TEST PROGRAMME REPORT

FOR THE CO-FIRING OF

MEAT AND BONE MEAL (MBM)

AT

IRISH CEMENT LIMERICK WORKS

December 2025

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Glossary:

ICL – Irish Cement Limited

MBM – Meat and Bone Meal

AF – Alternative Fuel

1. EXECUTIVE SUMMARY

Irish Cement Limited, Limerick Works (ICL) commenced co-firing of Meat and Bone Meal (MBM) in November 2024 under the conditions of the P0029-06 IE licence. A Test Programme with the EPA was agreed prior to firing of MBM. The introduction of MBM as an alternative fuel, is intended to reduce the fossil-based carbon emissions in the cement clinker manufacturing process and reduce reliance on unsustainable fossil fuel sources of thermal energy.

In March 2024, ICL applied to the EPA to enter into a Test Programme to demonstrate full compliance with the IE licence and test programme conditions. This application was approved by the EPA on the 12th of September 2024 subject to 13 conditions including a duration length of up to 10 months and a maximum MBM addition rate of 5 tonnes per hour. This Test Programme Report includes information relating to compliance to conditions of the test programme as well as results, commentary and analysis for the testing in order for ICL to request the approval of the Agency to continue to use MBM as an Alternative Fuel.

ICL's strategy throughout the Test Programme period was predicated on pursuing an orderly ramp up in MBM substitution rates, to ensure the delivery of its dual objectives, namely:

i. assuring environmental emissions compliance with IE licence and test programme conditions
ii. ensuring product quality consistency and compliance with applicable product quality standards.

The ramp up schedule of MBM was agreed with the Agency in advance of the programme and was followed throughout.

ICL has operated with MBM as a fuel since the 7th of November 2024 and with an orderly ramp up approach, ICL has achieved a progressive increase in thermal substitution. Since commencing the test programme, ICL has successfully consumed MBM during the Test Programme period thereby reducing the equivalent amount being exported.

Throughout the Test Programme, ICL has complied with all of the conditions of its IE licence and Test Programme requirements and has maintained consistent product quality performance in accordance with applicable product standards, all of which is detailed in this report and the associated Appendices.

ICL's AF strategy is to continue to pursue the highest possible MBM substitution rates achievable, so as to maximise the sustainability benefits in the immediate term whilst also investigating the feasibility of using other alternative fuels over the medium term. Whilst this Test Programme report demonstrates full compliance with IE and Quality Standards requirements, ICL is targeting thermal substitution rates in excess of ~80% in line with best practice cement kilns across Europe. The maximum substitution of MBM yields a wide range of sustainability benefits such as underpinning local employment, diverting waste from export to energy recovery and reducing fossil-based carbon emissions.

This test programme report will respond to all IE Licence conditions in relation to the use of MBM as an AF and the undertaking of a test programme. In conclusion, ICL believes that the extensive information provided in this test programme report demonstrates that the IE licence P0029-06 as granted by the Agency contains all the necessary operational control and emission limitations necessary to assure acceptable environmental outcomes from the operation of Limerick Works.

2. BACKGROUND

The alternative fuels project at Limerick is a critical part of ICL's sustainability strategy which includes reducing CO_2 emissions and dependency on imported fossil fuels. Fundamental to ICL's ability to deliver on this strategy has been the multi-million Euro investment in the process technology required to substitute a proportion of the fossil fuels used in its Kiln 6 cement kiln at Limerick Works with Meat and Bone Meal (MBM). MBM is a byproduct of the animal rendering process and is a largely homogenous material, making it very suitable as a fuel in the cement manufacturing process.

Approximately 40% of the Carbon Dioxide (CO_2) generated in the production of cement clinker arises from the carbon content of the fuels used. Due to the traditional reliance on fossil fuels within the industry, the European cement industry has been progressively introducing Alternative Fuels (AF) for the past 40 years. This strategy has seen a significant displacement of the reliability on fossil fuel sources with greater than 90% of energy used in firing cement kilns in some plants within the EU now accounted for by the use of lower carbon intensity alternative fuels. The use of MBM as a fuel in cement kilns is now an integral component of the management of this material within the island of Ireland. If the material was not used as a fuel, the material would be required to be exported for final treatment.

There are many sustainability advantages that arise from the use of AF in the cement manufacturing process, some of which are summarised below:

- Complete recovery of the energy value of the material due to the efficiency of the combustion process in the cement kilns
- Reduction in CO_2 emissions
  - Directly due to lower carbon emissions arising from the lower carbon intensity of the fuels
  - Indirectly by eliminating the need to export the MBM and associated transport emissions.

- MBM is considered to be 100% biomass. The fuel is therefore considered renewable and CO_2 free.
- Reduction in the dependency on imported fossil fuels.
- No residual wastes are produced from the cement manufacturing process. The organic fraction contributes to the combustion process and the inorganic components are incorporated into the cement product thereby eliminating the requirement for additional landfill capacity.
- Complete destruction of the fuels and full compliance with Industrial Emissions Directive (IED) requirements due to the high temperatures, long residence times and high thermal inertia.
- Reduction in the input of raw materials and additives due to the mineral contribution from AF.
- Contribution to achieving Ireland's international obligations by providing the most efficient energy recovery option and contributing to the management of MBM within the Republic of Ireland.
- Reduction in transport effects by indigenously sourcing fuel supply.
- Development of jobs in Irish companies producing and supplying MBM.

2.1 ICL MBM Project

In order to facilitate the MBM project, a full review of the Limerick Works IE licence was completed by the EPA and a new IE licence (Registration Number P0029-06) was issued on the 18th May 2021. New compliance conditions and emission limit values were included in the revised licence to ensure compliance with both IE and the IED.

In accordance with Condition 6.3 Co-incineration – Test Programme of IE Licence P0029-06, a Test Programme was prepared and submitted by Irish Cement. This was subsequently approved by the Agency on the 12th of September 2024 permitting the co-firing of Meat and Bone Meal (MBM), EWC Code 02 01 02, at Irish Cement Limited, Limerick Works under Test Programme conditions.

This Test Programme Report contains additional conditions from the IE licence in relation to the use of Alternative Fuels and conditions from the EPA on approval of the Test Programme. An Interim Test Programme Report was submitted by Irish Cement to the EPA in July 2025, which was one of the approval conditions.

The report contained herein constitutes the final report for the period from November 2024 to November 2025. This report focuses on the licence conditions, operational information and appropriate standard operating procedures.

2.2 Key Objectives

The core objectives of the MBM Project for Irish Cement are based on following three key pillars:

Figure 1: Key Pillars of ICL's Alternative Fuel Strategy

- ***Maximise Thermal Substitution…*** reduce CO_2 emissions per tonne and reduce dependency and usage on imported fossil fuels.
- ***Environmental Compliance…*** demonstrating compliance with the IE licence and agreed additional Test Programme conditions.
- ***Product Quality Compliance…*** demonstrating conformity with relevant cement standards and maintaining product quality assurance.

This Report documents the operational outcomes of the test programme period (e.g., MBM throughput and thermal substitution rates achieved) against each of these three objectives.

2.3 ICL Approach

In order to achieve the desired sustainability benefits from the MBM project, a deliberate and orderly ramp-up of MBM substitution for fossil fuel was necessary from the outset of the Test Programme. A progressive ramp-up was designed to ensure that each targeted step change in MBM substitution rate was adequately assessed to:

- Demonstrate environmental compliance with the requirements of the IE licence and agreed Test Programme conditions.
- Assure consistent cement product quality performance and compliance with EN197-1, the Harmonised European standard for cement products.

Due to the nature of the cement production process and quality assurance testing, the rate of MBM ramp-up was dictated by the product quality performance testing requirements, as well as the agreed ramp up timeline with the EPA. This is best understood by considering the steps taken for each targeted MBM substitution rate as outlined in **Figure 2** below:

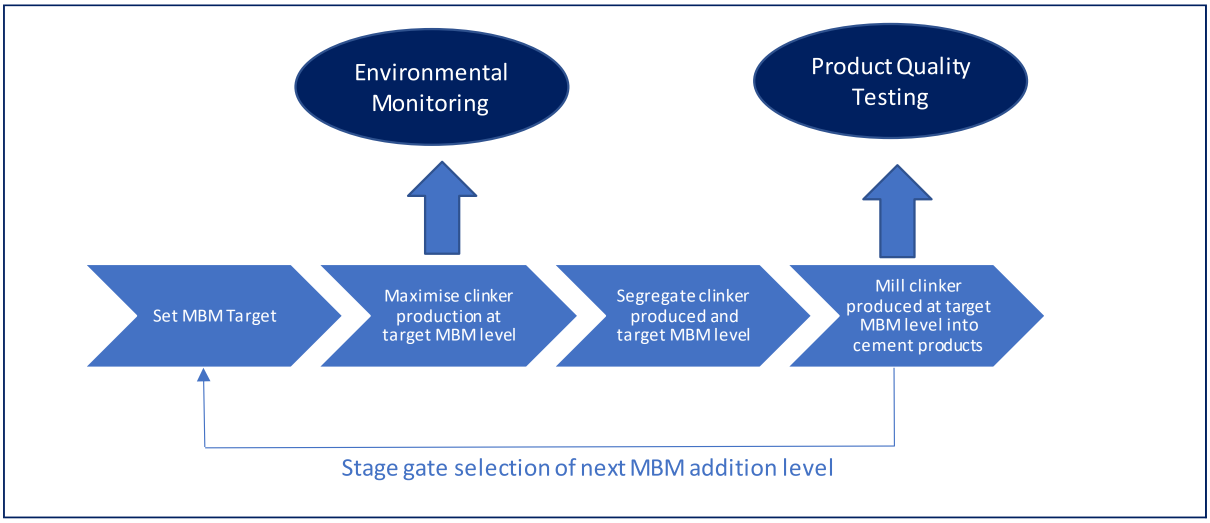


Figure 2: Key Pillars of MBM Test Programme Approach

Environmental monitoring was conducted in accordance with the conditions of IE licence P0029-06 and additional Test Programme conditions agreed with the EPA.

Product quality assurance included sampling, testing and analysis of the cement performance in mortar and concrete applications for a variety of quality characteristics including strength development, workability, durability and setting time.

In addition, as the MBM usage ramp-up progressed, the orderly ramp-up of the MBM supply chain was also necessary to ensure continued supply of MBM at increasing levels of substitution. To this end, Irish Cement has worked closely with their supplier to be able to attain MBM to the technical specification required to ensure consistently high thermal substitution rates. There is currently only one MBM supplier, Waterford Proteins, as approved by the Agency.

3. THERMAL SUBSTITUTION

3.1 MBM Usage Rates

MBM has been used as a fuel alongside pet-coke and SRF since November, 2024.

As shown in Figure 3 below, the hourly substitution rate steadily increased as equipment commissioning, supply chain development and compliance with environmental monitoring and product quality was demonstrated throughout the period.
The maximum hourly rate of MBM consumption achieved to date is 4 t/hr. This had progressively increased as per the agreed ramp up timeline.

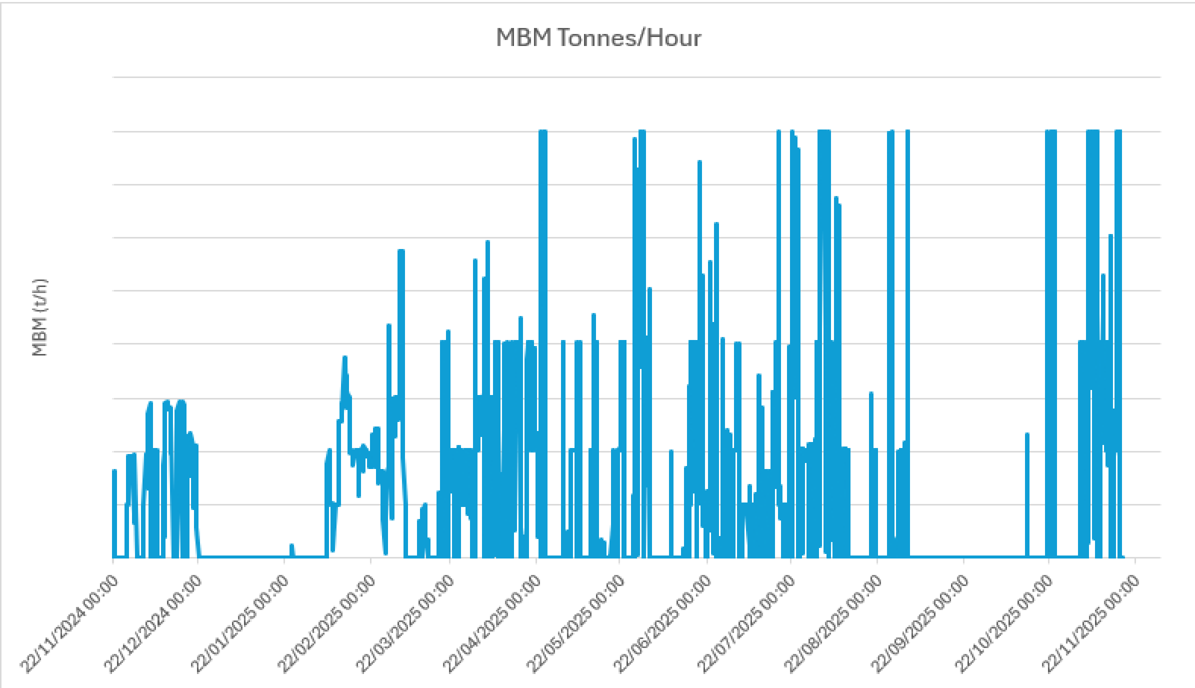


Figure 3: MBM t/h rates from November 2024 to November 2025

3.2 Thermal Substitution Performance

Figure 4 below depict the daily thermal substitution of MBM achieved throughout the Test Programme period and Figure 5 shows the daily consumption of MBM in tonnes from November 2024 to November 2025. The highest instantaneous hourly MBM substitution rate achieved by ICL is ~20%. The graph illustrates an increasing trend in the thermal substitution rates.

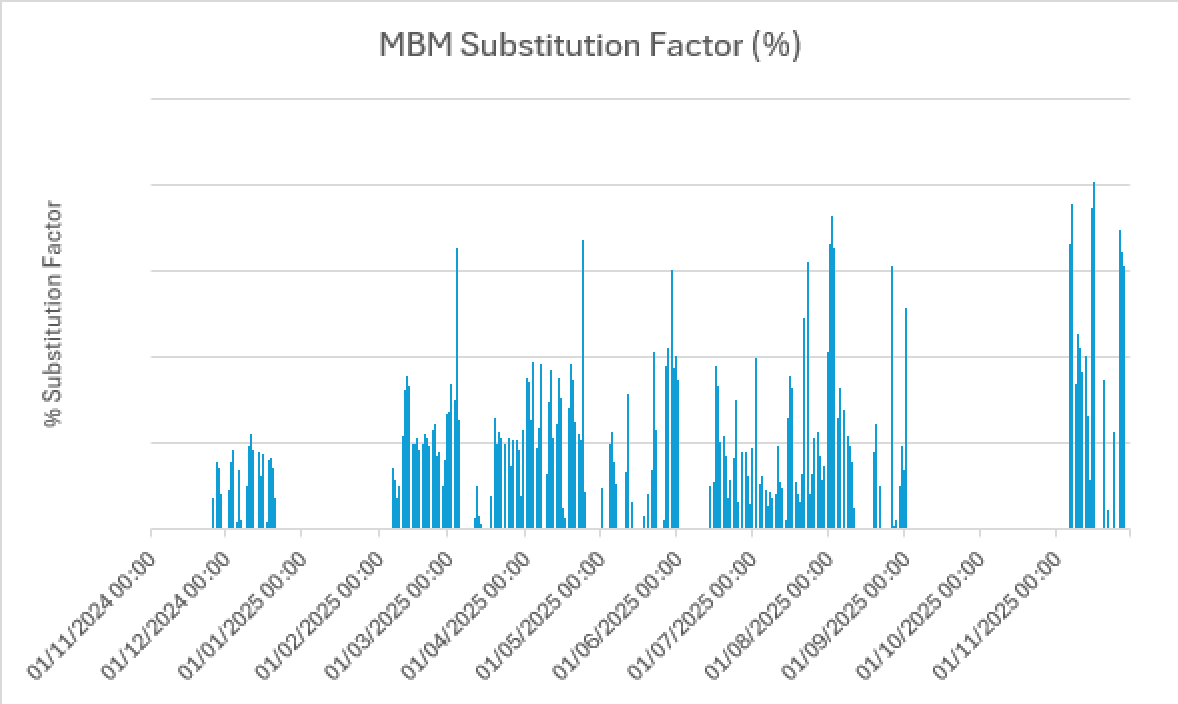


Figure 4: MBM Substitution rates from November 2024 to November 2025

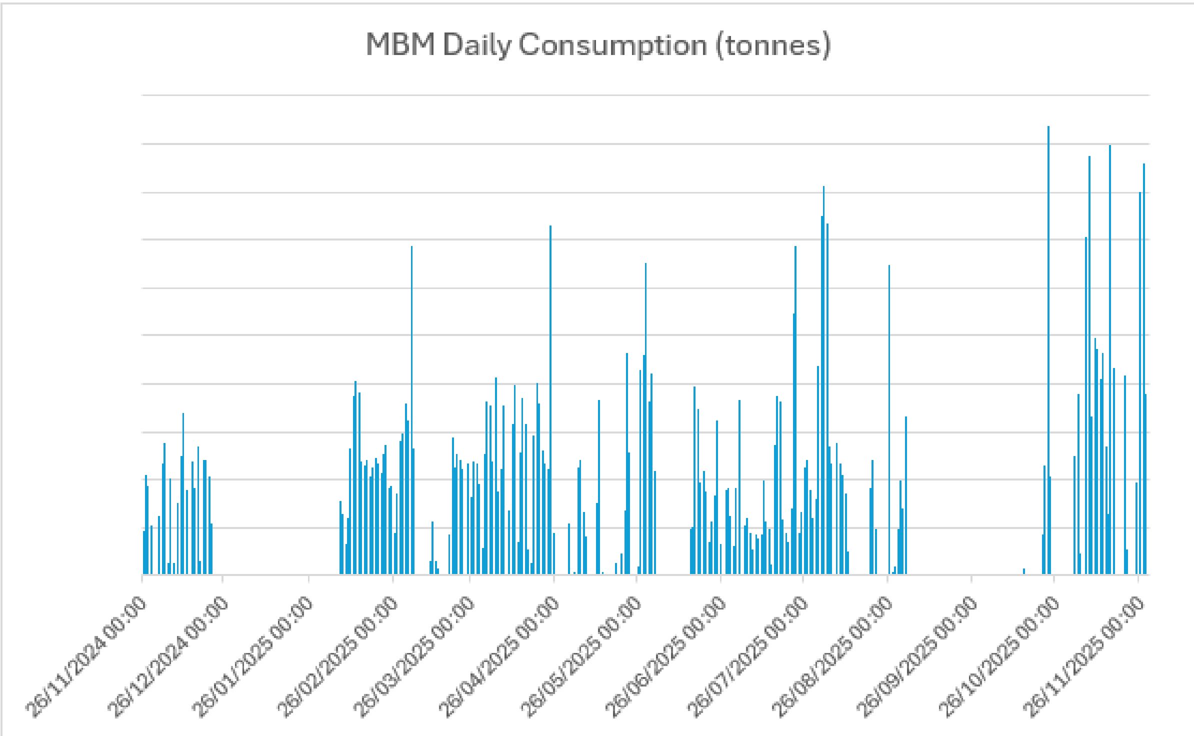


Figure 5: MBM Daily Consumption from November 2024 to November 2025

3.3 Summary of Key Points

- The average MBM substitution rate increased gradually over the course of the test programme.
- The max hourly rate of MBM loading achieved was 4t/hr.
- The MBM substitution has been achieved with full environmental compliance.

4. ENVIRONMENTAL COMPLIANCE

4.1 IE Licence Conditions

The following conditions of IE licence P0029-06 refer specifically to aspects of Alternative Fuel firing:

> ***6.3.4 The test programme shall as a minimum:***
> *(1) Verify the residence time, the minimum temperature and the oxygen content of the exhaust gas which will be achieved during normal operation and under the most unfavourable operating conditions anticipated.*
> *(2) Establish all criteria for operation, control and management of the abatement equipment to ensure compliance with the emission limit values specified in this licence.*
> *(3) Assess the performance of any monitors on the abatement system and establish a maintenance and calibration programme for each monitor.*
> *(4) Establish criteria for the control of all waste input; and*
> *(5) Confirm that all measurement equipment or devices (including thermocouples) used for the purpose of establishing compliance with this licence have been subjected, in situ, to normal operating temperatures to prove their operation under such conditions.*

> ***Condition 6.3.4.1: Verification of the Control Parameters***
> "*Verify the residence time, the minimum temperature and the oxygen content of the exhaust gas which will be achieved during normal operation and under the most unfavourable operating conditions anticipated*."

Limerick Works comply with EU Directive 2000/76/EC, referred to as the Industrial Emissions Directive (IED). The principal operating conditions established in the IED are that material must remain within the system for at least 2 seconds (residence time) at 850°C (temperature).

In the main burner, the flame temperature exceeds 2000°C (as shown on the schematic diagram in Figure 6. below). This high temperature is necessary to ensure that the raw materials reach temperatures of 1450°C in order to form clinker, the primary ingredient in the production of cement. The stability of the kiln burner flame is monitored using the burning zone temperature along with the preheater tower temperature probes and preheater tower exit analyser to ensure correct conditions are maintained for clinker formation. The oxygen content of the kiln gas is controlled and is verified by changes in gas concentration observed at the Preheater Exit Analyser (644XQ02) and the Secondary Analyser (644XQ06). The locations of the monitoring points are indicated on the schematic shown in Figure 6.

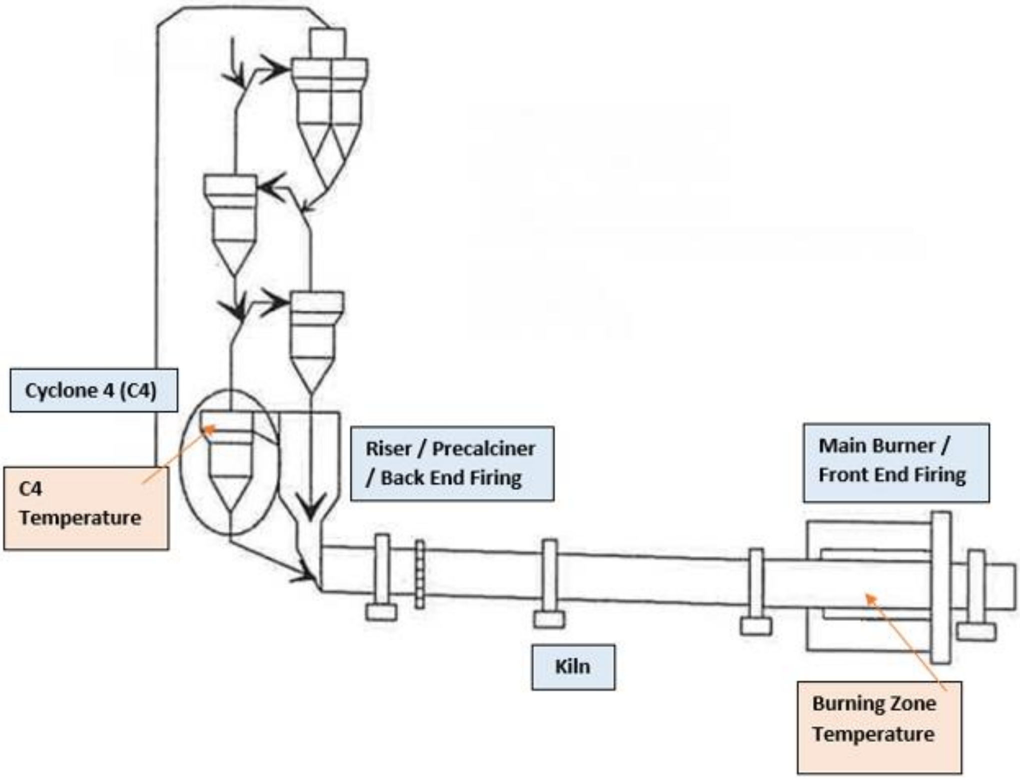


Figure 6: Schematic of Kiln 6 process

In order to verify the residence time, a range of scenarios were modelled to simulate expected operating conditions. The original equipment designer and manufacturer of Kiln 6, FLSmidth, were employed to model this data. A copy of the FLSmidth memo is provided for reference in Appendix II. The fuel injection is interlocked with the temperature in the burning zones to ensure stable specific heat consumption. A stable specific heat consumption is paramount to the formation of good quality Clinker and in turn good quality cement. Therefore, if this is not correct, there may be an effect on Clinker quality. There are two temperature measurements: one in Cyclone 4 also known as Stage 4 and the main kiln burning zone. The FLSmidth modelling indicates that the minimum gas residence time under even the worst-case scenario (simulated with complete substitution of MBM) is 6.64 seconds, which is far in excess of 2 seconds required under the IED.

The table below summarises the residence time when operating at a minimum temperature of 855°C:

Scenario	Main Burner Fuel Mix	Back End Fuel Mix	Back End Residence Time (s)	Residence Time from Main Burner (s)	Total Residence Time
1	80% Pet Coke	20% Pet Coke	3.77	3.42	7.19
2	5% MBM+20% SRF +55% Pet Coke	20% Pet Coke	3.70	3.32	7.02
3	15% MBM+20% SRF+45% Pet Coke	20% Pet Coke	3.69	3.30	6.99
4*	40% MBM+40% SRF	20% SRF	3.56	3.08	6.64

Table 1: Summary for Operating Scenarios as modelled by FLSmidth

** Scenario 4 is to show a total AF scenario for reference only*

Condition 6.3.4.2: Abatement Equipment Operation

"Establish all criteria for operation, control and management of the abatement equipment to ensure compliance with the emission limit values specified in this licence."

Emission abatement is an integral part of the cement manufacturing process. The Kiln 6 investment includes the Best Available Technology (BAT) fabric filters and ensures that Limerick can abate emissions to BAT emission levels. Limerick also installed a Selective Non-Catalytic Reduction (SNCR) for NO_x abatement and has lime injection for SO_x abatement.

Assessment of SNCR abatement compliance with NO_x ELV during co-firing of MBM

The NO_x abatement equipment installed on Kiln 6 is primarily ABC&I Selective Non-Catalytic Reduction (SNCR) technology. The SNCR technology was commissioned in a test programme and was commissioned in 2007. Limerick Works monitored the performance of the SNCR abatement system and the ABB ACF5000 CEMS analyser so as to ensure compliance with the Emission Limit Value.

During the test programme there was one breach in the daily NO_x average. This breach was reported to the EPA and was not connected to the use of MBM or any other AF addition. The breach was due to an interruption to the kiln emission interlocks because of a time change for daylight savings. Preventative actions have been put in place to prevent this from reoccurring. All other NO_x emissions have been compliant for both the daily and half hour averages to date.

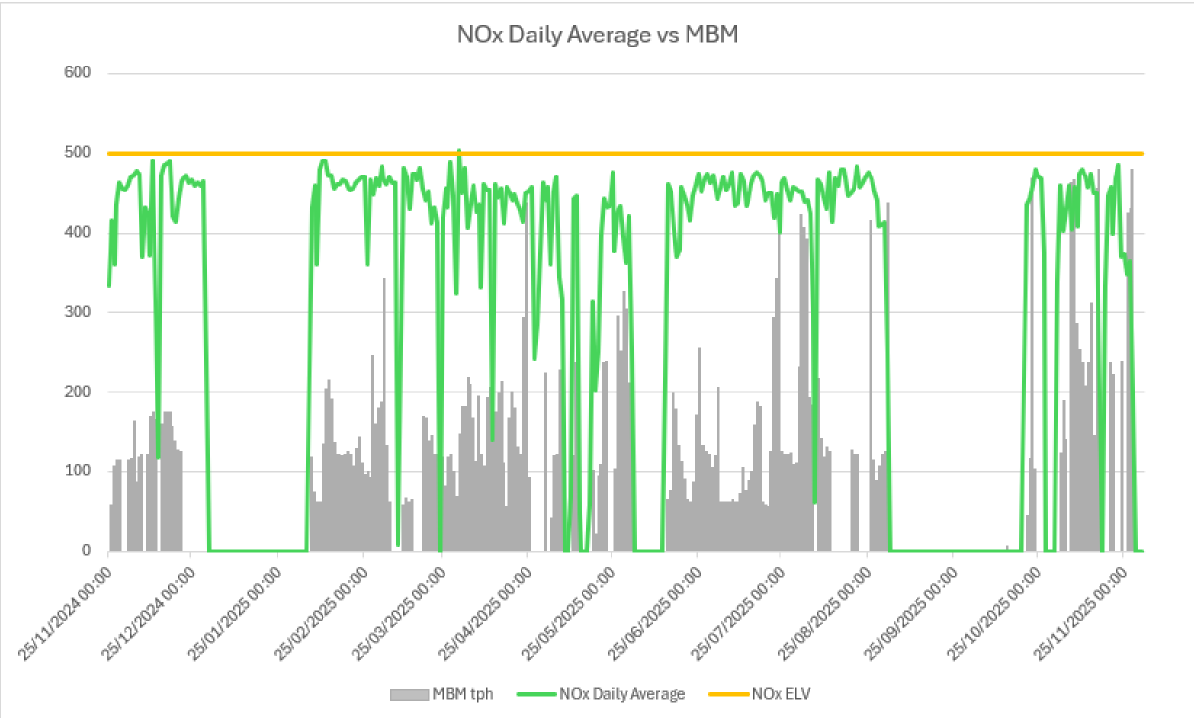


Figure 7: NOx Daily Average during the Test Burn Programme period

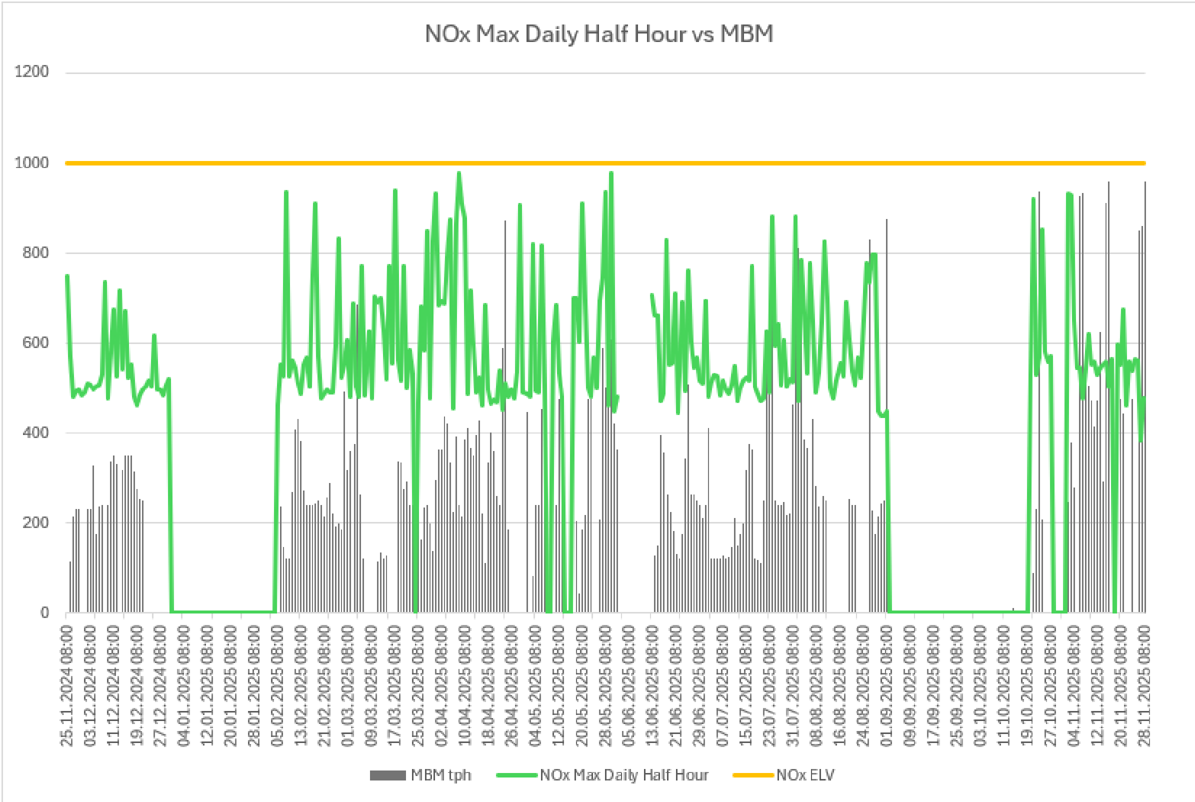


Figure 8: NO_x Daily Max Half hour during the Test Burn Programme period

NO_x Reduction	
Time Period	**% of Half Hourly Average Values within 1.2 times the NO_x ELV**
	%
November 24 – November 25	97.81

Table 2: % of Half Hourly Average Values within 97% of 1.2 times the NO_x ELV

Standard Operating Procedures for the abatement system, including operating with the co-firing of MBM, form part of Limerick's controlled documented procedures. These procedures have been reviewed as part of the MBM test programme. A copy of this procedure is included in appendix V.

Assessment of Kiln 6 bag filter abatement compliance with dust ELV during co-firing of MBM

Limerick Works installed an FLS Fabric Filter for Kiln 6 in 2010 for the abatement of particulates. Limerick Works monitored the performance of the bag filter using the differential pressure monitor installed and the PCME QAL 181 dust monitor on the Kiln 6 stack to ensure continued compliance with the Emission Limit Values for particulate emissions.

The co-firing of MBM does not affect the control of the filter, as there is no impact of MBM co-firing on the filter integrity and all half hourly and daily averages have been compliant during the co firing period from November 2024 to November 2025.

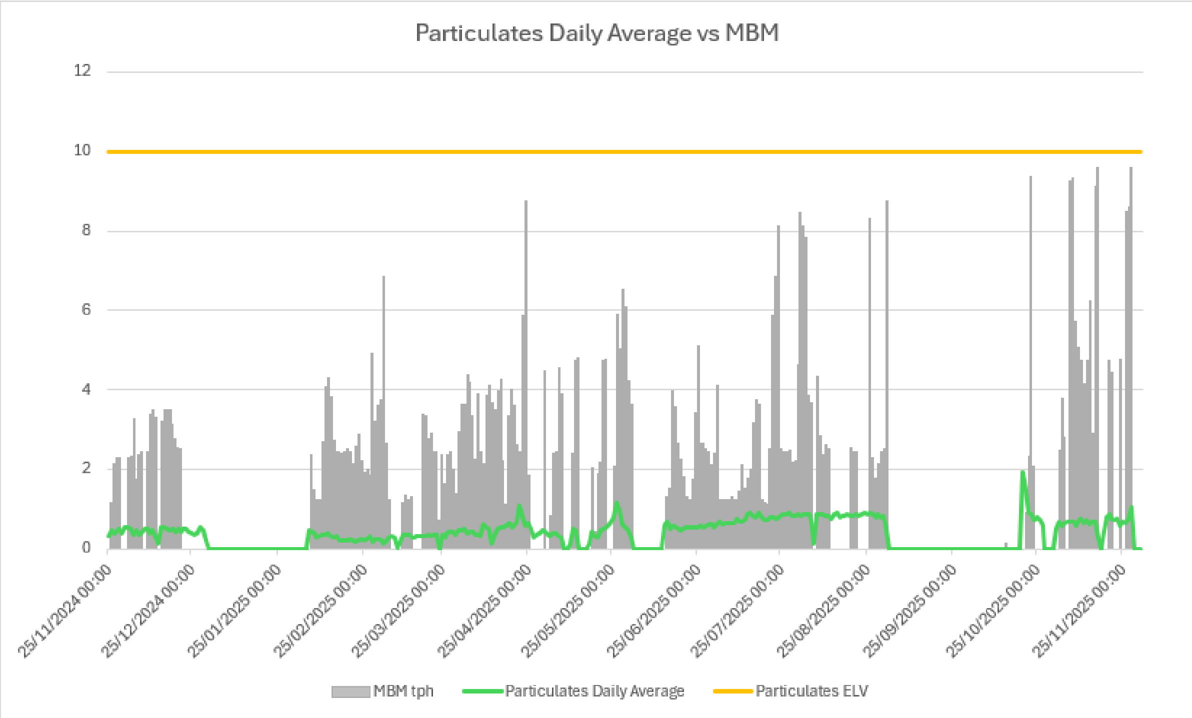


Figure 9: Particulate Daily Average during the Test Burn Programme period.

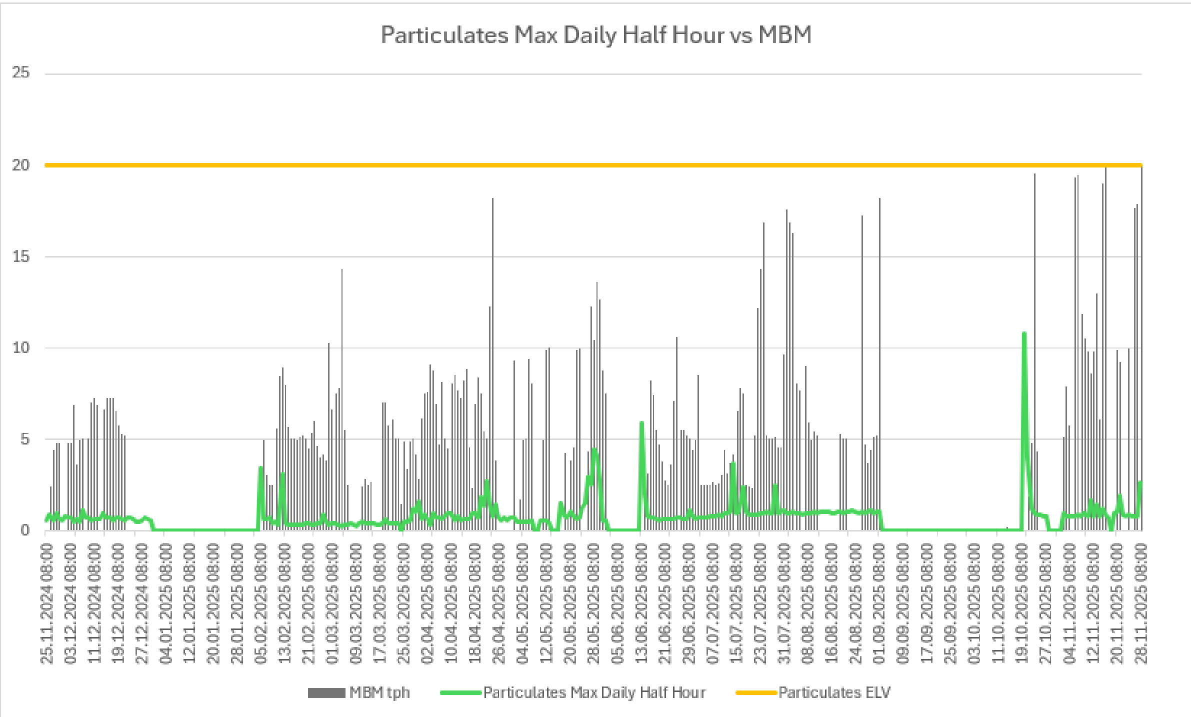


Figure 10: Particulate Daily Max Half hour during the Test Burn Programme period

<u>Assessment of SO_2 abatement compliance with dust ELV during co-firing of MBM</u>

In 2021 Limerick Works commissioned a lime injection system for the abatement of SO_2 following a significant reduction in the SO_2 ELV in the P0029-06 licence in May 2021. A high-quality lime powder is injected into the kiln gas stream before the gas enters the cooling tower to reduce emissions of SO_2. Hydrated lime is used to neutralise the acidic gases and remove sulphur dioxide from flue gases. The lime system is used dependent on the SO_2 emission which is determined by the raw materials. Co-firing MBM has no influence on the SO_2 emission. All SO_2 emissions during the test programme have been compliant for the daily and max half hourly averages during the co firing period from November 2024 to November 2025.

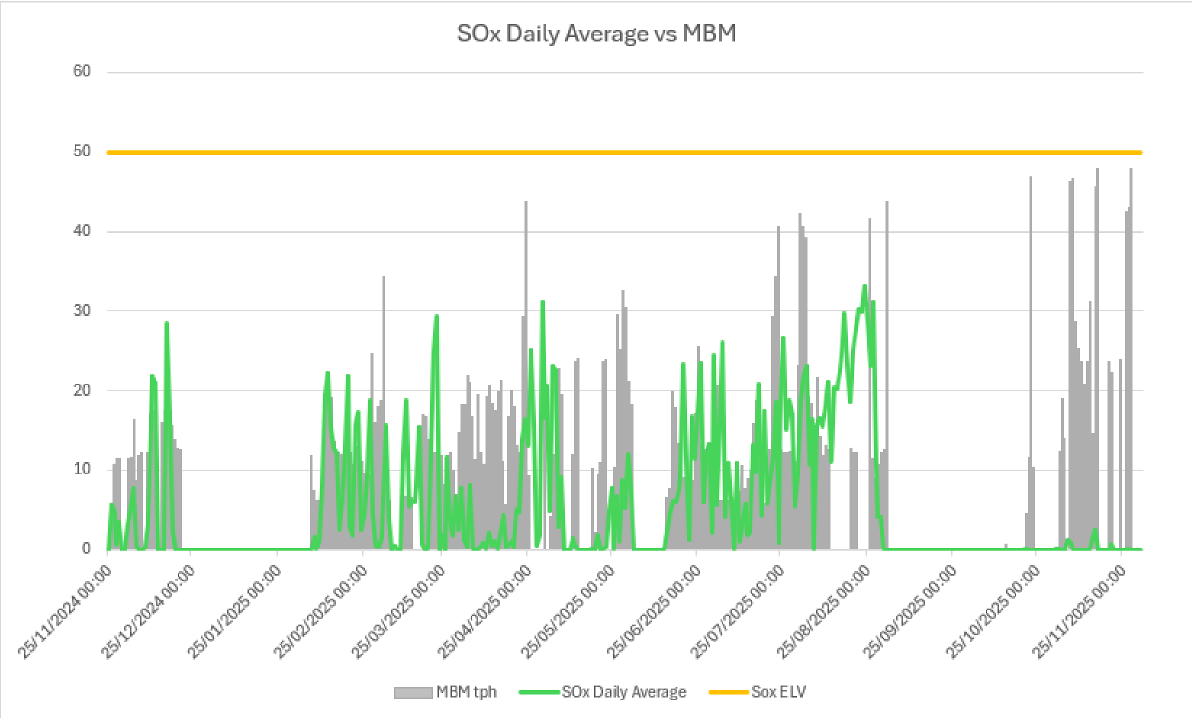


Figure 11: SOx Daily Average during the Test Burn Programme period.

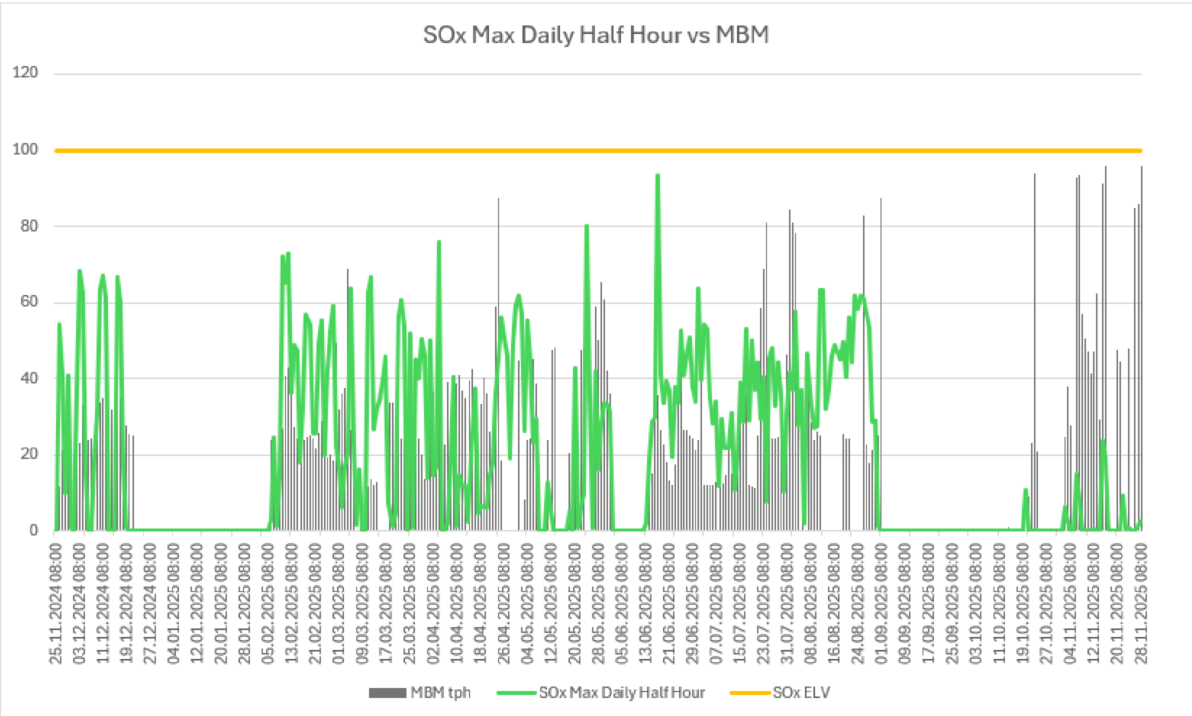


Figure 12: SOx Daily Max Half hour during the Test Burn Programme period

The other parameters which are subject to ELV's include:

- Ammonia Slip (NH_3)
- Hydrogen Chloride (HCl)
- Hydrogen Fluoride (HF)
- Total Organic Carbon (TOC)
- Carbon Monoxide (CO)

The following graphs demonstrate the daily average and max half hourly data during the co-firing period from the November 2024 to the November 2025, as well as the ELV's for the individual parameters.

Ammonia (NH_3):

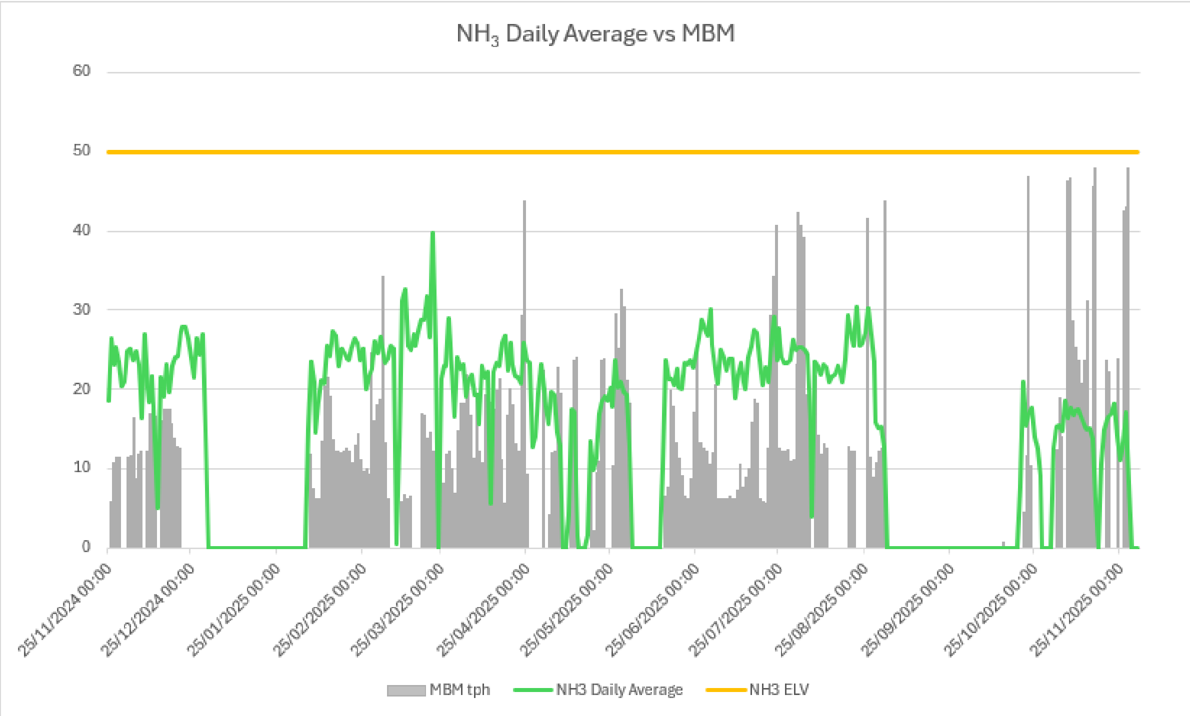


Figure 13: NH_3 Daily Average during the Test Burn Programme period.

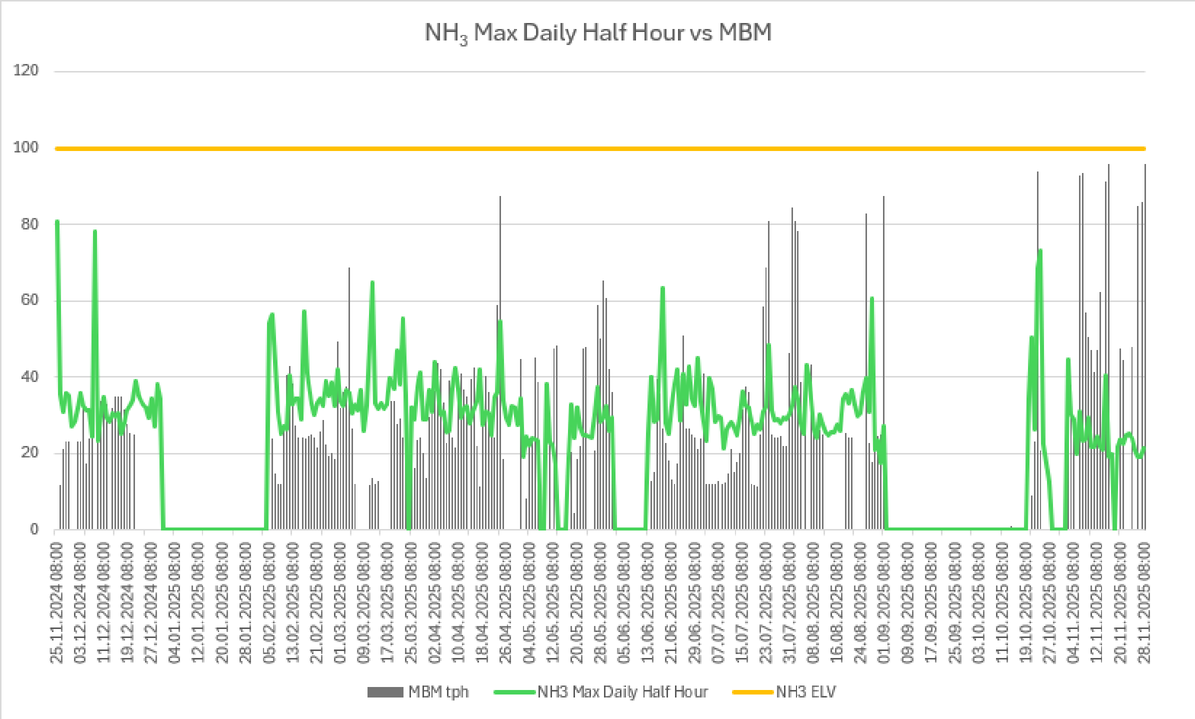


Figure 14: NH_3 Daily Max Half hour during the Test Burn Programme period.

Hydrogen Chloride (HCl):

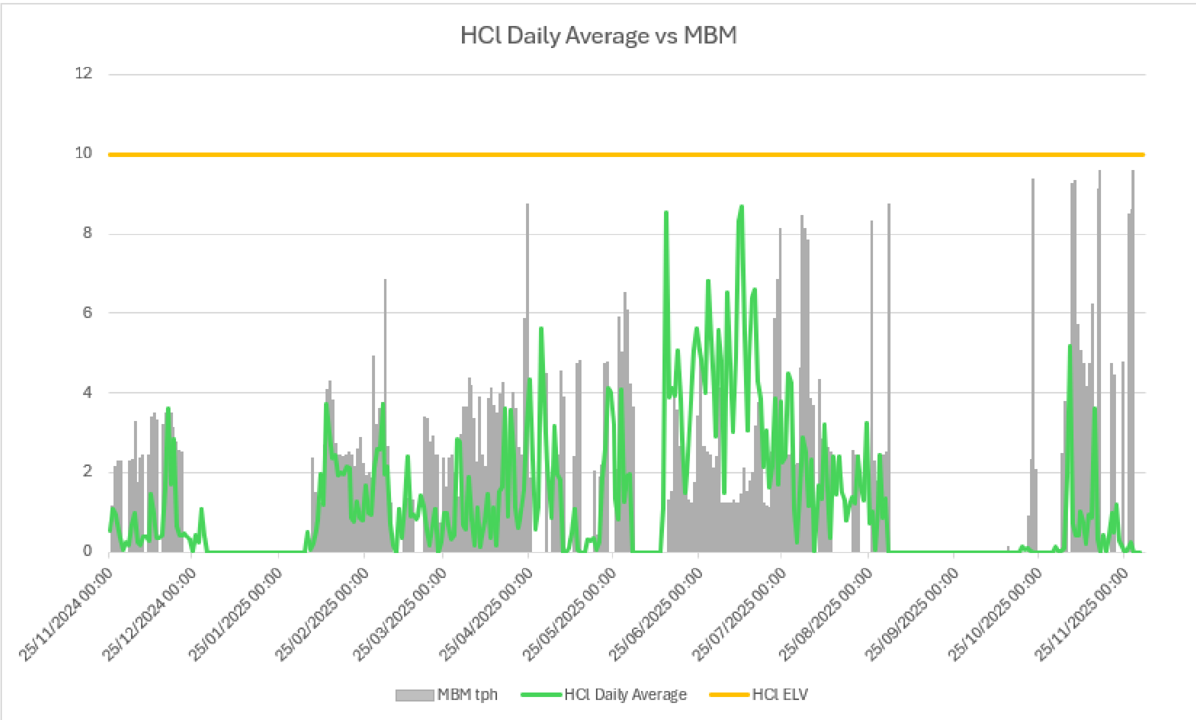


Figure 15: HCl Daily Average during the Test Burn Programme period.

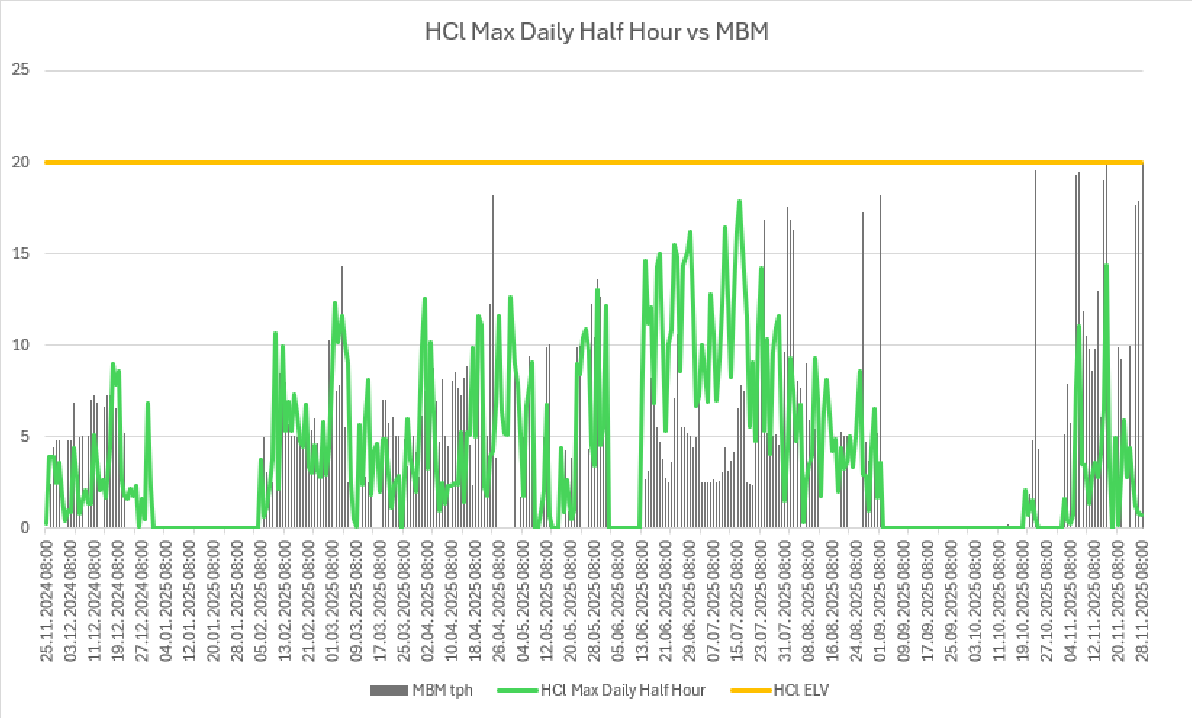


Figure 16: HCl Daily Max Half hour during the Test Burn Programme period.

Hydrogen Fluoride (HF):

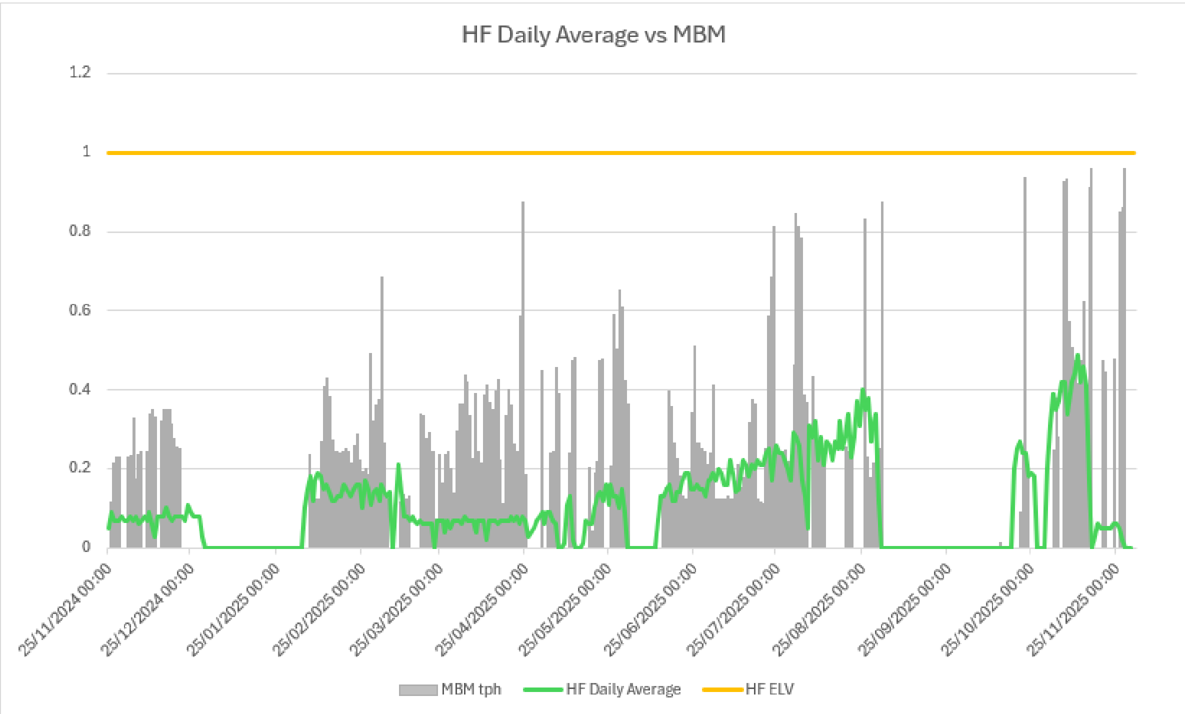


Figure 17: HF Daily Average during the Test Burn Programme period.

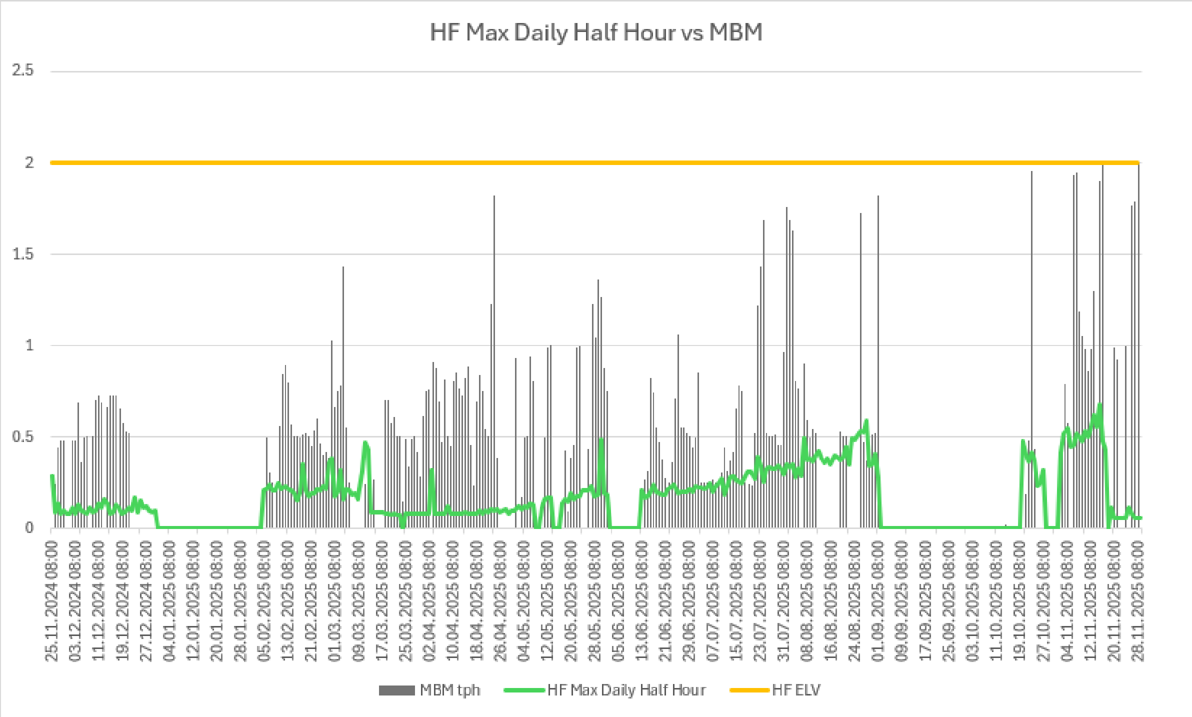


Figure 18: HF Daily Max Half hour during the Test Burn Programme period.

Total Organic Carbon (TOC):

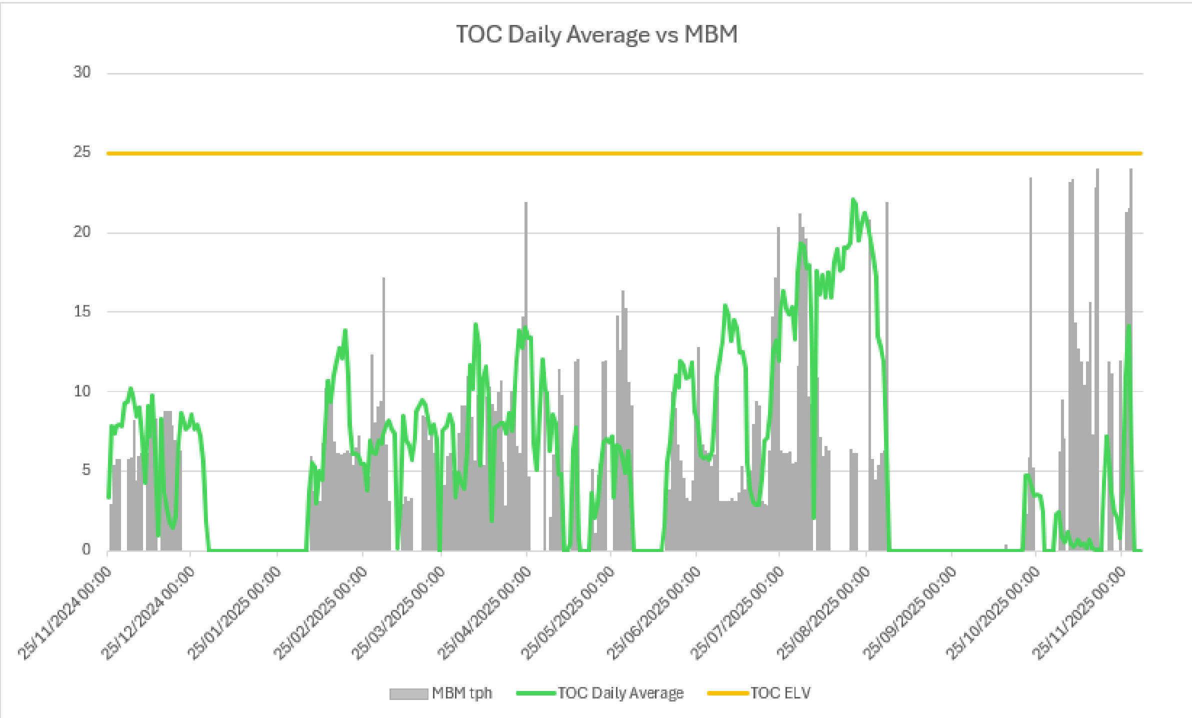


Figure 19: TOC Daily Average during the Test Burn Programme period.

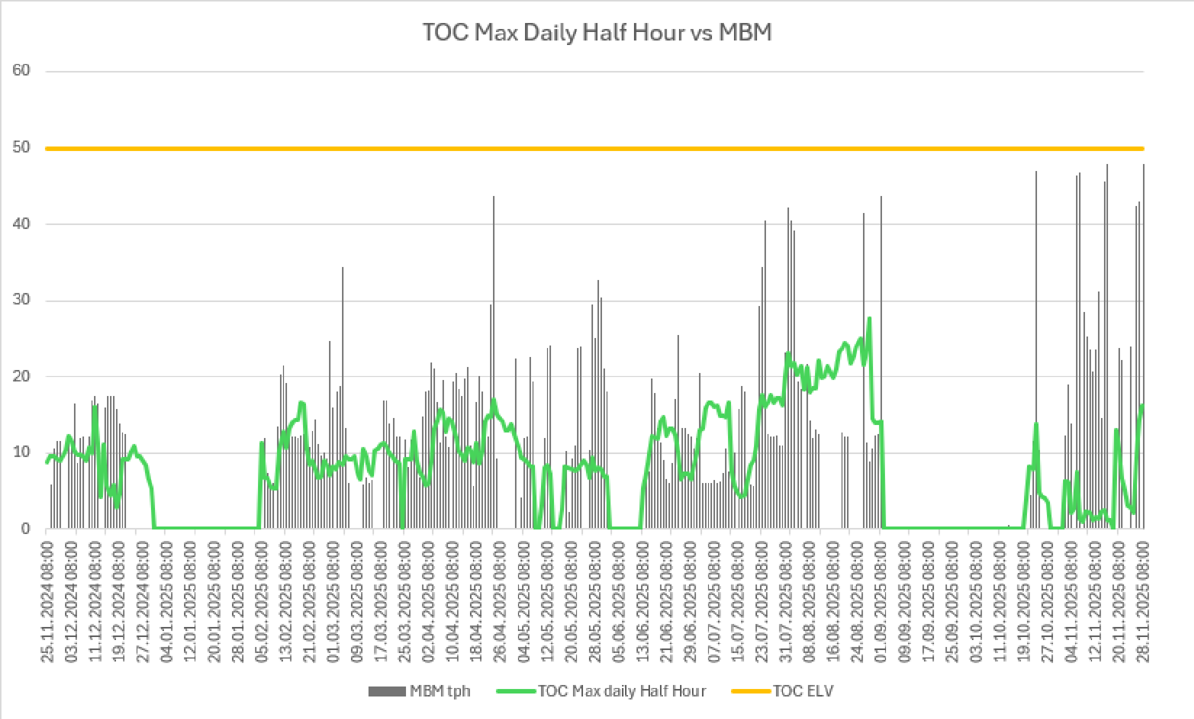


Figure 20: TOC Daily Max Half hour during the Test Burn Programme period.

Carbon Monoxide (CO):

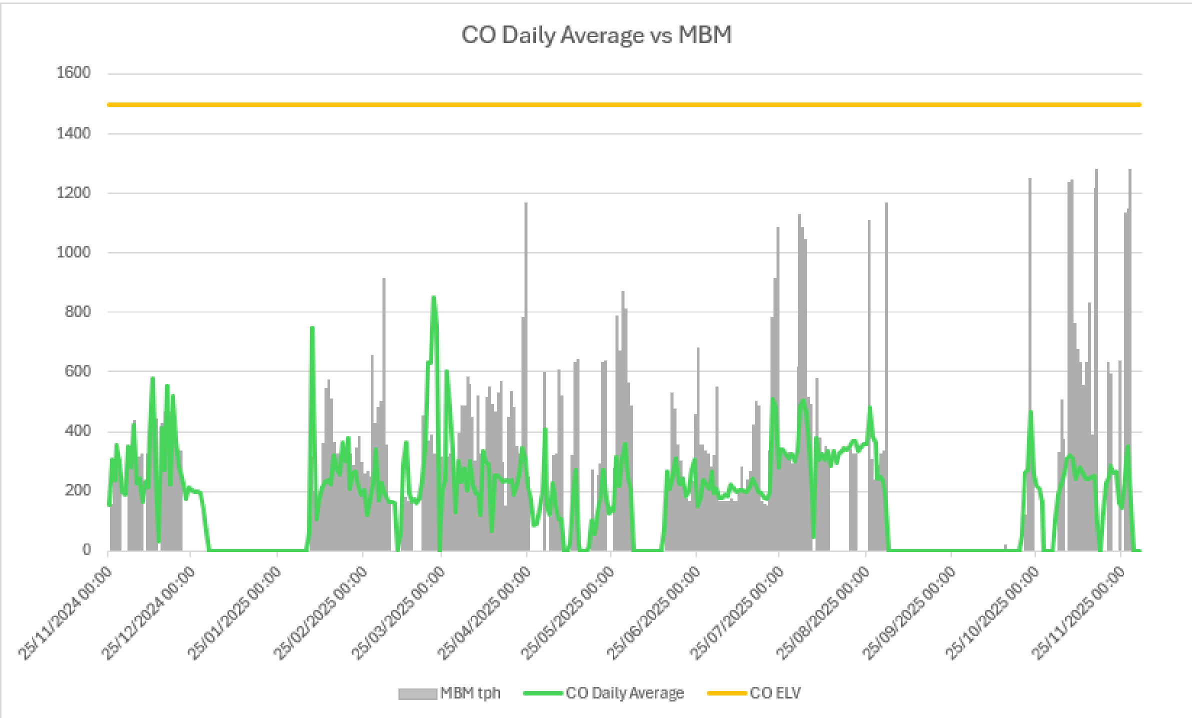


Figure 21: CO Daily Average during the Test Burn Programme period.

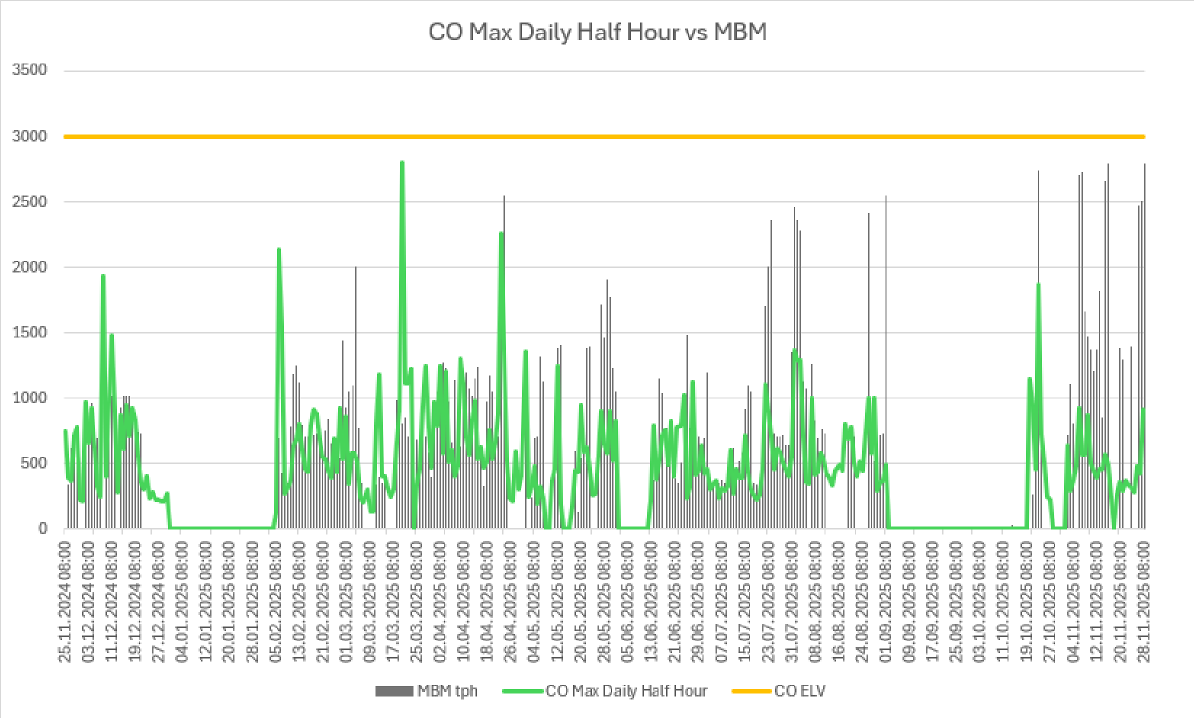


Figure 22: CO Daily Max Half hour during the Test Burn Programme period.

Aside from the one instance of NOx exceeding the ELV, as reported, all continuously monitored parameters were compliant during the test programme and were not affected by the use of MBM. The trends show that the use of MBM did not change these emissions.

Non-Continuously Monitored Parameters

IE Licence P0029-06 requires the discrete monitoring of several parameters over defined sampling periods. As per the test programme these parameters were required to be tested in triplicate on separate days at various MBM addition rates. The full reports for the testing external testing are included in Appendix I.

The following emissions parameters were monitored during MBM co-firing:

- Dioxins & Furans
- Mercury
- Cadmium & Thallium
- Heavy metals

The following tables detail the results of the testing data available:

Dioxins and Furans				
Run	**Date**	**MBM Addition**	**P0029-06 ELV**	**External Testing Result**
		t/h	***ng/m3***	***ng/m3***
Run 1	22/05/2025	2	0.1	<0.02
Run 2	23/05/2025	2	0.1	<0.0021
Run 3	28/05/2025	2	0.1	<0.0012
Run 4	23/07/2025	4	0.1	<0.01

Run 5	26/08/2025	4	0.1	<0.01
Run 6	07/11/2025	4	0.1	<0.001

Table 3: Discrete Monitoring for Dioxins and Furans at 2 tph & 4 tph MBM Addition Rates

Mercury				
Run	**Date**	**MBM Addition**	**P0029-06 ELV**	**External Testing Result**
		t/h	***mg/m3***	***mg/m3***
Run 1	23/05/2025	2	0.05	<0.008
Run 2	28/05/2025	2	0.05	<0.001
Run 3	26/08/2025	2	0.05	<0.002
Run 4	29/05/2025	4	0.05	<0.003
Run 5	23/07/2025	4	0.05	<0.01
Run 6	24/07/2025	4	0.05	<0.006

Table 4: Discrete Monitoring for Mercury at 2 tph & 4 tph MBM Addition Rates

Cadmium and Thallium				
Run	**Date**	**MBM Addition**	**P0029-06 ELV**	**External Testing Result**
		t/h	***mg/m3***	***mg/m3***
Run 1	23/05/2025	2	0.05	<0.003
Run 2	26/08/2025	2	0.05	<0.006
Run 3	27/11/2025	2	0.05	<0.002
Run 4	22/05/2025	4	0.05	<0.008
Run 5	27/05/2025	4	0.05	<0.013
Run 6	29/05/2025	4	0.05	<0.003

Table 5: Discrete Monitoring for Cadmium and Thallium at 2 tph & 4 tph MBM Addition Rates

Heavy Metals				
Run	**Date**	**MBM Addition**	**P0029-06 ELV**	**External Testing Result**
		t/h	***mg/m3***	***mg/m3***
Run 1	23/05/2025	2	0.5	<0.137
Run 2	26/08/2025	2	0.5	<0.076
Run 3	27/11/2025	2	0.5	<0.044
Run 4	29/05/2025	4	0.5	<0.031
Run 5	27/05/2025	4	0.5	<0.252
Run 6	23/07/2025	4	0.5	<0.012

Table 6: Discrete Monitoring for Heavy Metals at 2 tph & 4 tph MBM Addition Rates

All results were compliant with the licence and have shown no correlation to the use of MBM.

Limerick Works dedicate significant time and resources to ensure the continued management of the abatement systems. The operation and performance of these systems are monitored on an ongoing basis. In addition, emission values are assessed on a daily basis using data from the data acquisition and handling system (DAHS) at Limerick Works. This practice will continue as it has before and during the test programme as per the relevant schedule under IEL P0029-06.

Condition 6.3.4.3: Performance of Abatement Systems

The test programme shall as a minimum:

Assess the performance of any monitors on the abatement system and establish a maintenance and calibration programme for each monitor.

As required under the Industrial Emissions Directive (IED), Limerick Works complies with the requirements of the International Standard EN 14181:2004 "Stationary Source Emissions – Quality Assurance of Automated Measuring Systems". There are 3 Quality Assurance Levels (QAL) associated with this Standard. In accordance with the agreed Test Programme QAL 1, 2 and 3 have all been completed as appropriate and where technically feasible during the Test Programme period.

All CEM's equipment are MCert equipment and therefore qualify for QAL 1. Two ABB ACF5000 analysers are in place for continuous monitoring (one as a standby), two PCME dust monitors are in place for monitoring dust and a DURAG flowmeter is in place for motoring the Volumetric Flow. All analysers underwent QAL 2 testing during the test programme while using MBM. QAL 2 reports have been submitted to the EPA via EDEN for approval. Limerick Works performed QAL3 tests for both ACF5000 analysers during the test programme for MBM in accordance with the "Air Guidance Note on the Implementation of I.S. EN 14181 (AG3)" issued by the EPA and to meet the requirements of Condition 4.1.3 of IE Licence P0029-06.

All QAL's and AST's, as appropriate, for the necessary monitors will continue going forward as per EN14181.

Condition 6.3.4.4: Control of MBM Input

"Establish criteria for the control of all waste input"

Kiln control systems are designed to monitor and control a range of variables to produce stable operating conditions. These controls allow for the increase or decrease of fuel or raw meal inputs as required. Under normal operating conditions alternative fuels are the final input to be added once stable kiln operation has been established. For all shutdowns the alternative fuels will be the first input to be stopped. The high thermal inertia or heat load of the kiln system means that even after the kiln is 'shutdown' the system maintains temperature for an extended period of time and all fuel will be fully combusted.

The fuel injection to the kiln is controlled to maintain a stable temperature and constant specific heat consumption. The alternative fuel injection is interlocked with the temperature probe in the fuel burning zone to maintain a minimum temperature of 855°C. A fuel control loop is in place in the control system which operates to a fuel energy target and regulates the balance of fossil fuel and MBM injection to the kiln to ensure constant specific heat consumption. A detailed description of the control interlock is provided in Appendix 3. Fossil fuel (coal or pet coke) will remain the primary control fuel for the kiln to maintain this temperature (855°C). A minimum input of fossil fuel will be maintained at all times. MBM was incrementally increased throughout the test programme as per an agreed timeline with the Agency. A maximum setpoint for MBM injection was interlocked at each stage so as to limit the MBM maximum tonnes/hour which can be fired into the kiln. The maximum set point allowed for a controlled ramp up of MBM t/h each month. Control of the temperature is ensured by control of the

gas analysis at the Preheater Exit Analyser (644XQ02) and Secondary Analyser (644XQ06). The kiln camera and Burning Zone Temperature (pyrometer) provides further temperature information.
The maximum calorific value of the fuel input, including MBM, is established by controlling the energy input to the kiln and ensuring a minimum temperature for the combustion of MBM. These temperatures are used in control system interlocks to limit the maximum flow of MBM. A copy of the control logic and evidence of the limits on MBM is provided in Appendix III.

Condition 6.3.4.5: Measurement Devices

> *"Confirm that all measurement equipment or devices (including thermocouples) used for the purpose of establishing compliance with this licence have been subjected, in situ, to normal operating temperatures to prove their operation under such conditions."*

All measurement equipment devices installed, including thermocouples, are specified with accuracy in accordance with the International Standard for a Type K Thermocouple. Independent temperature and pressure measurements, where possible, were taken to verify that measurement devices are reading correctly.

In addition, the following requirements under the IE licence P0029-06 have been addressed as part of this test programme below.

5. CO-INCINERATION – OPERATIONAL CONTROLS

The following sub-sections address how full compliance with the relevant parts of Clause 3.19 of IE licence P0029-06 will be demonstrated during the proposed test programme period.

5.1 Standard Operating Procedures

Condition 3.19.1:

> *The licensee shall maintain standard operating procedures for the operation of the co-incineration plant.*

Standard Operating Procedures for kiln operation, including operating with the co-firing of MBM, form part of Limerick's controlled documented procedures. These procedures have been reviewed and revised as necessary during the commissioning and ramp up of MBM. Full copies of these procedures are available to the Agency upon request.

5.2 Co-incineration

Condition 3.19.2:
The installation, when co-incinerating waste, shall be operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of 850°C, as measured near the inner wall or at another representative point of the combustion chamber as may be authorised by the Agency, for two seconds.

Condition 3.19.3:
Waste shall be charged into the plant only when these operating conditions are being complied with and when the emission limit values which are subject to continuous monitoring are not being exceeded.

The MBM fuel injection is interlocked with the temperature in the fuel burning zone to ensure stable specific heat consumption in the kiln. The minimum residence time and temperature required to burn alternative fuels is 2 seconds and 850°C respectively. Injection of MBM will only be possible if the temperature is in excess of 855°C. This is controlled automatically by a fuel control loop.

MBM is not used as a start-up fuel and use in the kiln is not possible until the kiln is no longer in start up or shut down mode and interlocks are in place to ensure this. MBM cannot be fired until the kiln temperatures have reached the interlocked temperature limit of 855°C for the co-firing of MBM.

Furthermore, injection of MBM is not possible unless the emission limit values, which are subject to continuous monitoring, are not being exceeded. Interlocks are in place within the control system to stop the kiln before any emission limit value is exceeded. The MBM will be stopped automatically when the kiln stops.

5.3 Provision for Auxiliary firing

Condition 3.19.4:
The burner and kiln shall be equipped with at least one auxiliary burner. The auxiliary burner shall be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850°C. The auxiliary burners shall also be used during plant start-up and shut-down operations in order to ensure the temperature of >850°C is maintained at all times during the co-incineration of waste and as long as there is unburned waste in the combustion chamber.

Introduction and continued firing of alternative fuels into the kiln process is interlocked with stable process conditions and as such can only occur when the following conditions exist:

- Pet coke (or Coal) is being fed to the Kiln
- Raw meal is being fed to the Kiln system
- A minimum temperature of 855°C

During the start-up sequence MBM is not be permitted until the same conditions specified above, as a minimum, have been achieved. MBM is not used as a start-up fuel and interlocks are in place to ensure this.
In effect, the kiln system is only started up and stable operation established using Diesel Oil, Pet coke or Coal as the fuel input. Only when the kiln is normal production mode (i.e. out of start-up and/or shut down mode and temperature >855°C) is MBM introduced. As the volume of alternative fuels increases, the volume of fossil fuels can be gradually reduced, maintaining stable plant operation at all times. The fuel input in the Kiln is a function of both clinker quality and achieving the correct quality targets for product optimisation. This is achieved by means of a fuel control loop. The fuel control loop is described in detail under clause 3.19.6.2.

MBM injection stops automatically should the kiln become unstable, the temperature in the fuel burning zone is below 855°C or the kiln stops. This is controlled by means of a control system interlock. Should the kiln stop, whether it be planned or unplanned, MBM is automatically shut off immediately.

5.4 Start-Up and Shut-Down Scenarios

Condition 3.19.5:

During start up or shut down or when the temperature of the combustion gas falls below 850°C, the auxiliary burner shall be fed with coal, oil or gas.

Condition 3.19.6:

The licensee shall maintain and operate an automatic system to prevent waste feed:

3.19.6.1 at start-up, until a temperature of ≥850°C has been reached;

3.19.6.2 whenever the temperature falls below 850°C;

3.19.6.3 whenever the continuous measurements show that any emission limit value is exceeded;

3.19.6.4 whenever stoppages, disturbances or failure of the purification devices or the measurement devices may result in the exceedance of the emission limit values; or

3.19.6.5 in the case of a breakdown or incident.

As described above, the introduction and continued firing of MBM is interlocked with stable process conditions and a minimum temperature of 855°C maintained. For all shutdowns or other kiln stops, the alternative fuels are the first input to be stopped. The high thermal inertia or heat load of the kiln system means that even after the kiln is 'shutdown' the system maintains temperature for an extended period of time and all fuel will be fully combusted. Additionally in the event of a kiln stop, MBM injection will automatically stop. This will be controlled by means of a control system interlock.

ICL Limerick has a fuel control loop in place for controlling the addition of MBM. The fuel control loop operates by inputting a specific energy value which is necessary for the formation of Clinker by ensuring sufficient temperature. In order to meet the specific energy value, the correct proportion of fuel is added to the kiln and can be in the form of pet coke solely or pet coke with MBM and/or SRF. When two or more fuels are being used there is balance between the energy from each fuel to meet the specific energy value. If MBM is not being used in the kiln for any reason, this reduction in energy is immediately replaced by the required amount of pet coke / other AF to ensure a stable input of energy into the kiln and maintaining the burning zone temperature. An interlock is in place to ensure a minimum temperature is in place for the combustion of the alternative fuels and if this temperature reduces below this limit for any reason, the alternative fuels are immediately stopped and cannot be restarted until the threshold of temperature has been met.

Furthermore, injection of MBM is not possible unless the emission limit values are not being exceeded. A control system interlock has been implemented to ensure these conditions are met. ICL has put in place safety measures and interlocking systems which will result in the Kiln being automatically shut down prior to the exceeding the ELV.

Emission limit values are monitored on a daily and half hourly basis. In the event of the parameter that is continuously monitored approaching the ELV, the MBM firing is stopped. Prior to a breach of the ELV, the kiln is stopped at a point below the relevant ELV so as not to breach the ELV. This takes place automatically. As per licence P0029-06, schedule C.1.1 lists the parameters that have 24-hour limits (NO_x, SO_x, Dust, TOC, CO, NH_3, HCl, HF). There are also ½ hour average limits for these parameters. In addition, an automatic interlock for half hour average limits is present such that the kiln is stopped at a point below the relevant ELV so as not to breach the ELV. This is also true for MBM firing. From a programming point of view technically MBM can be re-started when either the half hourly or daily average drops below the automatic stop points. However, in practice MBM would not be re-started until the emission trend is understood by the production team.

Condition 3.19.7:

There shall be no bypass of any electrostatic precipitator and/or bag filter

All gas flow leaving the preheater tower is taken through the cooling tower and a bag filter by a fan before it can leave the kiln system through the kiln stack, which is monitored continuously by an ABB ACF5000, particulates monitor, gas flowrate monitor and also for temperature and pressure. There are no facilities in place to allow for the bag filter to be bypassed and the kiln cannot operate unless it complies with the licenced ELV for particulates and all other licensed parameters at the kiln stack.

6. ADDITIONAL REQUIREMENTS RELATING TO MBM

The following sub-sections address how full compliance with other relevant Clauses of IE licence P0029-06 have been demonstrated during the test programme period.

6.1 Spillage and Containment

Condition 3.11:

Prior to the acceptance of waste at the installation, the licensee shall provide dedicated unloading and, where appropriate, storage areas

All alternative fuels used on site are sourced from pre-approved suppliers. Waterford Proteins have been the sole MBM supplier to date and are very experienced in the production and handling of MBM.

All safety, environmental and unloading procedures have been agreed and discussed with the supplier prior to coming to site. The MBM facility is a defined area where access is only possible with unique swipe cards, therefore only trained and pre-approved drivers can access the area. A dedicated unloading area is in place adjacent to the storage silos for the MBM. A unique swipe card is required to be able to unload at the unloading bay and several safety and access steps need to be completed in order to offload. Each area is clearly marked and has been communicated with the MBM suppliers.

6.2 Continuous Operational Parameter Monitoring

Condition 6.4:

The licensee shall ensure that the following operating parameters are continuously monitored and recorded when co-incinerating waste:
(i) the temperature near the inner wall of the combustion chamber (or other representative location agreed by the Agency);
(ii) the exhaust gas oxygen concentration;
(iii) the exhaust gas temperature;
(iv) the exhaust gas pressure; and
(v) if the gases are not dried prior to analysis, the exhaust gas water vapour content.

Continuous monitoring of the temperature and the oxygen content, as well as temperature, pressure and humidity of the exhaust gas in the kiln 6 stack have been applied. These values are automatically transferred to the Siemens Process Control System (PCS7). Thereafter the data is transferred and recorded on the data acquisition and handling system (DAHS).

6.3 Dust and Odour

Condition 6.18.5:

The licensee shall within one month of acceptance of each individual or combination of waste as the installation, undertake an odour assessment in accordance with the EPA guidance. An odour impact assessment shall thereafter be undertaken at a frequency to be approved by the agency and in any case no less than annually. The assessment shall be undertaken by the appropriate qualified professional and shall identify and quantify all significant odour sources at the installation, in particular the waste storage buildings and hardstanding areas, and shall include an assessment of the suitability and adequacy of the odour control system. Recommendations for improvement arising from the odour impact assessment shall be implemented.

An odour impact assessment was carried out by an approved contractor as per EPA Guidance and is in place at the site.
Odour assessments have also been carried out during the test programme. These assessments were carried out by an approved contractor. The assessments were carried out along the boundary of the site and there were no odour issues found.

6.4 Materials Handling

Condition 8.9:
No waste imported from outside Ireland shall be accepted for co-incineration at the installation

Only alternative fuels sourced from the Republic of Ireland will be used in Irish Cement Limerick.

Condition 8.11:
No waste that contains more than 1% halogenated organic compounds, expressed as chlorine, shall be accepted for co-incineration, or otherwise introduced to the kiln

All alternative fuels accepted into site have been from a pre-approved supplier where specifications for the fuel’s chlorine, moisture and NCV, as a minimum, have been agreed. The supplier has been approved by the Agency and any future suppliers will be sent to the Agency for approval prior to use. When agreeing specification with suppliers, ICL will take note of this condition.

Regular testing is carried out on the fuel to ensure that all agreed specifications are complied with.

6.5 Acceptance of Waste

Condition 8.12:
No waste other than the List of Waste codes listed in Schedule A: Limitations of this licence shall be accepted at the installation

This test programme report is for the use of MBM only. No other alternative fuels other than those listed in licence P0029-06 in Schedule A and until the test programmes have been agreed with the agency will be accepted to site.

Condition 8.13:
The acceptance of waste at the installation for co-incineration shall be for the purposes of:
- *Waste fuels with significant calorific value;*
- *Waste materials without significant calorific values but with mineral components used as raw materials that contribute to the intermediate product clinker; and*
- *Waste materials that have both a significant calorific value and mineral components*

All alternative fuels accepted into site are from a pre-approved supplier where specifications for the fuel’s chlorine, moisture and NCV, at a minimum, have been agreed.
Regular testing will be carried out on the fuel to ensure that all agreed specifications are complied with.

Condition 8.14.1:

Waste accepted at the installation shall be subject to a technical specification agreed between the licensee and the supplier. The technical specification shall set out criteria to be met in order that combustion or use of the material will not lead to failure to comply with the conditions of this licence. The technical specification shall have regard to any published or, as appropriate, Irish or international standard relevant to the supply of that material and any departure from such a standard shall be approved by the Agency. The technical specification shall conform to relevant best available techniques in Commission Implementation Decision 2013/163/EU for the production of cement, lime and magnesium oxide.

All alternative fuels accepted into site are from a pre-approved supplier where technical specifications for the fuels have been agreed. This will include at a minimum chlorine, moisture and NCV. MBM is only accepted to site once it complies with specifications as predetermined by ICL with Waterford Proteins.

Regular testing is carried out on the fuel to ensure that all agreed specifications are complied with. Continuous quality checks are also carried out during the cement manufacturing process as well as on the final cement product to ensure that all standards are continued to be complied with when using alternative fuels.

Condition 8.14.2:

The quantity of waste to accepted at the installation on a daily basis shall not exceed the storage capacity available.

Only waste which can be stored in the purpose-built MBM storage silos are accepted to site. No other location on site is permitted to store the material.

Condition 8.14.3:

The licensee shall maintain a record of the quantity of each waste type co-incinerated at the installation, introduced into the kiln or otherwise used in the manufacture of cement.

All material accepted to site is weighed over calibrated and certified weigh bridges and recorded on the material data base.
Any material used in the kiln is recorded on a weighted basis and is stored on the data acquisition and handling system (DAHS).

Condition 8.14.4:

Waste shall only be accepted at the installation from known suppliers or new suppliers subject to initial waste profiling, analysis, characterisation off site and demonstration of compliance with the technical specification

Commercial contracts for the supply of these fuels to defined specifications will continue to be adjudicated through the Irish Cement ISO 9001 quality control system in a similar manner to the supply of other raw materials or fossil fuels. The contracts require that all suppliers' material must conform to the agreed specifications and are produced in compliance with the relevant environmental requirements. Sampling and testing are performed by both the supplier and Irish Cement (or an approved contractor on behalf of Irish Cement).

Details of each fuel is entered into the site material database and full safety reviews and risk assessments have been performed in accordance with standard materials handling procedures.
Independent analysis of the MBM in an ISO 17025 laboratory was carried out prior to accepting the material to site to ensure that it met the technical specification for MBM. In addition, the MBM was tested for trace elements and heavy metals to ensure that the conditions of the IE licence can be complied with when using of the material. This testing will continue going forward.

MBM will only be accepted to site from suppliers which have been approved by the Agency.

Condition 8.14.5:

Alternative fuel shall only be accepted if delivered in appropriate sealed, leakproof, covered containers

All deliveries are scheduled in advance and are only permitted on site in sealed, covered containers.

Condition 8.14.6:

Prior to commencement of the acceptance of each waste at the installation, the licensee shall establish and maintain detailed written procedures for the acceptance and handling of each. These procedures shall at least include the following:

a) inspection and sampling at the point of entry to the installation;
b) criteria to be met prior to acceptance;
c) rejection criteria and procedures;
d) material characterisation and profiling s from known customers or new customers prior to acceptance at the installation;
e) frequency of technical testing and analysis and methods to be employed by the licensee to demonstrate compliance with the technical specification;
f) recording of each load of material on arrival at the installation in accordance with Condition 1 1.10 of this licence;
g) handling procedures including unloading, transfer and cleaning of all plant.

The requirements necessary for acceptance of the fuel deliveries are as follows:

- Confirmation of conformity to the fuel specification is provided by the supplier for all fuel supplied. This is a requirement of the supply contract in place between Irish Cement and the selected supplier. This confirmation will declare that the material delivered meets the supply specification as contracted.
- Each delivery must be made by an approved driver. All drivers have been provided with appropriate safety training which will be refreshed on a regular basis. Each qualifying driver has been issued with a unique identification card. This identification card must be presented before the delivery can gain entry to the site. Deliveries of other externally sourced raw materials are controlled in ICL Limerick using this system at present.
- On arrival at the Irish Cement entrance, all deliveries are verified by the automated delivery acceptance system.
- Characterisation of the fuel was carried out prior to MBM arriving to site and will continue during the full extent of the contract with the supplier. The process involved site visits to the MBM supplier processing plant and a defined sampling procedure. During the test programme, sampling frequency and procedures were put in place. Sampling is carried out per each individual load. These samples are then composited into a fortnightly sample and sent to an accredited ISO 17025 laboratory for the necessary testing. Attempts to deliver incompatible material will result in more frequent and onerous sampling and testing.
- Sampling/visual inspection will be carried out as per the sampling procedures. Testing of the samples can be carried out both in the internal Irish Cement laboratories and also at off-site accredited laboratories.

Subject to all of the foregoing steps being in order, unloading of the material will be commence and the offloading will be visually monitored using CCTV.
Detailed Material acceptance procedures are now in place for MBM in Limerick Works and a copy of this procedure is included in Appendix III.

Condition 8.14.7:

Waste arriving at the installation shall have its documentation checked at the point of entry to the installation and, subject to this verification, weighed, recorded and directed to the appropriate storage area or quarantine area as appropriate.

Each delivery is made by an approved driver. All drivers have been provided with appropriate safety training which will be refreshed in line with site safety policy. Each qualifying driver has been issued with a unique identification card. This identification card must be presented before the delivery will be permitted entry to the site. Deliveries of other externally sourced raw materials are controlled in ICL Limerick using this system at present. Unloading procedures have been provided to drivers as to the appropriate unloading location on site and how to carry out the unloading of the MBM.

All deliveries are scheduled in advance. Detailed delivery plans will be established with all suppliers in advance of arrival onsite. Vehicle and driver details along with supplier information is stored on the automated delivery acceptance system and unique swipe cards for each driver will be pre-loaded with this information. All hauliers delivering alternative fuels to site have been given full training in accordance with the CRH Code of Practice for Hauliers, as occurs for hauliers of other materials currently.

Condition 8.14.8:

Any waste deemed unsuitable for processing at the installation or in contravention of this licence or the technical specification shall be immediately separated and returned to the location supply within 48 hours or a longer time period as may be agreed by the Agency due to weekend and bank/public holiday closures. Secure storage of such waste shall be provided in a dedicated waste quarantine area. Waste stored in the quarantine area shall be stored under appropriate conditions to avoid loss to the environment, putrefaction, odour generation, the attraction of vermin and other nuisances or objectionable condition. If the original supplier of rejected waste cannot take the material back, an appropriate alternative destination for the rejected waste shall be approved by the agency.

Non-conforming loads will be rejected where they fail to satisfy the fuel acceptance procedures. There have been no non-conforming MBM loads during the test programme. If this was to occur in the future, any such rejected loads will be stored in sealed containers in the designated area adjacent to the MBM silos until it can be returned directly to the supplier. Material will be quarantined for no longer than 48 hours on site. Following a non-conforming load, a more onerous sampling and testing requirements for MBM will be imposed on suppliers until demonstration of sustained compliance with the agreed fuel specifications is evident.

During this Test Programme, ICL experienced challenges with the reliability of delivery of the MBM from the silos to the main burner. In order to carry out inspections and modify aspects of the system design, it was necessary to empty the silos in October during a routine plant shutdown. All MBM contained in the silos (c.150 t) was returned to the suppliers, Waterford Proteins.

The MBM silos were emptied into covered trailers, thereby mitigating against dust and odour. The emptying of the silos was carried out under ICL supervision and the MBM was delivered via sealed trucks to the suppliers. The same transport company was used to deliver the MBM back to the supplier. All the necessary paperwork is available on site for inspection. On start up in November, following resupply of MBM from Waterford proteins, there was an improvement in the delivery of MBM to the main burner, post design modification. This will be monitored throughout 2026.

Condition 8.14.9:

The rejection of waste and any failure to demonstrate compliance with the technical specification shall be recorded and reported in the AER.

At any stage in the process a delivery can be rejected and returned to the supplier. The supplier will be contacted immediately to determine the status of other planned deliveries. A notification of non-conformance stating the details of the delivery and the reason/s for rejection will be forwarded to the supplier. Copies of sample analysis results, if available, will be provided to the supplier.

Details of non-conforming loads will be recorded and reported to the Agency in the AER.

Condition 8.14.10:

Waste shall not be accepted from a supplier of rejected material until such time as the reasons for rejection have been investigated and corrective actions agreed in writing between the licensee and the supplier have been implemented to the licensee's satisfaction. All such correspondence shall be provided to the Agency upon request.

Following a rejected or returned load to a supplier, Limerick Works will not accept further deliveries of MBM from the supplier until a report detailing the cause of the non-conformance and the corrective actions taken by the supplier to ensure that it is not repeated has been received and is to the satisfaction of Limerick Works.

Condition 8.15 (a):

Waste shall only be introduced to the kiln when the appropriate operating conditions have been achieved. There conditions shall, as a minimum, meet those set out in Schedule C: Emissions, Monitoring and Control of this licence.

Condition 8.15 (b):

Waste shall only be introduced to the kiln when cement clinker is being manufactured.

Introduction and continued firing of alternative fuels into the kiln process is interlocked with stable process conditions and as such can only occur when the following conditions exist:

- Pet coke (or Coal) is being fed to the Kiln
- Raw meal is being fed to the Kiln system
- A minimum temperature of 855°C

During the start-up sequence, the use of MBM is not permitted until the same conditions specified above have been achieved and there are interlocks in place to ensure this.

In effect, the kiln system will only be started up and stable operation established using Diesel Oil, Pet coke or Coal as the fuel input. Only when stable operation has been established can MBM be introduced. As the volume of alternative fuels increases, the volume of fossil fuels can be gradually reduced, maintaining stable plant operation at all times. Should the kiln become unstable, the temperature in the fuel burning zone decrease below 855°C or the kiln stop, MBM injection stops automatically. This is controlled by the previously discussed control system interlock.

Condition 8.16:

No odour-forming wastes shall be accepted at the installation

An odour assessment was carried out on the MBM facility as well as odour assessments around the site boundary. Only non-odour forming materials will be accepted to the site.

7. CONCLUSIONS

The Test Programme period has successfully demonstrated that it is possible to continue to pursue maximisation of the MBM substitution rate at Limerick Works whilst complying with the conditions of IE licence P0029-06 and thus assuring environmental performance as well as maintaining compliance with all relevant product quality requirements. This final report demonstrates:

1. **Quality assurance of the CEMs equipment in use for compliance monitoring of continuously monitored parameters.**
2. **The co-firing of MBM does not result in any adverse impact on the Kiln or the associated Abatement equipment.**
3. **Robust standard operating procedures, standards, checks and balances for operational control of MBM usage and control of MBM input quality are in place.**

ICL proposes that the outcomes from the Test programme period have met the objective of assuring environmental performance whilst using MBM as an alternative fuel on Kiln 6 at progressively rising thermal substitution rates.

As such ICL believes that IE licence P0029-06 and test programme conditions as granted by the Agency contains all the necessary operational control and emission limitations necessary to assure acceptable environmental outcomes from the operation of Limerick Works whilst using MBM as an alternative fuel.

APPENDICES

8. APPENDIX I – EXCERPTS FROM AXIS ENVIRONMENTAL EMISSIONS TESTING REPORT

Air Emissions Monitoring Report

1.4 Summary of Results

Emission Point Number: A2-01 (22-05-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Carbon Monoxide (as CO)	EN 15058	mg.m^{-3}	171.9	3.3	1,500	10	Dry	N/a	22/05/2025	09:47	10:17	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	12.70	0.2	N/a	N/a	Dry	N/a	22/05/2025	09:47	10:17	Yes	N/a
Oxygen	EN 14789	vol%	13.44	0.3	N/a	N/a	Dry	N/a	22/05/2025	09:47	10:17	Yes	N/a
Ammonia	ISO 21877	mg.m^{-3}	<9.93	0.80	50	10	Dry	<0.28	22/05/2025	09:30	10:00	Yes	Yes
Sulphur Dioxide	EN 14791	mg.m^{-3}	11.13	0.90	50	10	Dry	0.80	22/05/2025	16:00	16:30	Yes	Yes
Hydrogen Chloride	EN 1911	mg.m^{-3}	<1.29	0.09	10	10	Dry	<0.03	22/05/2025	11:50	12:55	Yes	Yes
Hydrogen Fluoride	CEN/TS 17340	mg.m^{-3}	<0.05	0.004	1	10	Dry	<0.03	22/05/2025	11:50	12:55	Yes	Yes
Mercury	EN 13211	mg.m^{-3}	<0.01	0.0004	0.05	10	Dry	<0.001	22/05/2025	14:52	15:55	Yes	Yes
Total Cd / Tl	EN 14385	mg.m^{-3}	<0.003	0.00004	0.05	10	Dry	<0.001	22/05/2025	13:17	14:20	Yes	Yes
Remaining Metals	EN 14385	mg.m^{-3}	<0.015	0.0006	0.5	10	Dry	<0.01	22/05/2025	13:17	14:20	Yes	Yes
Total Gaseous Organic Carbon	EN 12619	mg.m^{-3}	17.8	0.67	25	10	Dry	N/a	22/05/2025	12:14	13:44	Yes	N/a
Dioxins and Furans	EN 1948-1	ng.m^{-3}	<0.02	0.001	0.1	10	Dry	<0.001	22/05/2025	16:15	22:30	Yes	Yes
Total Particulate Matter (TPM)	EN13284	mg.m^{-3}	<5.56	0.37	10	10	Dry	<0.76	22/05/2025	11:50	12:24	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	m^3.hr^{-1}	202,947	19,467	500,000	10	Dry	N/a	22/05/2025	11:50	12:24	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^{O}C and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 7: Emission Testing Results from 22/05/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (23-05-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Nitrogen Oxides (as NO_2)	EN 14792	mg.m^{-3}	490.0	28.6	500	10	Dry	N/a	23/05/2025	11:20	13:20	Yes	N/a
Oxygen	EN 14789	vol%	13.28	0.3	N/a	N/a	Dry	N/a	23/05/2025	11:20	13:20	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	mg.m^{-3}	502.3	6.4	1,500	10	Dry	N/a	23/05/2025	11:20	13:20	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	31.38	0.3	N/a	N/a	Dry	N/a	23/05/2025	11:20	13:20	Yes	N/a
Total Gaseous Organic Carbon	EN 12619	mg.m^{-3}	19.3	0.67	25	10	Dry	N/a	23/05/2025	08:48	09:18	Yes	N/a
Ammonia	ISO 21877	mg.m^{-3}	17.26	1.49	50	10	Dry	<0.34	23/05/2025	11:30	12:00	Yes	Yes
Sulphur Dioxide	EN14791	mg.m^{-3}	3.25	0.28	50	10	Dry	0.31	23/05/2025	12:40	13:10	Yes	Yes
Dioxins and Furans	EN 1948-1	ng.m^{-3}	<0.0021	0.0001	0.1	10	Dry	<0.0004	23/05/2025	13:14	19:25	Yes	Yes
Hydrogen Chloride	EN 1911	mg.m^{-3}	<0.21	0.02	10	10	Dry	<0.14	23/05/2025	08:45	09:45	Yes	Yes
Hydrogen Fluoride	CEN/TS 17340	mg.m^{-3}	<0.21	0.02	1	10	Dry	<0.14	23/05/2025	08:45	09:45	Yes	Yes
Mercury	EN 13211	mg.m^{-3}	<0.008	0.0003	0.05	10	Dry	<0.001	23/05/2025	08:54	09:57	Yes	Yes
Total Cd / Tl	EN 14385	mg.m^{-3}	<0.003	0.0001	0.05	10	Dry	<0.001	23/05/2025	10:14	11:17	Yes	Yes
Remaining Metals	EN 14385	mg.m^{-3}	<0.137	0.006	0.5	10	Dry	<0.01	23/05/2025	10:14	11:17	Yes	Yes
Total Particulate Matter (TPM)	EN13284	mg.m^{-3}	1.82	0.18	10	10	Dry	<0.48	23/05/2025	17:24	17:58	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	m^3.hr^{-1}	206,475	21,435	500,000	10	Dry	N/a	23/05/2025	17:24	17:58	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^{O}C and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 8: Emission Testing Results from 23/05/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (27-05-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Nitrogen Oxides (as NO_2)	EN 14792	mg.m^{-3}	498.6	29.8	500	10	Dry	N/a	27/05/2025	15:31	17:31	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	mg.m^{-3}	370.2	4.4	1,500	10	Dry	N/a	27/05/2025	15:31	17:31	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	15.05	0.2	N/a	N/a	Dry	N/a	27/05/2025	15:31	17:31	Yes	N/a
Oxygen	EN 14789	vol%	12.35	0.3	N/a	N/a	Dry	N/a	27/05/2025	15:31	17:31	Yes	N/a
Ammonia	ISO21877	mg.m^{-3}	<19.62	1.56	50	10	Dry	<0.65	27/05/2025	19:18	19:48	Yes	Yes
Hydrogen Chloride	EN1911	mg.m^{-3}	<0.90	0.07	10	10	Dry	<0.48	27/05/2025	16:45	17:45	Yes	Yes
Hydrogen Fluoride	CEN/TS17340	mg.m^{-3}	<0.81	0.06	1	10	Dry	<0.24	27/05/2025	16:45	17:45	Yes	Yes
Mercury	EN 13211	mg.m^{-3}	<0.001	0.00003	0.05	10	Dry	<0.001	27/05/2025	18:46	19:49	Yes	Yes
Total Cd / Tl	EN 14385	mg.m^{-3}	<0.013	0.001	0.05	10	Dry	<0.001	27/05/2025	16:34	17:37	Yes	Yes
Remaining Metals	EN 14385	mg.m^{-3}	<0.252	0.01121	0.5	10	Dry	<0.01	27/05/2025	16:34	17:37	Yes	Yes
Total Gaseous Organic Carbon	EN 12619	mg.m^{-3}	18.1	0.68	25	10	Dry	N/a	27/05/2025	16:53	17:23	Yes	N/a
Volumetric Flow Rate (Ref)	EN 16911	m^3.h^{-1}	170,298	7,308	500,000	10	Dry	N/a	27/05/2025	16:34	17:37	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^{o}C and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 9: Emission Testing Results from 27/05/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (28-05-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Total Particulate Matter (TPM)	EN13284	mg.m^{-3}	0.45	0.18	10	10	Dry	<0.39	28/05/2025	21:08	21:42	Yes	Yes
Nitrogen Oxides (as NO_2)	EN 14792	mg.m^{-3}	322.3	19.0	500	10	Dry	N/a	28/05/2025	12:22	14:22	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	mg.m^{-3}	729.4	8.7	1,500	10	Dry	N/a	28/05/2025	12:22	14:22	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	12.99	0.2	N/a	N/a	Dry	N/a	28/05/2025	12:22	14:22	Yes	N/a
Oxygen	EN 14789	vol%	13.14	0.3	N/a	N/a	Dry	N/a	28/05/2025	12:22	14:22	Yes	N/a
Sulphur Dioxide	EN14791	mg.m^{-3}	2.36	0.17	50	10	Dry	0.286	28/05/2025	10:54	11:54	Yes	Yes
Ammonia	ISO 21877	mg.m^{-3}	<41.79	3.31	50	10	Dry	<0.78	28/05/2025	16:15	16:45	Yes	Yes
Hydrogen Chloride	EN1911	mg.m^{-3}	<0.55	0.04	10	10	Dry	<0.21	28/05/2025	08:09	09:09	Yes	Yes
Hydrogen Fluoride	CEN/TS 17340	mg.m^{-3}	<0.43	0.03	1	10	Dry	<0.21	28/05/2025	08:09	09:09	Yes	Yes
Mercury	EN 13211	mg.m^{-3}	<0.001	0.00004	0.05	10	Dry	<0.001	28/05/2025	11:39	12:42	Yes	Yes
Total Cd / Tl	EN 14385	mg.m^{-3}	<0.003	0.00015	0.05	10	Dry	<0.001	28/05/2025	09:49	10:52	Yes	Yes
Remaining Metals	EN 14385	mg.m^{-3}	<0.029	0.00126	0.5	10	Dry	<0.01	28/05/2025	09:49	10:52	Yes	Yes
Total Gaseous Organic Carbon	EN 12619	mg.m^{-3}	13.9	0.62	25	10	Dry	N/a	28/05/2025	08:20	09:50	Yes	N/a
Dioxins and Furans	EN 1948-1	ng.m^{-3}	<0.0012	0.00005	0.1	10	Dry	<0.0003	28/05/2025	14:25	21:00	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	m^3.h^{-1}	203,617	8,739	500,000	10	Dry	N/a	28/05/2025	09:49	10:52	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^{o}C and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 10: Emission Testing Results from 28/05/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (29-05-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Total Particulate Matter (TPM)	EN13284	$mg.m^{-3}$	2.05	0.25	10	10	Dry	<0.44	29/05/2025	14:29	15:03	Yes	Yes
Carbon Monoxide (as CO)	EN 15058	$mg.m^{-3}$	261.8	3.7	1,500	10	Dry	N/a	29/05/2025	09:40	11:40	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	14.05	0.2	N/a	N/a	Dry	N/a	29/05/2025	09:40	11:40	Yes	N/a
Oxygen	EN 14789	vol%	12.73	0.3	N/a	N/a	Dry	N/a	29/05/2025	09:40	11:40	Yes	N/a
Ammonia	ISO21877	$mg.m^{-3}$	<17.25	1.28	50	10	Dry	<0.41	29/05/2025	14:10	15:10	Yes	Yes
Sulphur Dioxide	EN14791	$mg.m^{-3}$	4.18	0.31	50	10	Dry	0.14	29/05/2025	12:05	13:05	Yes	Yes
Hydrogen Chloride	EN1911	$mg.m^{-3}$	<6.72	0.50	10	10	Dry	<0.21	29/05/2025	10:06	11:06	Yes	Yes
Total Cd / Tl	EN 14385	$mg.m^{-3}$	<0.003	0.0001	0.05	10	Dry	<0.001	29/05/2025	11:09	12:12	Yes	Yes
Mercury	EN 13211	$mg.m^{-3}$	<0.003	0.0001	0.05	10	Dry	<0.0003	29/05/2025	08:54	09:57	Yes	Yes
Remaining Metals	EN 14385	$mg.m^{-3}$	<0.031	0.001	0.5	10	Dry	<0.004	29/05/2025	11:09	12:12	Yes	Yes
Dioxins and Furans	EN 1948-1	$ng.m^{-3}$	<0.001	0.00004	0.1	10	Dry	<0.0003	29/05/2025	12:45	19:00	Yes	Yes
Total Gaseous Organic Carbon	EN 12619	$mg.m^{-3}$	23.9	0.77	25	10	Dry	N/a	29/05/2025	08:14	08:44	Yes	N/a
Volumetric Flow Rate (Ref)	EN 16911	$m^3.hr^{-1}$	204,422	8,700	500,000	10	Dry	N/a	29/05/2025	14:29	15:03	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^oC and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 11: Emission Testing Results from 29/05/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (23-07-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Total Particulate Matter (TPM)	EN13284	$mg.m^{-3}$	<0.46	0.17	10	10	Dry	<0.40	23/07/2025	17:42	18:16	Yes	Yes
Sulphur dioxide	EN 14791	$mg.m^{-3}$	9.82	0.73	50	10	Dry	0.13	23/07/2025	14:45	15:45	Yes	Yes
Ammonia	ISO 21877	$mg.m^{-3}$	<48.50	3.60	50	10	Dry	<0.17	23/07/2025	11:30	12:30	Yes	Yes
Nitrogen Oxides (as NO_2)	EN 14792	$mg.m^{-3}$	386.0	22.9	500	10	Dry	N/a	23/07/2025	14:37	15:07	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	$mg.m^{-3}$	269.8	4.3	1500	10	Dry	N/a	23/07/2025	14:37	15:07	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	13.22	0.2	N/a	N/a	Dry	N/a	23/07/2025	14:37	15:07	Yes	N/a
Oxygen	EN 14789	vol%	13.06	0.3	N/a	N/a	Dry	N/a	23/07/2025	14:37	15:07	Yes	N/a
Hydrogen Chloride	EN1911	$mg.m^{-3}$	<0.53	0.04	10	10	Dry	<0.08	23/07/2025	09:50	10:50	Yes	Yes
Hydrogen fluoride	CEN/TS 17340	$mg.m^{-3}$	0.16	0.01	1	10	Dry	0.08	23/07/2025	09:50	10:50	Yes	Yes
Mercury	EN 13211	$mg.m^{-3}$	<0.01	0.0005	0.05	10	Dry	<0.0004	23/07/2025	10:53	11:56	Yes	Yes
Total Cd / Tl	EN 14385	$mg.m^{-3}$	<0.002	0.0001	0.05	10	Dry	<0.002	23/07/2025	09:08	10:11	Yes	Yes
Remaining Metals	EN 14385	$mg.m^{-3}$	<0.012	0.0005	0.5	10	Dry	<0.01	23/07/2025	09:08	10:11	Yes	Yes
Total Gaseous Organic Carbon	EN 12619	$mg.m^{-3}$	23.9	1.13	25	10	Dry	N/a	23/07/2025	13:08	13:38	Yes	N/a
Dioxins and Furans	EN 1948-1	$ng.m^{-3}$	<0.01	0.0002	0.1	10	Dry	<0.001	23/07/2025	12:40	18:40	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	$m^3.hr^{-1}$	204,497	8,704	500,000	10	Dry	N/a	23/07/2025	17:42	18:16	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^oC and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 12: Emission Testing Results from 23/07/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (24-07-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Nitrogen Oxides (as NO_2)	EN 14792	$mg.m^{-3}$	491.6	29.1	500	10	Dry	N/a	24/07/2025	09:46	10:16	Yes	N/a
Sulphur Dioxide (as SO_2)	EN/TS 17021	$mg.m^{-3}$	10.8	2.3	50	10	Dry	N/a	24/07/2025	09:46	10:16	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	$mg.m^{-3}$	272.2	5.5	1500	10	Dry	N/a	24/07/2025	09:46	10:16	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	15.39	0.2	N/a	N/a	Dry	N/a	24/07/2025	09:46	10:16	Yes	N/a
Oxygen	EN 14789	vol%	12.07	0.3	N/a	N/a	Dry	N/a	24/07/2025	09:46	10:16	Yes	N/a
Ammonia	ISO 21877	$mg.m^{-3}$	<29.55	2.17	50	10	Dry	<0.15	24/07/2025	11:00	12:00	Yes	Yes
Hydrogen Chloride	EN1911	$mg.m^{-3}$	<0.487	0.036	10	10	Dry	<0.07	24/07/2025	09:05	10:05	Yes	Yes
Hydrogen Fluoride	CEN/TS 17340	$mg.m^{-3}$	<0.197	0.014	1	10	Dry	<0.10	24/07/2025	09:05	10:05	Yes	Yes
Mercury	EN 13211	$mg.m^{-3}$	<0.006	0.0002	0.05	10	Dry	<0.0003	24/07/2025	10:31	11:34	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	$m^3.h^{-1}$	205,221	8,734	500,000	10	Dry	N/a	24/07/2025	08:48	09:51	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^oC and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 13: Emission Testing Results from 24/07/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (26-08-2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Ammonia	ISO 21877	$mg.m^{-3}$	<39.17	3.11	50	10	Dry	0.323	26/08/2025	18:01	19:01	Yes	Yes
Nitrogen Oxides (as NO_2)	EN 14792	$mg.m^{-3}$	455.0	26.7	500	10	Dry	N/a	26/08/2025	10:00	10:30	Yes	N/a
Sulphur Dioxide (as SO_2)	EN/TS 17021	$mg.m^{-3}$	18.5	3.2	50	10	Dry	N/a	26/08/2025	10:00	10:30	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	$mg.m^{-3}$	284.3	6.4	1,500	10	Dry	N/a	26/08/2025	10:00	10:30	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	13.54	0.2	N/a	N/a	Dry	N/a	26/08/2025	10:00	10:30	Yes	N/a
Oxygen	EN 14789	vol%	12.92	0.3	N/a	N/a	Dry	N/a	26/08/2025	10:00	10:30	Yes	N/a
Dioxins and Furans	EN 1948-1	$ng.m^{-3}$	<0.01	0.0003	0.1	10	Dry	<0.002	26/08/2025	14:12	20:12	Yes	Yes
Total Cd / Tl (R1)	EN 14385	$mg.m^{-3}$	<0.006	0.0003	0.05	10	Dry	<0.001	26/08/2025	10:15	11:18	Yes	Yes
Total Hg (R1)	EN 13211	$mg.m^{-3}$	<0.002	0.0001	0.05	10	Dry	<0.001	26/08/2025	10:15	11:18	Yes	Yes
Remaining Metals (R1)	EN 14385	$mg.m^{-3}$	<0.483	0.022	0.5	10	Dry	<0.01	26/08/2025	10:15	11:18	Yes	Yes
Total Cd / Tl (R2)	EN 14385	$mg.m^{-3}$	<0.004	0.0002	0.05	10	Dry	<0.002	26/08/2025	12:00	13:03	Yes	Yes
Total Hg (R2)	EN 13211	$mg.m^{-3}$	<0.003	0.0001	0.05	10	Dry	<0.001	26/08/2025	12:00	13:03	Yes	Yes
Remaining Metals (R2)	EN 14385	$mg.m^{-3}$	<0.076	0.003	0.5	10	Dry	<0.02	26/08/2025	12:00	13:03	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	$m^3.h^{-1}$	217,541	9,180	500,000	10	Dry	N/a	26/08/2025	14:12	20:12	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^oC and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 14: Emission Testing Results from 26/08/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (06/11/2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Nitrogen Oxides (as NO_2)	EN 14792	$mg.m^{-3}$	444.0	26.7	500	10	Dry	N/a	06/11/2025	10:46	11:16	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	$mg.m^{-3}$	410.4	7.6	1500	10	Dry	N/a	06/11/2025	10:46	11:16	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	14.91	0.2	N/a	N/a	Dry	N/a	06/11/2025	10:46	11:16	Yes	N/a
Oxygen	EN 14789	vol%	12.26	0.3	N/a	N/a	Dry	N/a	06/11/2025	10:46	11:16	Yes	N/a
Sulphur Dioxide (SO_2)	EN 14791	$mg.m^{-3}$	9.67	0.77	50	10	Dry	2.40	07/11/2025	13:10	13:40	Yes	Yes
Total Gaseous Organic Carbon	EN 12619	$mg.m^{-3}$	24.9	0.83	25	10	Dry	N/a	06/11/2025	13:01	13:31	Yes	N/a
Ammonia	ISO 21877	$mg.m^{-3}$	<21.65	1.72	50	10	Dry	<0.69	07/11/2025	11:45	12:15	Yes	Yes
Dioxins and Furans	EN 1948-1	$ng.m^{-3}$	<0.001	<0.00005	0.1	10	Dry	<0.0004	07/11/2025	09:54	15:54	Yes	Yes
Total Particulate Matter (TPM)	EN13284	$mg.m^{-3}$	1.19	0.24	10	10	Dry	<0.44	06/11/2025	15:53	16:27	Yes	Yes
Total Cd / Tl	EN 14385	$mg.m^{-3}$	<0.005	0.0002	0.05	10	Dry	<0.001	06/11/2025	12:18	13:21	Yes	Yes
Remaining Metals	EN 14385	$mg.m^{-3}$	<0.019	0.0008	0.5	10	Dry	<0.008	06/11/2025	12:18	13:21	Yes	Yes
Mercury	EN 13211	$mg.m^{-3}$	<0.003	0.0001	0.05	10	Dry	<0.0004	06/11/2025	14:32	15:35	Yes	Yes
Hydrogen Chloride (HCl)	EN1911	$mg.m^{-3}$	<0.325	<0.024	10	10	Dry	<0.19	06/11/2025	10:10	11:10	Yes	Yes
Hydrogen Fluoride (HF)	CEN/TS 17340	$mg.m^{-3}$	<0.248	0.019	1	10	Dry	<0.19	06/11/2025	10:10	11:10	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	$m^3.hr^{-1}$	222,067	9,405	500,000	10	Dry	N/a	06/11/2025	15:53	16:27	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^OC and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 15: Emission Testing Results from 06/11/2025 & 07/11/2025

Air Emissions Monitoring Report

Emission Point Number: A2-01 (27/11/2025)

Parameter	Method	Units	Result	MU +/-	Limit	O_2 Ref. (%)	Moisture Ref. (%)	Blanks	Date	Time on	Time off	Accreditation	
												Sampling	Analysis
Hydrogen Chloride	EN1911	$mg.m^{-3}$	<0.373	0.027	10	10	Dry	0.08	27/11/2025	19:45	20:45	Yes	Yes
Hydrogen Fluoride	CEN/TS 17340	$mg.m^{-3}$	<0.162	0.012	1	10	Dry	0.08	27/11/2025	19:45	20:45	Yes	Yes
Nitrogen Oxides (as NO_2)	EN 14792	$mg.m^{-3}$	446.2	26.1	500	10	Dry	N/a	27/11/2025	19:45	20:15	Yes	N/a
Sulphur Dioxide (as SO_2)	EN/TS 17021	$mg.m^{-3}$	12.7	2.4	50	10	Dry	N/a	27/11/2025	19:45	20:15	Yes	N/a
Carbon Monoxide (as CO)	EN 15058	$mg.m^{-3}$	346.3	4.4	1500	10	Dry	N/a	27/11/2025	19:45	20:15	Yes	N/a
Carbon Dioxide	EN/TS 17405	vol%	15.36	0.3	N/a	N/a	Dry	N/a	27/11/2025	19:45	20:15	Yes	N/a
Oxygen	EN 14789	vol%	11.98	0.3	N/a	N/a	Dry	N/a	27/11/2025	19:45	20:15	Yes	N/a
Total Cd / Tl	EN 14385	$mg.m^{-3}$	<0.002	0.0001	0.05	10	Dry	<0.001	27/11/2025	20:22	21:25	Yes	Yes
Remaining Metals	EN 14385	$mg.m^{-3}$	<0.044	0.002	0.5	10	Dry	<0.01	27/11/2025	20:22	21:25	Yes	Yes
Mercury	EN 13211	$mg.m^{-3}$	<0.0002	0.00001	0.05	10	Dry	<0.0001	27/11/2025	20:22	21:25	Yes	Yes
Volumetric Flow Rate (Ref)	EN 16911	$m^3.h^{-1}$	235,310	10,013	500,000	10	Dry	N/a	27/11/2025	20:22	21:25	Yes	N/a

Note 1: All results are normalised to standard temperature and pressure (0^OC and 101.3kPa)
Note 2: All results are reported in the format as defined by the EPA in guidance note AG2:2021.

Table 16: Emission Testing Results from 27/11/2025

9. APPENDIX II - MEMO FROM FLSMIDTH REGARDING GAS RESIDENCE TIME MODELLING

Memo

To	Eve Howard (Enviromental Manager, Irish Cement, Limerick Works), Seamus Breen (Environmental Manager, Irish cement)
Copies to	Shane Mc Carthy (Plant manager, Irish Cement, Limerick works), Colin Murphy (Production manager, Irish cement, Limerik works)
From	PRos (FLS)
Filing	Report-34/ICL/Limerick/PRos/2023/08/21
Subject	**Kiln system – gas and material retention times (in the complete kiln, kiln riser duct, ILC-E calciner and bottom stage cyclone) for an outlet temperature on 855 from the C4/cyclone. The simulations are only made for the scenarios where the kiln system is fired with petroleum coke, SRF and MBM.** **This report is an supplement to the previous reports:** • **Report-21/ICL/Limerick/PRos/2016/02/15** • **Report 28/ICL/Limerick/PRos/2021/10/04** • **Report-29/ICL/Limerick/PRos/2022/11/02** • **Report-32/ICL/Limerick/PRos/2022/11/29** • **Report-33/ICL/Limerick/PRos/2022/12/05**

Resume/Conclusion

Irish Cement Ltd. Limerick works is converting to burn different alternative fuels in there ILC-E calciner kiln system.

ICL, Limerick is currently planning to fire MBM in the main burner and this report comprise simulations of different scenarios at a production level of 3000 tpd clinker and a fourth stage cyclone exit temperature on 855°C, where FE=front end firing and BE=backend firing:

ICL, Limerick is installing a 0-12.000 Nm^3/h by-pass for the kiln exit gas and have requested the simulations 3.16A, 3.17A, 3.18A and 3.19A repeated with maximum by-pass rate. These simulations with maximum bypass are designated 3.16AB, 3.17AB, 3.18AB and 3.19AB.

The estimated retention times in the kiln, the calciner and total for the revised operational conditions are for the considered scenarios shown in the following table:

Based on Kiln output on 3000 t / day when co-firing with Solid refuse derived fuel (SRF)								
Total retention time in kiln, calciner				Kiln heat	FE - whole kiln	Pre-calciner + C4	Pre-calciner + C4	
Scenario	By-Pass	Fuel Mix		Consumption	Residence time	Temperature	Residence Tir	Total
	%	FE	BE	Kcal/kg Clinker	Seconds	deg.C	Seconds	seconds
2A	0	80% PC	20% PC	841	3.77	855	3.42	7.19
3.12A	0	5% MBM&10%SRF-FE&65% PC	20% PC	846	3.75	855	3.36	7.11
3.13A	0	5% MBM&20%SRF-FE&55% PC	20% PC	850	3.70	855	3.32	7.02
3.14A	0	5% MBM&25%SRF-FE&50% PC	20% PC	852	3.69	855	3.29	6.98
3.15A	0	10%MBM&10%SRF-FE&60%PC	20% PC	847	3.73	855	3.35	7.08
3.16A	0	10%MBM&20%SRF-FE&50%PC	20% PC	851	3.70	855	3.30	7.00
3.17A	0	10%MBM&25%SRF-FE&45%PC	20% PC	854	3.68	855	3.27	6.95
3.18A	0	15%MBM&20%SRF-FE&45%PC	20% PC	853	3.69	855	3.30	6.99
3.19A	0	40%MBM&40%SRF-FE	20% SRF BE	878	3.56	855	3.08	6.64
3.16AB	7	10%MBM&20%SRF-FE&50%PC	20% PC	851	3.47	855	3.35	6.82
3.17AB	6.9	10%MBM&25%SRF-FE&45%PC	20% PC	854	3.44	855	3.32	6.76
3.18AB	6.9	15%MBM&20%SRF-FE&45%PC	20% PC	853	3.47	855	3.33	6.80
3.19AB	6.6	40%MBM&40%SRF-FE	20% SRF BE	878	3.35	855	3.12	6.47

The considered scenarios are made for estimating the corresponding retention times of the combustion gases at a production level on 3000 tpd clinker. The retention times at lower production levels can be estimated as:

Retention time(@X tpd clinker) =
Retention time(@3000 tpd clinker)*((3000 tpd)/(X tpd)

10.APPENDIX III - FUEL CONTROL LOGIC

Irish Cement A CRH COMPANY		Alternative Fuels Interlocks
Revision: See Revision History in Sharepoint	**Form No.:** *PRO_AF_21*	Irish Cement Ltd
	Compiled by: E. Scanlan/D. Funnell	*(Limerick Works)*

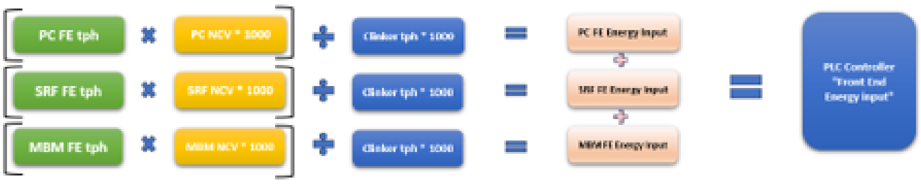
Alternative Fuel Interlocks

1. Kiln Fuel Control Loop

The main burner operates with three fuels during normal operation (outside of start up), pet coke, SRF and MBM. In order to use the correct amount of fuel to create sufficient heat for both the formation of clinker and a stable kiln operation, a fuel firing logic has been developed which ensures the correct balance of energy is being inputted at all times.

A specific amount of energy is required to create sufficient heat in the kiln. To do this, the logic inputs this specific energy requirement with pet coke, SRF and MBM. If either the SRF or MBM is lost for any reason, the correct balance of pet coke will be added in its place to ensure the heat in the kiln is maintained.

Should the pet coke in the main burner be lost, both SRF and MBM will be automatically stopped and the kiln will also stop because we cannot operate without pet coke on the front burner during normal operation. The kiln is interlocked to keep a minimum t/h of pet coke on at all times. The main burner cannot operate with alternative fuels only. The diagram below shows how this fuel ratio will be calculated:



2. MBM Main burner on interlocks

Introduction and continued firing of alternative fuels into the kiln process will be interlocked with stable process conditions and as such can only occur when the following conditions exist;

- Petcoke (or Coal) is being fed to the main burner
- Raw meal is being fed to the Kiln system
- A minimum temperature of 870°C in the burning zone
- If Burning Zone Temperature (642XT01) < 870°C or 'kiln stop' then both SRF main burner group "645/G03 → SRF_TO_BURNER" and MBM Main Burner Group "64X/GXX → MBM_TO_BURNER" stops.

- During the start-up sequence, the use of MBM or SRF will not be permitted until the same conditions specified above, as a minimum, have been achieved. MBM will not be used as a start-up fuel and interlocks will be in place to ensure this.
- The kiln system will only be started up and stable operation established using Diesel Oil, Petcoke or Coal as the fuel input. Only when the kiln is normal production mode (i.e. out of start up and / or shut down mode) will MBM be introduced.

Irish Cement A CRH COMPANY		Alternative Fuels Interlocks
Revision: See Revision History in Sharepoint	**Form No.:** *PRO_AF_21*	Irish Cement Ltd
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- As the volume of alternative fuels increases, the volume of fossil fuels can be gradually reduced, maintaining stable plant operation at all times. This will be achieved by means of a fuel control loop.
- There is currently maximum MBM t/h limit of 5 t/h. This limit will be modified as require throughout the test programme by the Environmental Manager or Production Manager.

3. MBM Main burner off interlocks

- MBM injection will stop automatically should the kiln become unstable, the temperature in the burning zone is below 855°C or the kiln stops. This will be controlled by means of a control system interlock.
- Should the kiln stop, whether it be planned or unplanned, MBM will automatically be shut off immediately.

4. Minimum injection of fossil fuels main burner -> if 'kiln on' and SRF burning

Main burner SRF group "645/G03 -> SRF_TO_BURNER" can only run if Fossil Fuel to Kiln group "646G05/05" is running.

A fossil fuel set point of < 0.5 T/hr cannot be entered for the main burner fossil fuel to ensure fossil fuel firing is always on.

5. MBM off before any parameter is greater than Emission Limit Value (ELV)

In the event of the parameter that is continuously monitored approaching the ELV, the MBM firing is stopped. Prior to a breach of the ELV, the kiln is stopped at a point below the relevant ELV so as not to breach the emission limit value (ELV). This takes place automatically.
There is a requirement to have 30 min rolling average values and 24 hour rolling averages for the following parameters. A lower limit is set below all ELVs in order to avoid breaching the limits outlined below.

Parameter	24 hour - ELV mg/Nm³	30 min - ELV mg/Nm³
Dust	10	20
NOx	500	1000
SO_2	50	100
HCl	10	20
HF	1	2
TOC	25	50
CO	1500	3000
NH_3	50	100

* Referenced for STP and 10% O2

Irish Cement A CRH COMPANY		Alternative Fuels Interlocks
Revision: See Revision History in Sharepoint	**Form No.:** *PRO_AF_21*	Irish Cement Ltd
	Compiled by: E. Scanlan/D. Funnell	*(Limerick Works)*

MBM will be switched off if the parameters breach the below limits:

	30 Min Avg
	Mg/Nm³
NOx	965
SOx	88
NH3	92
CO	2700
HCl	18
HF	1.8
TOC	45
Dust	18

	Daily Avg
	Mg/Nm3
NOx	485
SOx	45
NH3	45
CO	1400
HCl	8.5
HF	0.9
TOC	22
Dust	8.9

As has been standard practice prior to the introduction of MBM, the kiln will stop prior to a breach in any continuously monitored parameters.

11.APPENDIX IV - MATERIAL ACCEPTANCE PROCEDURE

Irish Cement (A CRH COMPANY)		MBM Delivery and Handling Procedure
Revision: See Revision History on Sharepoint	**Form No.:** *PRO_AF_08*	Irish Cement Ltd
	Compiled by: Eve Howard	*(Limerick Works)*

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2 Scope 2
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3.3 Delivery drivers 2
5 Onsite MBM Acceptance procedure 2
6 Onsite sampling procedure 3
7 Analysis 3
8 Handling of rejected material 4
9 Abbreviations I Glossary 5

<table>
<tr><td colspan="2">Irish Cement A CRH COMPANY</td><td>MBM Delivery and Handling Procedure</td></tr>
<tr><td rowspan="2">Revision: See Revision History on Sharepoint</td><td>Form No.: PRO_AF_08</td><td rowspan="2">Irish Cement Ltd
(Limerick Works)</td></tr>
<tr><td>Compiled by: Eve Howard</td></tr>
</table>

1 Purpose

The purpose of this SOP is to define the procedure for accepting and handling Meat and Bone Meal (MBM) onsite at Limerick Works.

2 Scope

This document applies to ICL employees or contractors who are involved in the delivery, handling and sampling of MBM.

3 Responsibilities

3.1 Environmental Manager

To ensure compliance with this SOP

3.2 Process Manager

Manage deliveries and material handling onsite

3.3 Delivery drivers

To ensure that they are aware of the details of this procedure and comply with the instructions contained within.

4 Delivery of MBM to Limerick Works.

Irish Cement will only contract with suppliers licensed to produce MBM (EPA waste licence, Local Authority permits) for the supply of ready-to-use fuels with the EWC code 02 01 02. The fuels will arrive on site prepared to specification and no further processing of fuels will take place on the site in Limerick.

All deliveries will be scheduled in advance and will only be permitted on site in sealed, covered containers.

- The supplied MBM will be produced to a strict supply specification to assure of environmental compliance to the licensed emission parameters and quality compliance to the harmonised cement product standard.

5 Onsite MBM Acceptance procedure

Vehicle and driver details along with supplier information will be entered into the automated delivery acceptance system. Individual driver identification tags will be provided.

All hauliers delivering alternative fuels to site will be given full training in accordance with the CRH Code of Practice for Hauliers, as occurs for hauliers of other materials currently.

Irish Cement A CRH COMPANY		MBM Delivery and Handling Procedure
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The unloading procedure for unloading of MBM into the intake system should be followed. See separate unloading procedure.

Confirmation of conformity to the fuel specification will be provided in advance by the supplier for all fuel supplied. This confirmation will declare that the material delivered meets the supply specification as contracted.

Each delivery must be made by an approved driver. Each qualifying driver will be issued with a unique identification card. This identification card must be presented before the delivery will be permitted entry to the site.

On arrival at the Irish Cement entrance, all deliveries will be verified by the automated delivery acceptance system. Offloading of each load will be observed via CCTV from the central control room.

All MBM loads must be accompanied by the correct documentation including details of the material and specifying that the material is Cat 1, a seal number and the truck details.

6 Onsite sampling procedure

Sampling procedures on site will be in compliance with the on-site ISO 9001 Quality System. Fortnightly composite samples from each supplier will be analysed to determine compliance with fuel specification. Regular internal testing will be carried out by Limerick Works to determine compliance of the following parameters with the relevant alternative fuels specification;

MBM	
Moisture	Particle Size

Testing of a composite sample is carried out to confirm that the fuels supplied are in compliance with the agreed specification. Testing frequency will be greater during initial evaluations and be adjusted as compliance confidence increases.

Samples will be taken from each load of MBM. Each sample is then composited into a fortnightly sample is to be sent to an ISO 17025 lab for analysis.

7 Analysis

Analysis will be completed in either the internal Irish Cement laboratories or at off-site accredited laboratories.

Specifically, the following parameters will be closely monitored:

- Particle size and moisture content so as to optimise handling and processing

MBM Delivery and Handling Procedure		
Revision: See Revision History on Sharepoint	**Form No.:** *PRO_AF_08*	Irish Cement Ltd
	Compiled by: Eve Howard	*(Limerick Works)*

- Calorific or heat value of MBM (Megajoule per kilogram (MJ/kg)) so as to ensure adequate heat/energy content of the fuel.

8 Handling of rejected material

At any stage in the process a delivery can be rejected and returned to the supplier in compliance with Irish cement and Supplier procedures.

The criteria for accepting / rejecting is as follows:

- Size
- Not meeting specifications
- Not meeting visual inspection

The supplier will be contacted immediately to determine the status of other planned deliveries. A notification of non-conformance stating the details of the delivery and the reason/s for rejection will be forwarded to the supplier. Copies of sample analysis results, if available, will be provided to the supplier.

Rejected loads will be stored in their sealed containers adjacent to the MBM store within the MBM facility until it can be returned directly to the supplier. Material will be quarantined for no longer than 48 hours on site.

Following a rejected or returned load to a supplier, Limerick Works will not accept further deliveries of MBM from the supplier until a report detailing the cause of the non-conformance and the corrective actions taken by the supplier to ensure that it is not repeated has been received and is to the satisfaction of Limerick Works. A more onerous sampling and testing requirement for MBM will be imposed on suppliers until demonstration of sustained compliance with the agreed fuel specifications is evident. Details of non-conforming loads will be recorded and reported to the Agency in the AER.

12. APPENDIX V - ABATEMENT SYSTEM PROCEDURE

Irish Cement (A CRH COMPANY)		**Abatement Procedures during AF Firing to Kiln 6**
Revision: See Version History SharePoint	**Form No:** *PRO_AF_09* **Compiled by:** D Curran (Chemical Engineer) **Reviewed By:** D. Funnell	Irish Cement Ltd *(Limerick Works)*

Abatement Procedures during AF Firing to Kiln 6

Document Revision Number	Date	Production Manager	Signature
1	29/04/2025		
2	04/12/2025		

Irish Cement (A CRH COMPANY)		**Abatement Procedures during AF Firing to Kiln 6**
Revision: See Version History SharePoint	**Form No:** *PRO_AF_09* **Compiled by:** D Curran (Chemical Engineer) **Reviewed By:** D. Funnell	Irish Cement Ltd *(Limerick Works)*

Summary

The purpose of this document is to provide shift personnel with a guide on the abatement procedures to be followed while Alternative Fuels (AF) are fired to Kiln 6 at ICL Limerick.

Operating Principles

Multiple interlocks have been implemented at ICL Limerick in order to stop the firing of SRF and MBM to Kiln 6 if any of the below scenarios occur:

- Kiln stack emission interlocks – SRF and MBM off first when approaching an emission ELV and followed by a kiln stop if emissions continue to increase
- Temperature interlock to burning zone temperature - if temperature in the burning zone drops below 1000°C, SRF and MBM firing is automatically stopped by the control system.
- SRF and MBM firing cannot be commenced until out of "start-up" conditions and into "normal" conditions.
- Maximum SRF t/h limit is set at 5 tph – thereby preventing the system from running at >5 tph.
- Maximum MBM t/h limit is set at 4 tph – thereby preventing the system from running at >4 tph.
- A fuel control loop has been implemented which allows the system to automatically adjust the required petcoke feed to Kiln 6, in the event that the SRF or MBM feed is stopped.

Irish Cement A CRH COMPANY		Abatement Procedures during AF Firing to Kiln 6
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Emission Control

The table below highlights new emission limits implemented to stop SRF and MBM feed to Kiln 6 when approaching an emission ELV - emission limits for Kiln 6 stoppages are also shown below.

		SRF and MBM Interlock		Kiln Interlock	
Emission Control	Units	30 Minute Average	24 Hour Average	30 Minute Average	24 Hour Average
NO_x	Mg/Nm³	965	485	975	495
SO_2	Mg/Nm³	88	45	90	48
NH_3	Mg/Nm³	92	45	95	48
CO	Mg/Nm³	2700	1400	2900	1450
HCL	Mg/Nm³	18	9	18.5	9
HF	Mg/Nm³	1.8	0.9	1.9	0.95
TOC	Mg/Nm³	45	22	47	25
DUST	Mg/Nm³	18	9	19	9

Kiln 6 Process Related Interlocks

In order for SRF and MBM to be fired to the kiln, the following requirements must be met at all times. If any of the below parameters fall out of accepted ranges – the SRF and MBM feed will automatically stop. These interlocks ensure that the kiln is steady before SRF and MBM can be fired.

- Kiln burning zone temperature must be greater than 1000°C (measured using 642XT01S BZT)
- Kiln feed must be greater than 100tph.
- Temperatures in the stage 4 cyclone must be greater than 800°C (measured using 641XT04 and 641XT04A).

- 64402 ID Fan must be on for SRF feed to be enabled.

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SRF Process Related Interlocks

SRF Pfister Feeder is set at a maximum output of 5tph in the control system. Therefore, a controller input >5tph will cause the SRF feed to be shut off.

Figure 1: Screenshot of SRF Feed on PLC showing 5.0 tph as the max limit.

MBM Process Related Interlocks

MBM Pfister Feeder is set at a maximum output of 4 tph in the control system. Therefore, a controller input >4tph will cause the MBM feed to be shut off.

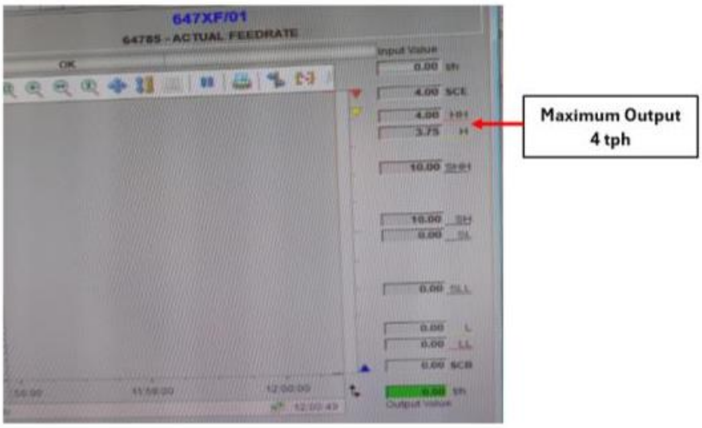

Figure 2: Screenshot of MBM Feed on PLC showing 4.0 tph as the max limit.

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Kiln Fuel Control and Stability

A fuel control loop is integrated into the plant control system to ensure that kiln fuel demands are met in the event either of SRF or MBM feeds are stopped or adjusted.
The loop utilises a kilocalorie target in order to establish total heat required for the kiln.

- SRF and MBM feed rates are set by the Process Controller or Engineer, while the petcoke feed is adjusted in order to meet the exact fuel demands for Kiln 6.
- In the event that SRF or MBM stops, the petcoke feed is increased to provide the entire fuel requirements to Kiln 6 instantly.

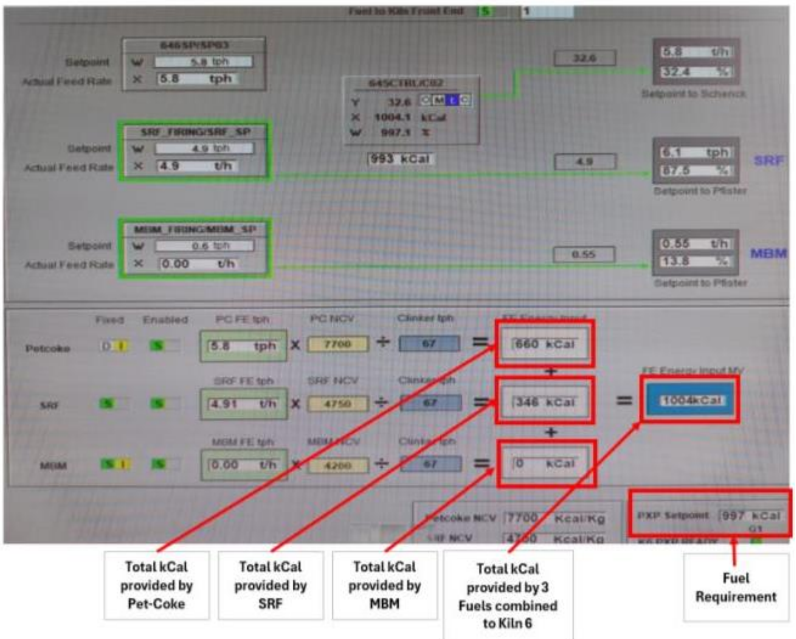

Figure 3: Screenshot of the fuel-controller PLC mimic.

Irish Cement (A CRH Company)		Abatement Procedures during AF Firing to Kiln 6
Revision: See Version History SharePoint	**Form No:** *PRO_AF_09* **Compiled by:** D Curran (Chemical Engineer) **Reviewed By:** D. Funnell	Irish Cement Ltd *(Limerick Works)*

NOx Abatement Procedure during SRF Firing

1. Objective

The objective of this procedure is to outline the principle of NOx abatement using the ABC&I SNCR system, the major equipment involved in the system as well as the operation and monitoring of the system to reduce NOx emissions to below emission limits set out in Environmental license issued by the EPA to Irish Cement Limerick Works.

2. Operating Principle

The reduction agent used to reduce NOx formation is 25% water-soluble ammonia.

After the injection of the reagent into the main PHT gas duct, the following chemical reactions takes place where ammonia reacts with nitrous oxide and oxygen to produce nitrogen and water.

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$

$$4NH_3 + 2NO + 2O_2 \rightarrow 3N_2 + 6H_2O$$

The SNCR system is required to maintain NOx emissions below our current EPA licence limits with adjusted figures for SRF to run.

- 30-min: 965 mg/Nm3
- 24-hr: 485 mg/Nm3

*Both limits come into account until kiln is in "Normal Production Mode" which is defined as; Stage 4 temperature (XT04) above 800 degrees Celsius.

3. Equipment

The SNCR system consists of four major parts: storage tanks, pump cabinet, process cabinet and injectors.

Storage Tanks: Ammonia is offloaded and stored here in stainless steel single-sheated tanks that are enclosed by a concrete bund to prevent leakage in the event of a spillage.

Pump Cabinet: Located at the tanks is a pump/filter module contained in a stainless-steel case. It contains pumps, filters, pressure transmitters, valves and ammonia piping. The pump is a centrifugal pump with a capacity of 6 bars and 3 m3/h.

Ammonia Piping: From the pump cabinet to the process cabinet located just below the 2nd floor of the PHT.

Process Cabinet: In the process cabinet there are pressure and flow transmitters for both ammonia and softened water. Via 7 injectors ammonia is sprayed into the NOx reaction/reduction zone at a pressure of 3-4 bar. Regulating valve 64125 controls the overall flow to the 7 injectors.

Irish Cement (A CRH Company)		Abatement Procedures during AF Firing to Kiln 6
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Injectors: 2 of the injectors are located at the PHT 2nd floor while 5 injectors are located at the kiln backend close to the petcoke backend firing pipes. Barrier air surrounds the injectors and nozzles which is produced by a central fan 64128.

4. Operation

<u>Starting/Stopping the SNCR System</u>

The SNCR system should be running when the kiln is in production to mitigate high NO_x generation.

To start the system, go to the control system and under the Plant Services drop down menu select SNCR tanks. Next to SNCR System Running select the Start Button in order to bring in 64123 or 64124 pump. Flow can be verified under the SNCR Injectors page when a flowrate is recorded at FT5005 as well as a flow indication at the individual injectors FT5034. A corresponding reduction in NOx should be recorded shortly after with at both the ground floor analysers and ACF5000 stack analysers.

The SNCR system is interlocked to stop if the kiln is to stop for any reason.

Running the SNCR System in Automatic

The SNCR system should be selected to run in automatic (Closed Loop Control), unless for operational reasons, it cannot be.

To run in automatic (CLC) select the Auto button next to SV50001 on the SNCR injectors page. The NO_x setpoint (SP/NOX_SETPOINT) is typically set to 480 mg/m³ just below the 24-hour interlock limit of 495 mg/m³. This activates a PID control loop that opens or closes 64125 regulator valve to increase or decrease ammonia flowrate to the injectors to control live NO_x readings taken at the kiln stack by the ACF5000 (644XQ/NOx EPA)

The 24-hour NO_x Average is good indication of whether the automatic control loop is working correctly with this value here should be within 5 mg/m³ of the current NO_x Setpoint.

Running the SNCR System in Manual

On occasion it may be required to run the SNCR system in manual (Open Loop Control) i.e. a flow rate setpoint is input by the Process Controller and the regulator valve opens or closes to achieve the target flowrate setpoint.

To run in manual (OLC) select the Auto button next to SV50001 on the SNCR injectors page and input the required flow rate setpoint.

Care should be taken by the Process Controller to monitor closely NO_x emissions when in manual control (OLC) as setpoint will need to be increased or decreased based on current NO_x readings.

Irish Cement A CRH COMPANY		**Abatement Procedures during AF Firing to Kiln 6**
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5. Operating Controls

In the computers in the CCR the mimics for the SNCR system are found under plant services, there are four mimics:

Mimic 1 – SNCR Tanks

The view of the PLC Mimic is shown in Figure 3 below.

A. This box is where the NO_X setpoint is inputted, the system then regulates the quantity of ammonia to the injectors to achieve this.

B. This is the level or quantity of ammonia in the tank in percentage form.

C. These are the two pumps, pump 1 and pump 2. Pump 1 gives slightly more pressure / flow than pump 2. To change from one pump to the other, it must be done manually and the group needs to be given a new start command.

D. These buttons will bring up the list of a) all alarms and b) critical alarms on the SNCR system.

E. This is a reading for the differential pressure across the filter, this will identify when the filter is blocking and therefore when it needs to be changed.

F. This is the button that starts the SNCR system.

G. This button will allow maintenance to be carried out on the NO_X analyser and the SNCR system will continue to dose ammonia using the flow rates that were used before the NO_X signal was removed due to maintenance of the analyser.

H. These are pop up boxes that allow the controller to move from one SNCR screen to another.

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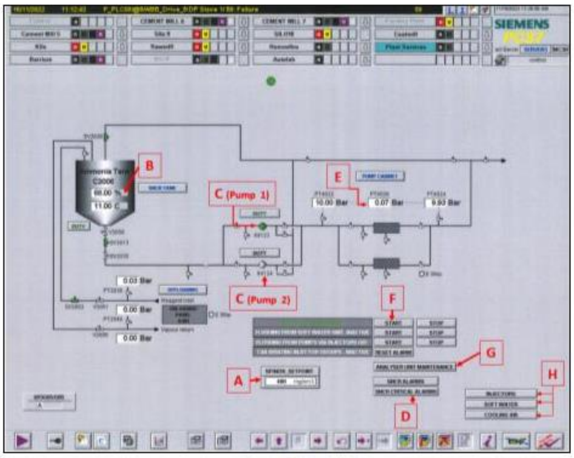

Figure 4: SNCR Tanks

SNCR Injectors

A. This is the total amount of softened water (litres/hr) being added to the ammonia going to the injectors in the preheater.
B. This is the valve that regulates the quantity of ammonia being injected to the preheater.
C. This is the total ammonia flow rate going to the preheater.
D. This is the differential pressure across the filter, therefore identifying when the filter needs to be changed.
E. This box is used by the CCR when manipulating injector control.
F. This box is used by the CCR when adjusting flow measurement.
G. Toggled flow meter that will change from injector to injector periodically as a check of ammonia addition through each injector, therefore helping to identify blockages or leaks in the system.
H. Cooling fan which supplies cooling air to the injectors, to protect same from burning in the very high preheater temperatures.

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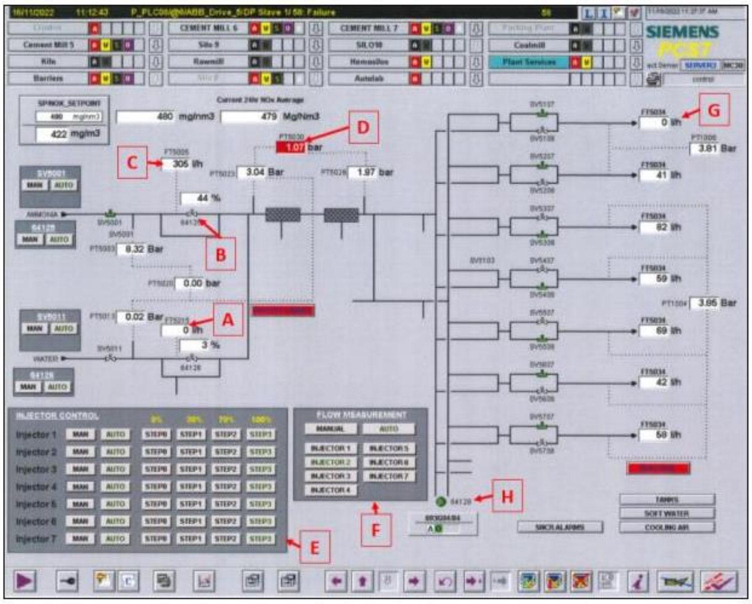

Figure 5: SNCR Injectors

Lime Feed System Operation for SO_x Abatement during SRF Firing

1. Objective

The objective of this procedure is to outline the principle of SO_x abatement using the Lime Feed system, the major equipment involved in the system as well as the operation and monitoring of the system to reduce SO_x emissions to below emission limits set out in Environmental license issued by the EPA to Irish Cement Limerick Works.

2. Operating Principle

Hydrated Lime Powder is fed into the Pre-Heater Tower Exhaust Gas stream by means of a pressure blower.

After the injection of the reagent into the main PHT exhaust gas duct a proportion of the SO_2 portion of the gas stream will react with the lime to form $CaSO_3$ and $CaSO_4$ which is captured by the main kiln bag filter incorporated in the dust returns and eventually exits the kiln system incorporated as clinker.

The Lime Feed system is required to maintain SO_x emissions below our current EPA licence limits with SRF firing to Kiln 6:

<table>
<tr><td colspan="2">Irish Cement A CRH COMPANY</td><td>Abatement Procedures during AF Firing to Kiln 6</td></tr>
<tr><td rowspan="2">Revision: See Version History SharePoint</td><td>Form No: PRO_AF_09</td><td rowspan="2">Irish Cement Ltd
(Limerick Works)</td></tr>
<tr><td>Compiled by: D Curran (Chemical Engineer) Reviewed By: D. Funnell</td></tr>
</table>

- 30-min: 88 mg/Nm^3
- 24-hr: 45 mg/Nm^3

*Both limits come into account until kiln is in "Normal Production Mode" which is defined as; Stage 4 temperature (XT04) above 800 degrees Celsius.

3. Equipment

The Lime Feed system consists of:

- a storage silo
- loss in weight feeder
- VSD controlled sluice
- screw conveyor
- air seal sluice
- high pressure blower.

4. Operation

The Lime Feed system should be started and running when SO_2 emissions are high (>45 mg/m^3) while the rawmill is running or if the rawmill is likely to be down for an extended period of time (>8hrs). When the rawmill is running the gas diverted to the rawmill circuit comes in contact with limestone which acts as a scrubber for SO_2 gas reducing SO_2 stack emissions.

To start the Lime Feed System, go to the PCS7 control system. Under the Rawmill drop down menu select Rawmill Feed. On the Rawmill Feed page of PCS7 select "Lime to Kiln Gas". This starts 631G11/G11 the Lime to Kiln Gas group. Open the 631CTRL/C09 and select CLC with a setpoint of 40 mg/m^3 (or lower if required).

644XQ/166 "Predicted 24hr SO_2 Average" can be monitored to ensure that the setpoint is sufficient to reduce SO_2 emissions so that the 24hr average interlock is not activated.
644XQ/92 "10s CO Value" can be monitored to ensure that the setpoint is sufficient to reduce SO_2 emissions so that the 30-minute average interlock in not activated.

Dust Abatement Procedure during SRF Firing

Under no circumstances should the Kiln be operated without adequate filter performance. The indicators of filter performance are the continuous dust monitor levels and differential pressure levels. A visual inspection will also confirm if the filter is operating satisfactorily. Under no circumstances should dust from the Kiln bag filter be run to the ground.

If the filter is not operating satisfactorily the Kiln should be stopped and all necessary repairs need to be carried out.

The operation of the kiln is interlocked with dust levels in the kiln stack. A breach of the dust levels will be prevented by these interlocks and the kiln will not be able to run until dust levels are below the ELV.

Alternative fuels will be stopped from firing to kiln 6 as per the following ELV's:

- 30-min: 18 mg/Nm^3
- 24-hr: 9 mg/Nm^3