MCERTS	EET	MCERTS	0.0026 ng/m³
PCBs	EN 1948	MD 007	MCERTS	EET	PM137, TM201	GC-HRMS	MCERTS	ELD	MCERTS	0.00015 ng/m³
Ammonia	ISO 21877	MD 014	MCERTS	EET	A6	IC	MCERTS	RPS	MCERTS	0.143 mg/m³
Total VOCs (as Carbon)	EN 12619:2013	MD 020	MCERTS	EET	Flame Ionisation Detection by Sick 3006				MCERTS	0.32 mg/m³
Oxides of Nitrogen (as NO_2)	EN 14792	MD 039	MCERTS	EET	Chemiluminescence by Horiba PG-350E				MCERTS	0.41 mg/m³
Carbon Monoxide	EN 15058	MD 039	MCERTS	EET	NDIR by Horiba PG-350E				MCERTS	0.25 mg/m³
Carbon Dioxide	CEN/TS 17405	MD 039	MCERTS	EET	NDIR by Horiba PG-350E				MCERTS	0.1 %
Oxygen	EN 14789	MD 039	MCERTS	EET	Dry Paramagnetic Cell by Horiba PG-350E				MCERTS	0.1 %
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	MD 041	MCERTS	EET	Pitot Tube and Thermocouple				MCERTS	1.2 m/s

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Element (Deeside Lab - ELD)	ISO 17025 Accreditation Number: 4225
Element (Stockport Lab - EET)	ISO 17025 Accreditation Number: 4279

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All	All	There are no deviations associated with the sampling employed.

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	2.60
Width	m	-
Area	m^2	5.31
Port Depth	cm	21
Orientation of Duct	-	Vertical
Number of Ports	-	2
Sample Port Size	-	5" Flange

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
Inside / Outside	Outside

Platform Details

Irish EPA Technical Guidance Note AG1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
Platform has vertical base boards (approx. 0.25m high)	Yes
Platform has chains / self closing gates at top of ladders	Yes
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in Irish EPA Guidance Note AG1 and EN 15259, and therefore there are no improvement recommendations.

EN 15259 Homogeneity Test Requirements

A valid EN 15259 Homogeneity test was performed by Element on this Stack on 19th June 2021, Report ID: EMT01136, and the stack gas profile was found to be homogenous.

Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	302.0	> 5 Pa	Yes
Mean Velocity	m/s	24.20	-	-
Lowest Gas Velocity	m/s	22.01	-	-
Highest Gas Velocity	m/s	26.53	-	-
Ratio of Above	: 1	1.21	< 3 : 1	Yes
Maximum Angle of Swirl	°	8.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

PLANT PHOTOS

Photo 1

Photo 2

SAMPLE POINTS