Increased Alternative Fuel Substitution

Adelaide Brighton Cement Limited

Post-Trial Report

149,819 | 64478

8 May 2023

Adelaide Brighton Cement Ltd

an ADBRI company

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Table of Contents

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List of Tables

List of Figures

Appendices

Abbreviations

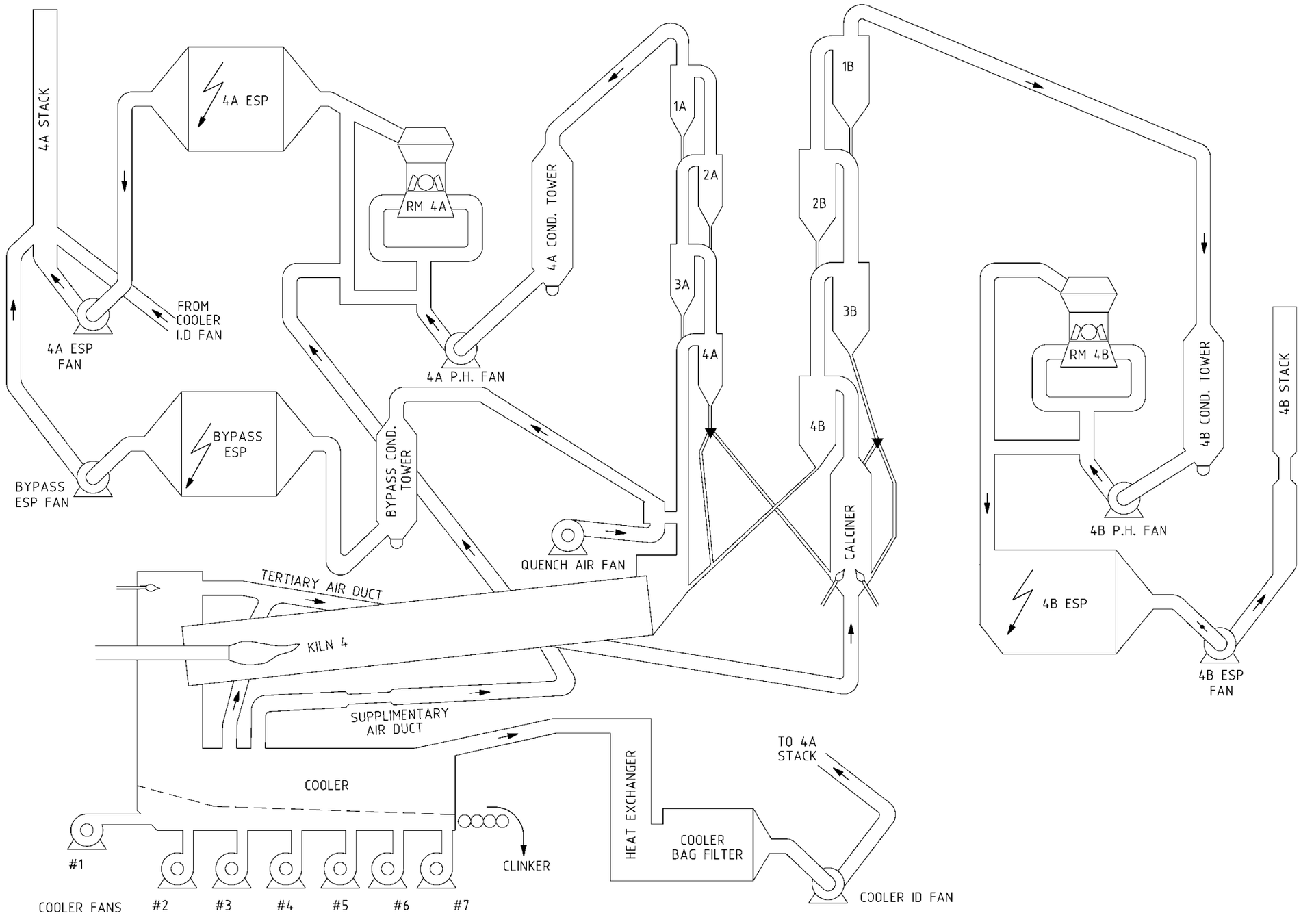
Term	Definition
ABC	Adelaide Brighton Cement Limited
AFRM	Alternative Fuels and Raw Materials
BaP-TEQ_{PAH}	Benzo(a)pyrene Toxic Equivalent Quotient
BAU	Business as Usual
C&D	Construction and Demolition (waste)
C&I	Commercial and Industrial (waste)
CLG	Community Liaison Group
CV	Calorific Value
EPA	South Australian Environment Protection Authority
EPP	Environment Protection Policy
ESP	Electrostatic Precipitator
GC/MS	Gas Chromatography Mass Spectrometry
GLC	Ground Level Concentration
ITEQ/$NATO_{89}$ I-TEQ	International Toxic Equivalent for PCDDs and PCDFs, (NATO 1989 basis)
LIMS	Laboratory Information Management System
LOD	Limit of Detection
NEPM	National Environmental Protection Measure
NOx	Oxides of Nitrogen
PAH(s)	Polycyclic Aromatic Hydrocarbons
PCDDs	Polychlorinated Dibenzo-p-Dioxins
PCDFs	Polychlorinated Dibenzofurans
RDF	Refuse Derived Fuel / processed fuel produced from waste materials generated by construction, demolition, commercial and industrial sources
RDF Standard	SA EPA Standard for the production and use of Refuse Derived Fuel, 2010
RPP	Recovered Products Plan
SCADA	Supervisory Control And Data Acquisition (a control system that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management)
SOx	Oxides of Sulfur
STP	Standard Temperature and Pressure (per SA EPA *Emission Testing Methodology for Air Pollution,* August 2012)
TSP	Total Solid Particulates
TSR	Thermal Substitution Rate
USEPA	United States Environmental Protection Agency

Glossary

Term	Definition
% Cl	Elemental chlorine concentration as a percentage of total composition
% (w/w)	Percentage by weight
db	Dry Balance
g/s	Grams per second
GJ/t	Gigajoules per tonne
m^3	Cubic metres
µg	Microgram (10^{-6} gram)
µm	Micrometre (10^{-6} metre)
mg	Milligram (10^{-3} gram)
mg/Nm^3	Milligrams (10^{-3} grams) per cubic metre
MJ/kg	Megajoules per kilogram
ng	Nanogram (10^{-9} gram)
Nm^3	Gas volume in cubic metres at STP dry basis
$PM_{2.5}$	Particulate matter with a nominal aerodynamic diameter ≤2.5 µm
PM_{10}	Particulate matter with a nominal aerodynamic diameter ≤10 µm
ppm	Parts per million
t/h	Tonnes per hour

GRP	ITEM	QTY	DESCRIPTION	MASS	REFERENCE

Figure 1-1: Birkenhead Process Schematic



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REV	DATE	DRN	REVISION	REFERENCE DRAWINGS	DRG. No

SURFACE TREATMENT: ALL WELDING 6mm C.F.W. U.N.O.

Adelaide Brighton Cement Ltd
Birkenhead Division
ACN 007 870 199

DRWN	CPO	12-01-00	
CHK,D			
PASS,D			
APP,D			
	INIT.	DATE	

SCALE: NTS

BIRKENHEAD SITE
KILN 4 AREA
PROCESS
FLOW DIAGRAM

REV

1. Introduction

1.1 Summary

In December 2022, Adelaide Brighton Cement Limited (ABC) undertook an increased alternative fuel substitution trial in the Calciner at its Birkenhead manufacturing facility (Calciner RDF Trial, or 'the trial'). The purpose of the trial was to determine and demonstrate the ability and benefit of the Calciner[1] to achieve a 100% thermal substitution rate (TSR) of the existing approved Refuse Derived Fuel (RDF), wherein RDF would become the control fuel.

This was proposed to be achieved by trialling an increased feed rate of the existing RDF, with a proposed instantaneous maximum feed rate to be determined as part of the trial. Comprehensive stack emissions testing was undertaken as part of the trial, in accordance with the AFRM trial management conditions of EPA Licence 1126.

The Calciner RDF Trial was undertaken successfully with stack emissions testing conducted between 6 December and 8 December (inclusive) 2022, in accordance with the EPA's *Emission Testing Methodology for Air Pollution (Version 2, August 2012)*. The results of stack emissions testing are presented within this Post-Trial Report prepared with regard to Schedule W-1.3 of the licence, which also presents an analysis of the results against the relevant air quality criteria expressed in the SA EPA's *Environment Protection (Air Quality) Policy 2016* (AQ EPP). This analysis additionally captures a comparison of stack testing data against baseline historical data from business-as-usual (BAU) stack testing undertaken routinely by ABC, expressed as historical averages and maxima.

Atypical particulate emission rates (TSP, PM_{10}, $PM_{2.5}$) that were unrelated to the trial[2] were observed around the trial period from Kiln Stack 4A, the release point for the rotary kiln. This occurred due to delays in the scheduled replacement of ageing electrostatic precipitator (ESP) components associated with Kiln Stack 4A. Maintenance previously scheduled was not been able to occur as planned due to supply constraints related to the SARS-CoV2 pandemic. The atypical particulate emissions from Kiln Stack 4A were unrelated to the RDF trial undertaken in the Calciner since the Calciner emissions report to the 4B Stack. The 4A and 4B stacks are sampled separately for the purposes of stack emissions testing, however ground level concentration (GLC) calculations take into account the cumulative emissions from both stacks, in addition to background sources. Additional stack testing conducted in March 2023 following completion of rescheduled maintenance to the Kiln Stack 4A ESP have shown that particulate emissions have returned to typical levels, consistent with efficient performance of the ESP.

ABC considers that the Calciner RDF Trial was successful, demonstrating the ability and benefit of the Calciner to operate safely at up to 100% TSR of RDF with a very low likelihood of adverse impacts to the environment or the surrounding community from air emissions. Results of the trial show that predicted GLCs from all parameters with the exception of oxides of nitrogen (NOx) are below the relevant criteria from the recently updated AQ EPP, and emissions from Calciner Stack 4B are broadly consistent with emission rates predicted by mass balance calculations in the pre-trial report submitted to the EPA on 19 July 2022 (Appendix B). Of note is the predicted particulate GLCs were below the AQ EPP criteria even with the higher contribution from the atypical (higher) particulate emissions from Kiln Stack 4A. The rescheduled maintenance and followup testing of Kiln Stack 4A demonstrate that there has been no change to the emissions profile from that stack, relative to BAU operations.

[1] Also referred to as the PreCalciner.

[2] Stack gases from the Kiln report to Kiln Stack 4A, and Calciner stack gases report to Calciner Stack 4B, as shown in **Figure 1-1**. There is no possibility for stack gases from the Kiln to be released from Calciner Stack 4B.

This Post-Trial Report includes a Summary of the Alternative Fuel and/or Raw Material (AFRM) Trial and an assessment of the suitability for ongoing use of RDF at the increased feed rate of up to 32 t/h determined by the trial. This report forms part of the submission by ABC requesting amendment of Licence 1126 to allow for the increased rate of RDF use in the Calciner at the Birkenhead Plant to an instantaneous maximum of 32 t/h. A Process Change Application will be submitted to the EPA to seek an amendment to the licence, and will be prepared in accordance with Licence Condition A-6 (Approval of Operating Processes), subject to feedback on this Post-Trial Report.

1.2 About ABC

Adelaide Brighton Cement Limited (ABC) operates within the Cement and Lime division of Adbri Ltd (Adbri), which has over 1400 employees with operations in all Australian states and territories. Adbri originated in 1882 and is an S&P/ASX 200 company whose main activities include the production of clinker, cement and lime products, premixed concrete and aggregates and concrete masonry products.

ABC has been a key employer in South Australia for over 110 years. ABC is one of South Australia's biggest manufacturers, with operations at Birkenhead, Angaston in the Barossa Valley and Klein Point on Yorke Peninsula. ABC's world class cement and clinker manufacturing plant at Birkenhead operates under EPA Licence 1126 and has been a part of Port Adelaide and South Australia for more than 100 years, providing employment opportunities for the community and producing approximately 1.6 million tonnes of cement annually. As a fully integrated cement manufacturing facility, the Birkenhead plant adds value to the South Australian manufacturing, mining and resources sector—particularly limestone and shale—which are manufactured into clinker and then ground to produce cement. In addition to the Birkenhead plant's supply to the South Australian market, ABC also exports cement to Victoria to service the Melbourne metropolitan market.

ABC acknowledges that clinker, cement, concrete, masonry and lime production are energy-intensive processes, and has continually sought to ensure the application of industry leading best practice across all sites, including the Birkenhead plant, in pursuit of the company's Sustainability targets[3]. Since 2010, Adbri has reported a 38% reduction in greenhouse gas (GHG) emissions across all of its sites. The company is working towards the goal of net zero emissions by 2050. ABC has been pursuing a strategy of continuous improvement in the environmental performance and sustainability of its operations, and contributes to the South Australian Government's circular economy objectives by progressively substituting approved alternative fuels for fossil fuels at the Birkenhead plant, beginning over 18 years ago.

The recently published Environmental Product Declaration[4] (EPD) indicates that the Type GP cement manufactured at Birkenhead has the lowest embodied carbon of any Type GP cement in Australia.

1.3 Current Licence and Operations

1.3.1 RDF use under Licence 1126

The current EPA Licence for the Birkenhead plant allows for the combustion of RDF under Schedule X-1 with a maximum plastics content of 20% by weight at a maximum feed rate of 25 t/h.

Under normal conditions, a combination of RDF and natural gas is consumed in the Calciner, with natural gas primarily used as the control fuel. Flow rates of natural gas are manipulated to control exit temperature from the Calciner, while the RDF feed rate remains relatively consistent. Normal fluctuations in RDF calorific value (CV), process chemistry, operating conditions and the thermal demand of the Calciner necessitate this variance in fuel input.

[3] https://www.adbri.com.au/sustainability/
[4] https://www.adbri.com.au/epd/

During periods of relatively low thermal demand and relatively high RDF CV, the Calciner at the Birkenhead plant has been observed to operate safely at 100% TSR of RDF under the existing 25 t/h maximum RDF feed rate.

1.4 Strategic Context

ABC through its Board has made a commitment to continue to seek to increase the sustainability of its operations and reduce its environmental footprint. In pursuit of this, ABC has committed to the Net Zero Emissions Roadmap[5] which includes a short term 5-year Sustainability Plans[6] and medium term targets to 2030. Under the 2019 5-Year Sustainability Plan, ABC has committed to 50% alternative fuel substitution across clinker kilns and an absolute reduction in CO_2 emissions of 7%. ABC is seeking to be Australia's lowest cost, lowest carbon cement producer[7]. Reforms by the Federal Government to the Safeguard Mechanism policy, which is administered through the National Greenhouse and Energy Reporting (NGER) scheme and seeks to provide a framework within which high-emitting industries and operations can reduce their reportable carbon emissions, enhance the importance of ABC's ongoing efforts to reduce carbon emissions to net zero by 2050.

In addition to this, the State Government through South Australia's Waste Strategy and the application of the *Environment Protection Act 1993* seeks to:

- Promote the principles of ecologically sustainable development.
- Protect, restore and enhance the quality of the environment.
- Regulate all aspects of waste management, and activities and products that cause environmental harm through the production of waste.
- Apply the waste management hierarchy.
- Promote the beneficial reuse of materials to contribute to a circular economy
- Support a strong market for recovered resources.

The decision to move towards the use of alternative fuels has been a strategic one by ABC. This decision along with the application of the waste management hierarchy aids in:

- Ensuring the best and safest use of recovered resources,
- Enabling the commercial separation of plastics for higher-use recycling,
- Reducing the reportable carbon emissions from ABC's operations,
- Reducing the amount of waste going to landfill and ending up in our environment, and
- Supporting South Australia's circular economy.

In doing so, ABC is aligning with EPA policies that actively promote the circulation of materials and a strong resource recovery market.

1.5 Details of the Approved Trial

On 19 July 2022, ABC submitted a Pre-Trial Report to the EPA, prepared with regard to Schedule W-1.1 of Licence 1126 (Appendix A). The objective of the trial was to ascertain the required feed rate of RDF to extend the operational time of the Calciner at 100% TSR RDF, and the benefits of doing so. It was predicted that in order to operate the Calciner at 100% TSR of RDF on an ongoing basis, the RDF feed rate would 'float' according to process requirements, as opposed to being fed at a continuous maximum rate. This accounts for variability

[5] https://www.adbri.com.au/sustainability/net-zero/
[6] https://www.adbri.com.au/sustainability/sustainable-future/
[7] https://www.adbri.com.au/wp-content/uploads/2022/11/2022-Adbri-Cement-Products-EPD-WebFinal.pdf

in the calorific value (CV) of RDF due to compositional variance and moisture content, as well as variance in Calciner thermal demand. To enable this to occur within licence limits, an instantaneous maximum RDF feed rate was predicted, which would allow the Calciner to operate at 100% TSR RDF in almost all normal and stable operating conditions.

The predicted instantaneous maximum feed rate of RDF to allow 100% TSR on an ongoing basis was calculated to be approximately 35 t/h, a rate which was anticipated only to be required for short periods when RDF exhibited a high moisture content (and relatively low CV) and the Calciner a high thermal demand. This calculation was based on the average CV range of RDF and the thermal demand range of the Calciner under normal operating conditions.

The objectives of the trial were to:

- Confirm the feed rate of RDF required by the Calciner to enable 100% TSR of RDF on an ongoing basis, and undertake process tuning to ensure stability.
- Allow for an extended period of operation at the higher proposed RDF feed rate, to allow adequate time to determine process parameters and conduct stack emissions testing under stable operating conditions at the increased RDF feed rate.
- Confirm the capacity of the RDF supplier to maintain the maximum proposed delivery rate of RDF on a consistent basis.
- Determine procedures for controlling RDF usage during periods of abnormal or unusual process conditions, including emergency response and shutdown events, if different from established controls.

On 1 September 2022, ABC received approval from the EPA to conduct the Calciner RDF trial at the Birkenhead plant.

2. Summary of AFRM Trial

2.1 Overview

The Calciner RDF trial was conducted according to the schedule proposed in the Pre-Trial Report (Appendix B). Comprehensive stack emissions sampling was conducted on both Kiln Stack 4A and Calciner Stack 4B during the trial by Airlabs Environmental Pty Ltd (Airlabs)[8] between 6th and 8th of December 2022 (inclusive), with the results initially reported in Airlabs Trial Air Emissions Monitoring Report dated 31 January 2023, and an Air Quality Impact Assessment Report that described the results from dispersion modelling of the measured emission rates. A revised monitoring report was subsequently issued on 4 April 2023 with corrections made to 4B stack gas temperatures that resulted in adjustments to the reported emission rates, and a revised Impact Assessment Report issued on 12 April 2023 that utilised the amended emissions rates for dispersion modelling. The modelling of stack testing data has been undertaken to provide predicted ground level concentrations (GLCs) for comparison with the ambient air criteria in the AQ EPP, which has recently been amended to reflect the changes to the National Environment Protection (Air Quality) Measure (NEPM) made in 2021. It is noted that the Pre-Trial Report was submitted to the EPA and approved prior to the release of the updated EPP. All data presented herein has been assessed and analysed against the updated AQ EPP.

[8] Airlabs are accredited to ISO/IEC17025 through the National Association of Testing Authorities (NATA), Accreditation No. 15463

2.2 Trial Timing and Fuel Consumption

Stack testing during the trial occurred over three consecutive days in December 2022, with average RDF feed rates entering the Calciner under trial conditions indicated in Table 2-1. At the time, the rotary kiln (reporting to Kiln Stack 4A) was operating under BAU conditions. The stack testing was commenced when stable operating conditions were achieved for the indicated average RDF feed rates.

Table 2-1: Trial Dates, RDF Fuel Consumption & Stack Testing

Date of Trial	Average RDF Feed Rate (t/h)	Duration of Stack Testing
6/12/2022	30.5	Approx. 8 hours 50 minutes
7/12/2022	31.6	Approx. 9 hours 30 minutes
8/12/2022	30.6	Approx. 14 hours 30 minutes

Over the course of stack testing, a total of 203 t of RDF was combusted that is directly attributable to the trial. This represents between 5 t/h and 7 t/h of additional RDF over and above BAU conditions at a maximum of 25 t/h.

Inclusive of baseline BAU RDF consumption of 25 t/h, a total of approximately 825 t of RDF was combusted in the course of stack testing.

2.3 Receival, Storage and Feed Method

Under normal operations, RDF is delivered to site in enclosed walking floor trucks. RDF is transferred to purpose-built storage bunkers within a fully enclosed containment structure to mitigate noise and dust emissions. From the storage bunker locations, RDF is conveyed and dosed to the target consumption rate, and then pneumatically transported in fully enclosed conveyance structures directly into the Calciner vessel.

RDF for the trial was delivered to site in enclosed walking floor trucks and was fed into the Calciner utilising the existing feed system, with no modifications or divergence from standard operating procedures required. As such the storage and feed procedures undertaken were consistent with normal operations and subject to existing risk mitigation and control methodologies. Existing receival, storage and conveyance equipment was shown to have adequate capacity to accommodate and efficiently combust RDF at a higher feed rate.

2.4 Demonstration of Beneficial Purposes

Historically, input materials in the manufacture of RDF have been disposed to landfill. When processed appropriately and in compliance with the requirements of the Standard, ABC has been able to demonstrate from almost twenty years of continuous use that RDF is a viable substitute for fossil fuels in its cement clinker manufacturing process. Use of RDF in this way reduces natural resource use and is a major contribution to the Government's zero waste philosophy, demonstrating tangible support for the waste hierarchy and assisting to move toward a circular economy.

Presently approved BAU conditions allow for RDF to be combusted in the Calciner up to 25 t/h. This represents, on average, a TSR of approximately 80%, subject to CV variability and thermal demand.

Increasing RDF usage to an instantaneous maximum of 32 t/h presents environmental and raw material conservation benefits commensurate with previous licence amendments and increases, including:

- Beneficial re-use of a material with no other current viable use. The proposed maximum feed rate of RDF (32 t/h) does not displace South Australia's total generation of the materials which contribute to the manufacture of RDF, which means there is still a significant surplus sent to landfill.
- The previous process change to utilise up to 25 t/h of RDF (an additional 10 t/h from the approved rate at that time) accounted for the additional diversion of 50,000 tonnes per annum of construction,

demolition, commercial and industrial waste from landfill, to be processed into an alternative fuel product.
    - It is anticipated that the proposed further increase in RDF use will provide a further increase in materials diverted from landfill to beneficial reuse as a manufactured alternative fuel product for use in cement manufacturing.
    - Actual usage of RDF under the proposed increased maximum is anticipated to vary between 27 to 32 t/h, depending on the CV of the RDF and the thermal demand of the Calciner.
- The approved RDF product contains 15% ash (annual average), which is primarily sand and clay minerals. These are useful raw materials in cement manufacture. Each 10 t/h increase in RDF consumption in the Calciner represents a substitution of approximately 10,000 tonnes per annum of mined clay.
- It has been observed through regular operations that an RDF consumption rate of 25 t/h of RDF represented the displacement of natural gas to approximately 80% TSR, based on an average RDF calorific value (CV) of 13 GJ/t.
    - Correspondingly, a further increase from the current 25 t/h to an increased rate with an instantaneous maximum of 32 t/h of RDF facilitates almost 100% thermal substitution of natural gas input into the Calciner on an ongoing basis, allowing the fuel input to 'float' according to process requirements and RDF variability within the parameters of the licence.

2.5 Demonstrated Support for the Waste Hierarchy

The proposed increase in RDF usage to an instantaneous maximum of 32 t/h is an extension of the existing approval for use in the Birkenhead plant. The RDF has an average calorific value of 13 GJ/t (range 11 to 15 GJ/t) which reflects compositional variance, particularly moisture, and so displaces a predictable quotient of traditional fuel input.

Cement production is a carefully controlled process, where exact product specifications must be met for quality reasons. Consequently, cement kilns are not utilised as incinerators for disposal of general waste, with fuel production and use required to meet defined quality specifications. Combustion of RDF in cement production is primarily an energy and mineral recovery activity. When assessed against the waste hierarchy, this is preferable to disposal into landfill. If ABC were not to use RDF, disposal to landfill would continue and use of a fossil fuel (natural gas) would continue along with the need to mine additional limestone and shale. Waste is therefore diverted from landfill to a more sustainable and useful purpose by manufacturing to specification into an alternative fuel product that displaces a thermal requirement which would otherwise continue to be derived from finite fossil fuel resources, additionally resulting in reduced mineral extraction requirements.

ABC recognises that community perception of the utilisation of alternative fuels is an important issue. The production method for the approved RDF effectively segregates and separates materials and components recyclable through established pathways prior to the alternative fuel production. This means that waste that is otherwise recoverable is not being consumed as RDF, and the RDF comprises only materials which are inert, and not otherwise recoverable. Technologies in this space have advanced since ABC undertook the company's first trials of RDF in 2003, reflected in process changes undertaken in the intervening years. The use of these materials to produce an RDF is a commercial enabler of higher-order waste recycling.

ABC concludes that extending the use of RDF in this manner demonstrates clear and vital support for the waste hierarchy and aligns with State Government objectives to support a strong resource recovery market and pursue a circular economy.

2.6 Community Engagement

Due to its metropolitan location and proximity to residential areas on the LeFevre Peninsula, ABC's Birkenhead operation places a high priority on working with local communities and key stakeholders.

As part of the Pre-Trial Report submitted to the EPA on 19 July 2022, ABC committed to uphold the EPA's expectation of effective engagement with the local Birkenhead community, and as expressed in Licence Conditions U-1552 and U-1553.

ABC's intention to undertake the Calciner RDF trial, and information pertaining to the trial's nature and duration, was communicated prior to commencement to:

- ABC Birkenhead employees
- EPA Communications team
- The Birkenhead CLG, via:
    - Briefing at the CLG meeting,
    - Direct email communication from the CLG Chair, and
    - The Birkenhead Community website (https://adelaidebrightoncommunity.com.au/), including:
        - Information on RDF:
            - https://adelaidebrightoncommunity.com.au/alternative-fuels-and-raw-materials/Calciner-rdf/
            - https://adelaidebrightoncommunity.com.au/alternative-fuels-and-raw-materials/faqs/
        - Notification of the RDF trial and progress:
            - https://adelaidebrightoncommunity.com.au/news-resources/latest-news/
- The Member for Port Adelaide and SA Minister for Climate, Environment and Water, Dr Susan Close MP, via written brief.

The preliminary outcomes of the trial were presented to the CLG at the quarterly meeting on 20 March 2023.

Feedback received from the community at the quarterly CLG meeting included some minor confusion as to the nature of the RDF which had been trialled. ABC was able to clarify that the alternative fuel used during the trial was the same RDF used successfully for many years, and not a product derived from municipal solid waste as previously reported in the media.

Discussions with the CLG also included the forthcoming Safeguard Mechanism federal emissions reduction policy, and the importance of alternative fuel substitution in ensuring ABC can continue to meet and exceed environmental standards.

Further community consultation and communication is planned to occur in accordance with the Community Engagement Plan established under Licence condition U-1552, having regard to the EPA's comments and feedback on the Post-Trial Report and as part of a future Process Change Application, subject to the acceptability of trial outcomes to the EPA. For the purpose of future and ongoing community consultation, ABC will utilise the communications channels highlighted above.

3. Stack Emissions Testing

3.1 Overview

Stack emissions testing was conducted on both Kiln Stack 4A and Calciner Stack 4B between 6 December and 8 December 2022 (inclusive). The RDF trial was undertaken solely in the Calciner, with stack gases reporting to Calciner Stack 4B. Emissions testing captures emissions from the two stacks at the Birkenhead Plant separately, to enable predicted cumulative GLC calculations to be undertaken.

Airlabs utilised the same sampling and analysis methods for the trial stack testing and measured the same parameters as for routine emissions testing. This facilitates a direct comparison of the data from the RDF trial with historical emissions testing data.

Around the time of the trial, atypical emissions of particulates (TSP, PM_{10} and $PM_{2.5}$) were recorded from Kiln Stack 4A, which while unrelated to the Calciner RDF Trial will have affected the predicted particulate GLCs. However the atypical particulate emissions did not give rise to predicted particulate GLCs that exceeded the AQ EPP criteria. With the exception of NOx, predicted GLCs of all parameters were below relevant AQ EPP criteria. A summary of follow-up particulate testing of Kiln Stack 4A following rescheduled maintenance is presented in Section 3.3 that demonstrates satisfactory ESP performance was restored.

3.2 Results of Stack Emissions Testing

The results of the emissions testing are shown in Table 3-1 (emissions concentrations) and Table 3-2 (emissions rates). Values with the < prefix represent concentrations at the lower limit of detection (LOD).

Whilst not directly related to the RDF increase as part of this trial, data from Kiln Stack 4A has been included in this report in consideration of the predicted cumulative GLC calculations presented in Table 3-5.

Table 3-1: Stack Emissions Concentrations from RDF trial

Parameter	Kiln Stack 4A (mg/Nm³)			Calciner Stack 4B (mg/Nm³)		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Total Solid Particulates	180	90	35	0.43	3.3	5.6
PM_{10}	140	76	31	0.43	3.1	4.8
$PM_{2.5}$	87	49	19	0.38	2.5	2.9
Sulfur Dioxide	27	30	36	< 2	< 2	< 2
Carbon Monoxide	150	66	35	450	510	340
Oxides of Nitrogen (as NO_2)	1,200	910	940	602	603	586
Hydrogen Chloride	0.27	0.61	1.2	0.68	0.30	0.47
Chlorine	0.44	0.27	0.26	0.92	0.14	0.26
Fluoride (as HF)	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Total VOCs	0.045	0.097	0.19	0.22	0.66	0.24
Benzene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Total Multi-Metals	4.0	1.7	1.1	0.097	0.37	1.1
Chromium VI and Compounds	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
PAHs (BaP-TEQ)	4.8E-06	6.3E-06	5.4E-06	5.4E-06	5.8E-06	5.9E-06
PCDDs and PCDFs total	4.4E-08	1.7E-08	4.0E-08	2.4E-09	5.6E-09	1.1E-08
PCDDs and PCDFs WHO_{05}TEQ	4.7E-09	2.1E-09	3.5E-09	5.4E-10	6.5E-10	7.3E-10
PCDDs and PCDFs $NATO_{89}$ I-TEQ	5.9E-09	2.6E-09	4.3E-09	4.1E-10	5.1E-10	6.0E-10
Antimony and its compounds	0.00088	0.00048	0.00020	<0.0003	0.000054	0.000075
Arsenic and its compounds	0.0015	0.00063	0.00033	<0.0003	0.000090	0.00016
Barium (soluble compounds)	0.016	0.0056	0.0052	0.00035	0.00098	0.00051

Parameter	Kiln Stack 4A (mg/Nm^3)			Calciner Stack 4B (mg/Nm^3)		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Beryllium and its compounds	0.000027	<0.0002	<0.0002	<0.0003	<0.0004	<0.0003
Cadmium and its compounds	0.0017	0.0014	0.0013	0.000030	0.000045	<0.00006
Chromium (III) and its compounds	0.034	0.015	0.0088	0.00096	0.014	0.019
Copper oxide fume (as CuO)	0.012	0.0079	0.0056	0.000050	0.00040	0.00069
Iron oxide fume (as Fe_2O_3)	2.4	1.1	0.75	0.049	0.31	1.0
Lead and its compounds	0.031	0.025	0.019	0.00039	0.00079	0.00038
Magnesium oxide fume (as MgO)	1.3	0.45	0.30	0.031	0.030	0.049
Manganese and its compounds	0.063	0.041	0.023	0.0012	0.0044	0.0082
Mercury and its compounds (as Hg) - organic	0.00010	0.00010	0.00010	0.000067	0.000052	0.000084
Mercury and its compounds (as Hg) - inorganic	0.0012	0.0021	0.00094	0.0081	0.0074	0.0071
Mercury and its compounds (as Hg) - total	0.0013	0.0022	0.0010	0.0082	0.0074	0.0072
Nickel and its compounds	0.013	0.0049	0.0023	0.00064	0.0029	0.0026
Zinc oxide fume (as ZnO)	0.058	0.023	0.030	0.0053	0.0096	0.0097

Notes: PAH and dioxins concentrations in Excel scientific format.

Dioxins concentrations include half detection limit values for non-detect congeners

Table 3-2: Stack Emission Rates from RDF trial

Parameter	Kiln Stack 4A (g/s)			Calciner Stack 4B (g/s)		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Total Solid Particulates	1.67E+01	9.50E+00	4.00E+00	3.67E-02	3.00E-01	5.00E-01
PM_{10}	1.35E+01	8.00E+00	3.50E+00	3.67E-02	2.83E-01	4.33E-01
$PM_{2.5}$	8.33E+00	5.17E+00	2.17E+00	3.17E-02	2.33E-01	2.67E-01
Sulfur Dioxide	2.67E+00	3.17E+00	4.00E+00	1.67E-01	1.67E-01	1.67E-01
Carbon Monoxide	1.45E+01	7.00E+00	4.00E+00	3.83E+01	4.67E+01	3.00E+01
Oxides of Nitrogen (as NO_2)	1.15E+02	9.67E+01	1.07E+02	5.12E+01	5.47E+01	5.27E+01
Hydrogen Chloride	2.67E-02	6.50E-02	1.37E-01	5.83E-02	2.67E-02	4.17E-02
Chlorine	4.17E-02	2.83E-02	3.00E-02	7.83E-02	1.13E-02	2.33E-02
Fluoride (as HF)	1.00E-02	3.33E-02	1.67E-02	1.67E-02	1.67E-02	1.67E-02
Total VOCs	4.33E-03	1.02E-02	2.17E-02	1.83E-02	6.00E-02	2.17E-02
Benzene	3.33E-03	3.33E-03	3.33E-03	3.33E-03	3.33E-03	3.33E-03
Total Multi-Metals	3.83E-01	1.83E-01	1.25E-01	8.33E-03	3.33E-02	9.83 E-02

Parameter	Kiln Stack 4A (g/s)			Calciner Stack 4B (g/s)		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Chromium VI and Compounds	1.00E-05	1.00E-05	1.17E-05	8.33E-06	8.33E-06	8.33E-06
PAHs (BaP-TEQ)	4.67E-07	6.67E-07	6.17E-07	4.50E-07	5.33E-07	5.33E-07
PCDDs and PCDFs total	4.17E-09	1.83E-09	4.50E-10	2.00E-10	5.17E-10	9.83E-10
PCDDs and PCDFs WHO$_{05}$TEQ	4.50E-10	2.17E-10	4.00E-10	4.67E-11	5.83E-11	6.50E-11
PCDDs and PCDFs NATO$_{89}$ I-TEQ	5.67E-10	2.83E-10	4.83E-10	3.50E-11	4.67E-11	5.33E-11
Antimony and its compounds	8.50E-05	5.00E-05	2.33E-05	3.33E-05	4.83E-06	6.67E-06
Arsenic and its compounds	1.45E-04	6.67E-05	3.67E-05	3.33E-05	8.17E-06	1.43E-05
Barium (soluble compounds)	1.53E-03	5.83E-04	5.83E-04	3.00E-05	8.83E-05	4.50E-05
Beryllium and its compounds	2.67E-06	1.67E-05	1.67E-05	3.33E-05	3.33E-05	3.33E-05
Cadmium and its compounds	1.63E-04	1.47E-04	1.47E-04	2.50E-06	4.17E-06	5.00E-06
Chromium (III) and its compounds	3.33E-03	1.58E-03	1.00E-03	8.17E-05	1.30E-03	1.67E-03
Copper oxide fume (as CuO)	1.15E-03	8.33E-04	6.33E-04	4.33E-06	3.67E-05	6.17E-05
Iron oxide fume (as Fe_2O_3)	2.33E-01	1.17E-01	8.50E-02	4.17E-03	2.83E-02	9.00E-02
Lead and its compounds	3.00E-03	2.67E-03	2.17E-03	3.33E-05	7.17E-05	3.33E-05
Magnesium oxide fume (as MgO)	1.25E-01	4.67E-02	3.33E-02	2.67E-03	2.67E-03	4.33E-03
Manganese and its compounds	6.00E-03	4.33E-03	2.67E-03	1.02E-05	4.0 E-04	7.33E-04
Mercury and its compounds (as Hg) - organic	9.67E-06	1.05E-05	1.13E-05	5.67E-06	4.67E-06	7.50E-06
Mercury and its compounds (as Hg) - inorganic	1.15E-04	2.17E-04	1.07E-04	6.83E-04	6.67E-04	6.33E-04
Mercury and its compounds (as Hg) - total	1.25E-04	2.33E-04	1.13E-04	7.00E-04	6.67E-04	6.50E-04
Nickel and its compounds	1.25E-03	5.17E-04	2.67E-04	5.50E-05	2.67E-04	2.33E-04
Zinc oxide fume (as ZnO)	5.67E-03	2.50E-03	3.33E-03	4.50E-04	8.67E-04	8.67E-04

Note: emission rates in Excel scientific format

3.3 Kiln Stack 4A particulate emissions after ESP repair

As discussed above, the particulate (TSP, PM_{10} and $PM_{2.5}$) emission concentrations and rates recorded for Kiln Stack 4A were atypical compared with historical values around the trial period. Planned maintenance to the Kiln Stack 4A ESP was rescheduled due to parts supply constraints related to the SARS-CoV2 pandemic. Stack testing of TSP has now been carried out since rescheduled maintenance to the ESP occurred in January 2023,

and the results confirm the restoration of particulate emissions from Kiln Stack 4A to typical levels. Table 3.3 shows a comparison of the average TSP emissions concentrations from June 2017 – April 2022, then individual runs and averages for October 2022, the RDF trial in December 2022 and the most recent testing conducted in March 2023.

Table 3.3: 4A Stack particulate (TSP) emission rates (prior to and after ESP maintenance)

Stack test	TSP concentration (mg/Nm^3)				
	Run 1	Run 2	Run 3	Run 4	Average
June 2017-April 2022 (average)					7.5
October 2022	18	20	32	-	23
December 2022 (RDF trial)	180	90	35	98	101
March 2023 (after ESP repair)	12	12	11	13	12

These data demonstrate that the atypical TSP emissions recorded in December 2022 were temporary, and rescheduled maintenance has restored the full effectiveness of the Kiln Stack 4A ESP. Notwithstanding temporarily elevated TSP emissions on Kiln Stack 4A, the emissions from Calciner Stack 4B are of primary interest with respect to the Calciner RDF trial, and the abnormal TSP emissions from Kiln Stack 4A were unrelated to that trial.

3.4 Significance of results

3.4.1 Emissions Concentrations

The significance of the concentrations measured for the various parameters is assessed in respect of trigger action and response concentrations prescribed in EPA Licence 1126 (1 November 2022), noting that air quality criteria expressed in the AQ EPP and Licence conditions were updated following EPA approval of the Pre-Trial Report to align with the updated NEPM.

In addition to the standard GLC limits expressed in Schedule 2 of the AQ EPP, Licence Conditions 1.3 and 1.4, which relate to stack particulate emission concentrations, were amended effective 1 November 2022, with the effect of:

- Particulate emissions (as TSP) from Kiln Stack 4A trigger action and response concentrations reduced from 100 mg/Nm^3 at STP dry basis to 80 mg/Nm^3 at STP dry basis, and
- Particulate emissions (as TSP) from Calciner Stack 4B trigger action and response concentrations reduced from 60 mg/Nm^3 at STP dry basis to 50 mg/Nm^3 at STP dry basis.[9]

TSP concentrations from Kiln Stack 4A exceeded the trigger action and response concentrations for Run 1 (180 mg/Nm^3) and Run 2 (90 mg/Nm^3), as a consequence of the atypical performance of the 4A ESP as previously discussed. The Calciner Stack 4B TSP concentrations were well below the trigger concentrations in the licence, well within historical variance and below historical maxima.

The Calciner Stack 4B ESP was performing as normal at the time of the trial and during stack testing. Residual particulates from combustion of RDF in the Calciner reports to the Calciner Stack 4B ESP. Very low TSP emission concentrations were recorded from Calciner Stack 4B during the trial (0.43, 3.3 and 5.6 mg/Nm^3 for the three runs). This suggests in the increased RDF combustion rate has no materially significant impact on TSP emissions concentrations from Calciner Stack 4B.

[9] "Calciner" has been used in this report instead of "Precalciner" as referred to in the Licence.

3.4.2 Emissions rates

A comparison of emission rates for all measured parameters with historical emission rates has been carried out to ascertain the impact of increased RDF combustion rate during the trial. This assessment has considered the historical maximum emission rates for each parameter as a benchmark to determine if the rates observed from the trial are materially different. If the emission rates are below the historical maxima then the impact of increased RDF combustion is considered of no material significance. However, if the emission rates are higher than the maxima then the significance is determined from risk posed by emissions of that parameter at ground level in the nearby community (Section 3.4.3).

The results of the comparison of emission rates from the RDF trial and historical emission rates from June 2017 to October 2022 stack testing are summarised in Table 3-4. Emission rates that are within the historical range are described as "in range" in the table and rates that exceed the maximum historical rate are described as ">max". It is noted that an emission rate described as ">max" refers only to that parameter being higher than the historically recorded maximum from the Birkenhead Plant. It does not indicate an exceedance of the relevant air quality criterion from the EPP.

Table 3-4: Comparison of emission rates with historical maximum rates

Parameter	Kiln Stack 4A			Calciner Stack 4B		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Total Solid Particulates	>max	>max	>max	in range	in range	in range
PM_{10}	>max	>max	>max	in range	in range	in range
$PM_{2.5}$	>max	>max	>max	in range	in range	in range
Sulfur Dioxide	in range	in range	in range	in range	in range	in range
Carbon Monoxide	>max	in range	in range	in range	in range	in range
Oxides of Nitrogen (as NO_2)	in range	in range	in range	in range	in range	in range
Hydrogen Chloride	in range	in range	in range	in range	in range	in range
Chlorine	in range	in range	in range	in range	in range	in range
Fluoride (as HF)	in range	in range	in range	in range	in range	in range
Total VOCs	in range	in range	in range	in range	in range	in range
Benzene	in range	in range	in range	in range	in range	in range
Total Multi-Metals	>max	in range	in range	in range	in range	in range
Chromium VI and Compounds	in range	in range	in range	in range	in range	in range
PAHs (BaP-TEQ)	in range	in range	in range	in range	in range	in range
PCDDs and PCDFs total	in range	in range	in range	in range	in range	in range
PCDDs and PCDFs WHO_{05}TEQ	in range	in range	in range	in range	in range	in range
PCDDs and PCDFs $NATO_{89}$ I-TEQ	>max	in range	in range	in range	in range	in range
Antimony and its compounds	>max	>max	in range	in range	in range	in range
Arsenic and its compounds	>max	>max	in range	in range	in range	in range
Barium (soluble compounds)	>max	in range	in range	in range	in range	in range
Beryllium and its compounds	in range	in range	in range	in range	in range	in range
Cadmium and its compounds	>max	>max	>max	in range	in range	in range

Parameter	Kiln Stack 4A			Calciner Stack 4B		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Chromium (III) and its compounds	>max	in range	in range	in range	in range	>max
Copper oxide fume (as CuO)	in range	in range	in range	in range	in range	in range
Iron oxide fume (as Fe_2O_3)	>max	>max	in range	in range	in range	>max
Lead and its compounds	>max	>max	>max	in range	in range	in range
Magnesium oxide fume (as MgO)	in range	in range	in range	in range	in range	in range
Manganese and its compounds	>max	in range	in range	in range	in range	in range
Mercury and its compounds (as Hg) - organic	in range	in range	in range	in range	in range	in range
Mercury and its compounds (as Hg) - inorganic	in range	in range	in range	in range	in range	in range
Mercury and its compounds (as Hg) - total	in range	in range	in range	in range	in range	in range
Nickel and its compounds	in range	in range	in range	in range	in range	in range
Zinc oxide fume (as ZnO)	in range	in range	in range	in range	in range	in range

With the exception of Chromium (III) and Iron Oxide, emission rates for Calciner Stack 4B are within the historical rates which are further discussed in Section 3.4.3. This suggests the increased combustion rate of RDF does not significantly impact on emission rates.

The Calciner Stack 4B Chromium (III) emission rates increased from a maximum of 0.0016 g/s from June 2017 to October 2022 stack testing to 0.0017 g/s for Run 3 from the RDF trial. The predicted ground level concentrations (GLCs) for dispersion modelling of emissions of this parameter from both stacks is < 1% of the AQ EPP criteria, which suggests the higher emission rates observed from Calciner Stack 4B for Run 3 of the RDF trial is of little significance.

Similarly, Calciner Stack 4B Iron Oxide emissions increased from the historical maximum rate of 0.043 g/s to 0.090 g/s for Run 3 from the RDF trial. The predicted cumulative GLC of this parameter represents 2.4% of the AQ EPP criteria, so the increase from the historical maximum is of little significance.

As discussed, the particulate (TSP, PM_{10} and $PM_{2.5}$) emissions rates from Kiln Stack 4A, in addition to several metals, were recorded higher than historical emission rates during stack emissions testing. The increases in the metals emission rates from Kiln Stack 4A are not consistent with the increases in particulates which suggests a relatively small contribution of the indicated metals to the total particulate matter. The metals emission rates from both stacks are (in absolute terms) very low, and as shown from the dispersion modelling give rise to predicted GLCs that are well below AQ EPP criteria. Therefore the increases in the indicated Kiln Stack 4A metals emissions rates are of no material significance.

3.4.3 Emissions impact assessment

Dispersion modelling was carried out using the average emission rates from the three stack sampling runs conducted during the trial for each stack. This is consistent with modelling conducted along with the routine biannual stack testing since June 2017, and demonstrates the expected ongoing emissions profile of combusting up to 32 t/h of RDF on an ongoing basis in the Calciner. Notably, results of the stack emissions testing undertaken during the trial may be regarded as a 'worst case' scenario, since the trial was operated at a continuous feed rate of 31 – 32 t/h of RDF. Under BAU conditions utilising RDF up to 100% TSR in the Calciner, the feed rate of RDF to the Calciner is anticipated to 'float' between approximately 23 and 32 t/h, resulting in a long-term average RDF consumption lower than the proposed instantaneous maximum.

Details of the modelling methodology and predicted GLCs are provided in the Airlabs Air Quality Impact Assessment Report dated 12 April 2023. The predicted GLCs shown in Table 3-5 were compared with the most recent (October 2022) AQ EPP criteria that included removal of the annual average AQ concentration criterion for SO_2 and reductions in the criteria concentrations for NOx (1-hour and annual averages) and SO_2 (1-hour and 24-hour averages). The average and maximum historical cumulative GLCs (from June 2017 to October 2022) for each parameter are also shown in Table 3-5. It is noted that the calculated exceedance of the AQ EPP NOx criteria is not reflective of an increase in NOx emissions from the Birkenhead Plant, but rather is related to the reduction in the relevant EPP criterion. This is discussed further below.

Table 3-5: Predicted GLCs as percentages of the AQ EPP Concentrations

Parameter	Averaging Period	RDF trial - cumulative GLC as % of AQ EPP criteria	Average 2017-2022 cumulative GLC as % of AQ EPP criteria	Maximum 2017-2022 cumulative GLC as % of AQ EPP criteria
Nitrogen Dioxide (NO_2)	1 hour	106.8%	93.6%	118.1%
	Annual	39.3%	39.2%	40.2%
Sulfur dioxide (SO_2)	1 hour	22.9%	6.0%	25.4%
	24 hours	10.3%	3.3%	7.0%
Carbon monoxide (CO)	1 hour	2.2%	2.3%	4.0%
	8 hours	3.0%	3.0%	3.3%
Particulate matter (PM_{10})	24 hours	49.6%	37.8%	39.6%
Particulate matter ($PM_{2.5}$)	24 hours	46.4%	31.0%	33.2%
	Annual	95.6%	91.8%	92.5%
Antimony and compounds	3 minutes	0.01%	0.01%	0.01%
Arsenic and compounds	3 minutes	1.6%	0.70%	1.6%
Barium (soluble compound)	3 minutes	0.14%	0.51%	5.2%
Benzene	3 minutes	0.34%	1.1%	2.0%
	Annual	0.004%	0.01%	0.03%
Beryllium and compounds	3 minutes	15.0%	17.4%	23.6%
Cadmium and compounds	3 minutes	12.2%	5.6%	36.1%
Chromium (III) compounds	3 minutes	0.37%	0.18%	0.37%
Chromium (VI) compounds	3 minutes	0.25%	3.2%	18.0%
Copper oxide fumes	3 minutes	0.41%	0.33%	1.2%
Iron oxide fumes	3 minutes	2.4%	0.84%	1.5%
Lead (as particles)	Annual	0.03%	0.01%	0.03%
Magnesium oxide fumes	3 minutes	0.56%	1.4%	12.8%
Manganese & compounds	3 minutes	0.36%	0.22%	0.61%
Mercury - inorganic	3 minutes	0.55%	0.40%	1.4%
Mercury - organic	3 minutes	0.11%	0.56%	5.6%
Nickel & compounds	3 minutes	5.8%	5.5%	17.1%
Zinc oxide	3 minutes	0.06%	0.12%	0.54%
PAH (as Benzo(a)pyrene) (BaP-TEQ_{PAH})	3 minutes	0.004%	0.01%	0.05%

Parameter	Averaging Period	RDF trial - cumulative GLC as % of AQ EPP criteria	Average 2017-2022 cumulative GLC as % of AQ EPP criteria	Maximum 2017-2022 cumulative GLC as % of AQ EPP criteria
PAH (as Benzo(a)pyrene) (Bap-TEQ_{PAH})	Annual	0.02%	0.08%	0.24%
Hydrogen chloride	3 minutes	1.1%	8.0%	29.4%
Chlorine	3 minutes	1.6%	11.2%	35.3%
Fluoride (as HF)	24 hours	1.0%	1.1%	2.1%
	7 days	0.40%	0.46%	0.85%
	90 days	0.40%	0.39%	0.86%
Polychlorinated Dioxins & Furans (NATO-ITEQ)	90 days	0.35%	0.26%	1.2%

Key findings from the dispersion modelling using data from stack emissions testing during the trial are:

- Aside from NOx, the cumulative GLCs of all parameters from the RDF trial were below the respective AQ EPP criteria during the trial;
- The predicted maximum 1-hour average NOx GLC when combined with the assigned background was 106.8% of the criteria;
- For the remainder of emissions, the highest GLCs from the RDF trial as a percentage of the AQ EPP criteria are predicted for the annual average $PM_{2.5}$ (95.6%), 24-hour average PM_{10} (49.6%), 24-hour average $PM_{2.5}$ (46.4%), 1-hour average SO_2 (22.9%) and annual average NOx (39.3%);
- GLCs for all other parameters recorded during the trial are less than 12.2% of the respective AQ EPP criteria;
- The annual average $PM_{2.5}$ cumulative GLCs are largely due to the background (96% of total);
- NOx cumulative GLCs are largely driven by stack emissions (93%);
- A comparison of cumulative GLCs from RDF trial with historical GLCs (as percentage of the AQ EPP criteria) shows:
    - The trial 1-hour average NOx GLC is marginally higher than the historical average and lower than the historical maximum;
    - The 1-hour SO_2 GLC is higher than the historical average and lower than the historical maximum;
    - The 24-hour SO_2 GLC is higher than the historical average and maximum;
    - CO GLC is lower than the historical average and maximum;
    - PM_{10} GLC is higher than the historical average and maximum;
    - $PM_{2.5}$ GLCs (24-hour and annual) are higher than the historical average and maximum.

During the trial, the emission rates of Chromium (III) and Iron Oxide Fume from Calciner Stack 4B were recorded to be higher than historical maxima (Table 3-4). Emission rates of these parameters also exceed the historical maxima for Kiln Stack 4A. Although the latter is not attributed to the increase in RDF combustion occurring in the Calciner, it is a consideration in the modelling that informs predicted cumulative GLCs. The predicted cumulative GLC of Chromium (III) represented 0.37% of the EPP criterion for Chromium (III). This is

equivalent to the historical maximum cumulative GLC as a percentage of the criterion. This suggests no material change to the potential impact on the environment or people from this parameter as a result of an increase in RDF combustion in the Calciner.

The predicted cumulative GLC of Iron Oxide represented 2.4% of the EPP criterion, which is higher than the historical maximum cumulative GLC of 1.5%. The extent to which the predicted cumulative GLC of Iron Oxide Fume is below the EPP criterion suggests a low risk of adverse impacts on the environment or people from this parameter as a consequence of the increase in RDF combustion in the Calciner.

As indicated above, the predicted cumulative maximum 1-hour average GLC of NOx slightly exceeds the EPP criterion (106.8%). It is noted that emission rates and concentrations of NOx recorded during the trial are within range of historical emissions from the Birkenhead Plant, and the exceedance of the EPP criterion is reflective of the recent amendment of the AQ EPP, which reduced the reportable threshold of NOx emissions. The measured NOx emission rate does not represent a statistically significant increase in NOx from the Birkenhead Plant. The extent to which the calculated GLC of NOx exceeds the EPP criterion is well within the uncertainty of the modelling methodology.[10]

NOx emissions are predominantly related to flame temperature. When compared to natural gas, RDF combusts with a lower flame temperature and longer fuel residence time in the combustion vessel, which suggests that an increase in the TSR of RDF in the Calciner is unlikely to increase NOx emissions from the Birkenhead Plant.

Predicted cumulative GLCs for the remaining parameters are below their respective AQ EPP criteria, also suggesting a low risk of adverse impacts on the environment or neighbouring community from the increase in RDF combustion in the Calciner.

3.4.4 Operational Considerations Associated with RDF use

The modelling predictions suggest a low risk to human health at nearby community locations from stack emissions from combustion of an increased RDF rate up to an instantaneous maximum of 32 t/h in the Calciner. The likelihood of higher emissions occurring from upsets in the RDF feed system is mitigated by the automatic shutdown procedures that can be initiated to cease RDF feeding at the higher rates and to reinstate natural gas as the control fuel. This is commensurate with established risk management procedures at the Birkenhead plant. Other considerations from the trial in respect of an ongoing low risk from emissions from 100% TSR of RDF are:

- The trials successfully demonstrated that storage, conveyance and firing equipment already onsite has adequate capacity to facilitate a higher feed rate of RDF with satisfactory control.
- The Calciner is able to be operated safely at 100% TSR of RDF on an ongoing basis, with RDF feed rate able to be adjusted in response to thermal demand. This can be effectively achieved through the existing dosing and conveyance infrastructure at the plant.
- The increased feed rate of RDF was maintained for an extended duration, as per EPA requirements.
    - Note that maintaining a consistently high feed rate is not necessarily representative of ongoing operations, and the predicted 35 t/h exceeded the thermal demand of the Calciner at the time of the trial, resulting in a lower feed rate.
    - Notwithstanding, the demonstrated process stability at a feed rate of 31.6 t/h will enable ABC to operate the Calciner at close to 100% TSR of RDF on an ongoing basis, accounting for the inherent variability of the RDF CV due to compositional variance and moisture content.

[10] USEPA (2003) advises that errors in the maximum predicted GLCs of ±10 to 40% are typically observed for models such as CALPUFF. (See Chapter 10 of https://www.govinfo.gov/content/pkg/FR-2003-04-15/pdf/03-8542.pdf)

- It is anticipated that during the colder, wetter months the CV of RDF will be lower (due to higher moisture content), necessitating higher feed rates to maintain 100% TSR. At an instantaneous maximum of 32 t/h RDF, this may necessitate some ongoing use of natural gas to meet thermal demand.

- Overall, the Calciner RDF trial was successful, and use of RDF up to 32 t/h is considered to pose a low risk of adverse impacts to the environment or adjacent communities, while contributing to ABC's stated environmental commitments and supporting South Australian Government policies around the waste hierarchy, resource recovery and circular economy objectives.

3.4.5 Community Feedback During Trial

The trial was communicated to all stakeholders in advance of trial activity commencing, and no complaints or feedback was received from the community relating to the execution of the trial.

ABC recognises the importance of maintaining open and transparent lines of communication with neighbouring communities, businesses and other stakeholders, and the importance of taking positive steps in pursuit of environmental protection, preservation and restoration.

A key parameter of ABC's commitment to the Birkenhead, LeFevre Peninsula and Port Adelaide communities, as well as the State more broadly, is the company's ongoing pursuit of continuous environmental improvement. In accordance with Condition U-1553 (Clause 3.5) of License 1126, ABC maintains a 24/7 hotline for members of the public to contact ABC about any concerns with operations. All complaints and feedback received are logged and investigated promptly.

4. Assessment of Suitability for Ongoing Use

4.1 Suitability of RDF for ongoing use at up to 32 t/h

Ongoing operations utilising RDF in the Calciner have shown its suitability for ongoing use. No significant increase in any substance was detected during stack testing which could be directly attributed to the increased combustion rate of RDF. The scrubbing properties of raw materials utilised in the clinker manufacturing process helps to ensure that almost all inorganic compounds found within RDF, or generated by combustion, are immobilised within the clinker product and precluded from emission to the surrounding environment. The effective operation of ESPs further mitigates emissions. Organic compounds found in the fuel are efficiently destroyed in the combustion process due to the high temperature of the combustion vessel, and de-novo formation of organic compounds of concern is mitigated through the rapid quenching of combustion off-gases.

The Calciner RDF trial continued this demonstration, with Calciner Stack 4B emission rates of almost all analytes under trial conditions at up to 32 t/h RDF being well within historical variance and, in some cases, lower than the historical average. The only analytes to show any increase beyond historical maxima during the trial (Iron Oxide and Chromium-III) remain significantly below of the relevant AQ EPP criteria. As discussed above, the Kiln Stack 4A TSP emissions were elevated due a deterioration in the ESP performance, which has since been resolved through maintenance of the ESP.

Analysis indicates a low probability of negative impacts to the environment or community from ongoing use of RDF in the Calciner at an increased feed rate up to 32 t/h, as necessary to achieve 100% TSR on an ongoing basis (under stable conditions). Natural gas will still be required for Calciner start-ups to achieve operating temperature and stability prior to any RDF introduction (as currently occurs for 25 t/h RDF usage, pursuant to Licence condition U-725) and also for shutdowns when RDF rates are reduced to zero.

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4.2 Net Zero Carbon Emissions

ABC's goal is to conduct all its operations at net zero carbon emissions by 2050 in line with the ambitions of the Paris Agreement. ABC continues to work towards this goal through the Net Zero Emissions Roadmap that has been adopted by the company.

The increase in alternative fuel TSR in the Calciner from the current approximately 80% to the proposed approximately 100% will reduce ABC's reportable CO_2 emissions against the Adbri NZE 2050 Roadmap by more than 30,000 tonnes per year. An RDF firing rate of up to 32 t/h represents a nominal 100% thermal substitution in the Calciner (subject to process variations) aligning with ABC's Sustainability Plan.

4.3 Next Steps

This Post-Trial Report is being formally submitted to the EPA pursuant to Schedule W-1 of Licence 1126, to provide the EPA with a summary and analysis of the outcomes of the Calciner RDF trial undertaken in December 2022.

Subject to this report being acceptable to the EPA, ABC will initiate a formal Process Change Application to amend Licence 1126 to allow an increased instantaneous maximum feed rate of 32 t/h RDF to the Calciner at the Birkenhead plant.

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5. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. JBS&G has also not attempted to determine whether any material matter has been omitted from the data. JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JBS&G. The making of any assumption does not imply that JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

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Appendix A EPA Licence 1126

Licence No. 1126

ISSUED:
01 Nov 2022

EXPIRY:
31 Oct 2027

ACN:
007 870 199

ADELAIDE BRIGHTON CEMENT LIMITED

Environmental Authorisation under Part 6 of the *Environment Protection Act 1993*

South Australian Environment Protection Authority
GPO Box 2607
Adelaide SA 5001
Tel: 08 8204 2004

Environment Protection Authority

LICENCE NUMBER 1126

LICENSEE DETAILS

Licence Holder: ADELAIDE BRIGHTON CEMENT LIMITED

ACN: 007 870 199

Registered Address: Level 1, 157 Grenfell Street, ADELAIDE SA 5001

LICENSED ACTIVITIES

The Licensee is authorised to undertake, at the location(s) shown above, the following prescribed activities of environmental significance under Schedule 1 Part A of the Act, subject to the conditions in this Licence.

2(3)	Cement works
3(5)(a)	Activity producing listed waste
7(1)	Bulk shipping facilities
7(3)(c)	Crushing, grinding or milling works (rock, ores or minerals)
8(2)(a)	Fuel burning coal or wood
8(2)(a)	Fuel burning not coal or wood

TERMS OF LICENCE

Commencement Date: 01 Nov 2022

Expiry Date: 31 Oct 2027

PREMISES ADDRESS

Victoria & Elder Roads, PETERHEAD SA 5016

Table of Contents

Licence Explanatory Notes – Do Not Form Part of the Licence

Compliance with this licence

The EPA seeks to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment according to the principles of ecologically sustainable development. To achieve this objective, the EPA uses a number of regulatory decision making principles and actions outlined in the 'Compliance and enforcement regulatory options and tools' document available on the EPA website.

Notification – serious or material environmental harm caused or threatened

If serious or material environmental harm from pollution is caused or threatened in the course of an activity, the licence holder must, as soon as reasonably practicable after becoming aware of the harm or threatened harm, notify the EPA (preferably on EPA emergency phone number 1800 100 833) of the harm or threatened harm, its nature, the circumstances in which it occurred and the action taken to deal with it in accordance with section 83 of the *Environment Protection Act 1993* (the Act). In the event that the primary emergency phone number is out of order, the licence holder should phone (08) 8204 2004.

Variations, transfers and surrender of a licence

The EPA may impose or vary the conditions of a licence by notice in writing to the licence holder in accordance with sections 45 and 46 of the Act. Public notice may be required where the variation of licence conditions results in a relaxation of the requirements imposed for the protection or restoration of the environment and results in an adverse effect on any adjoining land or its amenity.

If a licence holder wishes to vary the conditions of a licence, transfer a licence to another entity, or surrender a licence, the licence holder must submit an application to the EPA in accordance with the applicable provisions of the Act (sections 45, 49 and 56, respectively). A licence remains in effect and in its original form until such time as any proposed variation, application for surrender, or transfer has been made and approved in writing by the EPA.

Suspension or cancellation of a licence

The EPA may suspend or cancel a licence by notice in writing to the licence holder in accordance with section 55 of the Act if satisfied the licence holder has either obtained the licence improperly, contravened a requirement under the Act or if the holder is a body corporate, a director of the body corporate has been guilty of misconduct of a prescribed kind (whether in this State or elsewhere).

Responsibilities under Environment Protection legislation

In addition to the conditions of any licence, a licence holder must comply with their obligations under all State and Federal legislation (as amended from time to time) including: the *Environment Protection Act 1993;* the *Environment Protection Regulations 2009;* all Environment Protection Policies made under the *Environment Protection Act 1993;* and any National Environment Protection Measures not operating as an Environment Protection Policy under the *Environment Protection Act 1993*

Public Register Information

The EPA maintains and makes available a Public Register of details related to its determinations and other information it considers appropriate (i.e. excluding trade processes or financial information) in accordance with section 109 of the Act. These details include, but are not limited to:

- licensing and beverage container applications and approvals
- enforcement actions
- site contamination
- serious or material environmental harm caused or threatened in the course of an activity
- environment improvement programmes and environment performance agreements
- environment assessment reports; results of testing, monitoring or evaluation required by a licence
- EPA advice or direction regarding development approvals referred to the EPA by a planning authority

Definitions

Unless the contrary intention appears, terms used in this licence that are defined in the Act (including any regulations or environment protection policies made pursuant to the Act) have the respective meanings assigned to those terms by the Act.

THE ACT: The *Environment Protection Act 1993*

PREMISES: The whole of the land comprised in Titles Register - Certificate of Title, Crown Lease and Crown Record.

CT5142/523	CT5142/522
CT5485/422	CT5411/669
CT5750/769	CT5750/770
CT5742/582	CT5742/581
CT5813/976	CT5816/637
CT5816/2	CT5841/73
CT5683/198	CT5968/732
CT6057/913	CT6057/917
CT6057/918	CT6057/920
CT6057/921	CT6057/922
CT6057/914	CT6087/695
CT6087/694	CT6087/700
CT6087/696	CT6087/697
CT6087/698	CT6087/701
CT6087/702	CT6126/858
CT6057/936	CT6057/933
CT6057/931	CT6057/929
CT6057/927	CT6057/925
CT6057/924	CT6145/889
CT6145/895	CT6146/576

ACOUSTIC ENGINEER: means an Engineer who is eligible for membership of both the Institution of Engineers Australia and the Australian Acoustical Society.

AUTHORISATION FEE PAYMENT DATE: means the anniversary of the grant or renewal of this authorisation.

CERTIFIED TYPE B GAS APPLIANCE: means an appliance with a gas consumption in excess of 10 megajoules per hour which has been certified under the Gas Act 1997 as meeting the requirements of AS3814 and AS/NZS5601.

CONTAMINATED STORMWATER: is as defined in the Environment Protection (Water Quality) Policy 2015.

CONTROLLED WASTE: means any wastes of a category listed in Column 1 of the Table in Schedule 1 that has 1 or more characteristics listed in the Table in Schedule 2 of the Environment Protection (movement of Controlled Waste) Policy 2014.

DESTINATION FACILITY: 'Destination Facility' in relation to a consignment of controlled

waste means the depot, facility or works to which the waste is, or is to be delivered under the consignment.

EMERGENCY SPILL KIT: means a kit containing materials that when used would prevent and/or minimise listed waste from entering the stormwater or groundwater system in the event of a spill.

ENVIRONMENTAL HARM: means the same as is defined in section 5 of the Environment Protection Act 1993.

LISTED WASTE: means wastes listed in Part B of Schedule 1 of the Environment Protection Act 1993.

POLLUTION CONTROL EQUIPMENT: means 'control equipment' as defined in the Environment Protection (Air Quality) Policy: any device that controls, limits, measures, records or indicates air pollution.

RECOVERED PRODUCTS PLAN: means a written document that is approved by the EPA in accordance with Section 6 of the EPA 'Standard for the Production and Use of Refuse Derived Fuel,' dated February 2010.

REFUSE DERIVED FUEL: A fuel material produced from waste that is otherwise destined to landfill and which will not cause harm to the environment or human health when used to beneficially replace or supplement a fossil or other standard commercial fuel in an industrial process. RDF must be produced to an approved consistent and fit for purpose specification with sufficiently high net calorific value by segregating, targeting and processing specific wastes.

SUITABLY QUALIFIED EXPERT: means a person who holds relevant qualifications, has demonstrated professional experience and expertise encompassing an appropriate range of competencies, and is either a full member or is eligible for full membership of one or more of the following or equivalent professional organisations:

1. The Institution of Engineers Australia

2. The Association of Consulting Engineers Australia

WASTE: means -

1. As defined under the Environment Protection Act 1993,

1(a) any discarded, dumped, rejected, abandoned, unwanted or surplus matter, whether or not intended for sale or for purification or resource recovery by a separate operation from that which produced the matter; or

1(b) any matter declared by regulation to be waste for the purposes of this Act (following consultation by the Minister on the regulation with prescribed bodies in accordance with the regulations); or

1(c) any matter declared by an environment protection policy to be waste for the purposes of this Act,

whether or not of value.

2. However, waste does not include—

2(a) an approved recovered resource whilst it is being dealt with in accordance with the declaration of that resource—see section 4A; or

2(b) anything declared by regulation or an environment protection policy not to be waste for the purposes of this Act,

even though the resource or the thing so declared might otherwise, but for the declaration, fall within the definition of waste in subsection (1).

WASTEWATER: as defined in the Environment Protection (Water Quality) Policy 2015.

WATERS: is as defined in the Environment Protection (Water Quality) Policy 2015.

Acronyms

EPA: means Environment Protection Authority

AFRM: means Alternative Fuel and/or Raw Material.

STP: means standard temperature and pressure (zero degrees Celsius and 101.3 kiloPascals absolute).

TSP: means Total Suspended Particles.

WTC: means Waste Transport Certificate.

Conditions of Licence

The Licensee is authorised to conduct the prescribed activities as described in this Licence at the Premises nominated, subject to the following conditions:

---

1 CONTROL OF EMISSIONS

1.1 AIR PARTICULATE MANAGEMENT PLAN (U - 1549)

The Licensee must:

1.1.1 develop and submit to the satisfaction of the EPA an Air Particulate Management Plan by the compliance date listed below;

1.1.2 ensure that the Air Particulate Management Plan includes, but need not be limited to:

- a specification of trigger values to prevent and minimise particulate emissions;
- b specification of trigger values required by sub paragraph 2(a) of this condition should have regard to the following items:
  - i existing monitoring data;
  - ii data collected as part of conditions U-1555, U-1556;
  - iii meteorological conditions; and
  - iv visual observations, including the use of electronic and/or remote visual methods;
- c detailed action and response strategies that will be taken when the trigger values, identified under sub paragraph 2(a) of this condition are reached, to prevent and minimise particulate emissions;
- d a methodology and framework for providing public access to the Air Particulate Management Plan (or any revised plan approved by the EPA) and to quarterly and annual reporting;

1.1.3 submit a quarterly report to the EPA by the last day of January, April, July and October of each year that includes but need not be limited to:

- a the date, time and trigger value exceeded;
- b action and response strategies implemented;
- c summary of events notified under condition U-765;
- d a summary of air particulate related complaints received and recorded pursuant to condition U-1553;

1.1.4 submit an annual report to the EPA by the 15th day of February of each year, that includes but need not be limited to:

- a a review of all the trigger values identified in sub paragraph 2(a) of this condition;
- b a review of the effectiveness of all action and response strategies identified in sub paragraph 2(c) of this condition;
- c a trend analysis of data collected;
- d a review and analysis of complaints received and recorded pursuant to condition U-1553 with the exceedance of trigger values identified in sub paragraph 2(a) of this condition; and
- e opportunities for improvement in air particulate management;

1.1.5 implement the Air Particulate Management Plan approved in writing by the EPA (or any revised plan approved in writing by the EPA).

Compliance Date: 30-May-2023

1.2 GROUND LEVEL PARTICULATE NOTIFICATION (U - 765)

The Licensee must:

1.2.1 provide notification to the EPA, within 48 hours, when the following particulate limits are exceeded at any of its monitoring locations outside the Premises:

a a PM10 concentration of 50 micrograms per cubic metre over a 24 hour averaging period; or

b a PM2.5 concentration of 25 micrograms per cubic metre over a 24 hour averaging period;

1.2.2 ensure any notification provided under sub paragraph 1 of this condition includes but is not limited to:

a the date;

b the cause;

c the measured particulate concentration over the 24 hour averaging period; and

d remedial actions taken to reduce particulate emissions from the Premises.

1.3 PARTICULATE EMISSIONS - KILN STACK 4A (U - 1550)

The Licensee must:

1.3.1 take all reasonable and practicable measures to prevent particulate emissions (as TSP) from Kiln Stack 4A exceeding a limit of 80 milligrams per cubic metre at STP, dry basis, based on a 1 hour average;

1.3.2 where particulate emissions exceed the limit specified under sub paragraph 1 of this condition, take all reasonable and practicable immediate action to reduce particulate emissions to below that limit;

1.3.3 provide notification to the EPA as soon as reasonably practicable of any exceedance of the limit specified under sub paragraph 1 of this condition and include the reason(s) for the exceedance, and the corrective actions implemented to reduce particulate emissions to below that limit.

1.4 PARTICULATE EMISSIONS - PRECALCINER STACK 4B (U - 1565)

The Licensee must:

1.4.1 take all reasonable and practicable measures to prevent particulate emissions (as TSP) from Precalciner Stack 4B exceeding a limit of 50 milligrams per cubic metre at STP, dry basis, based on a 1 hour average;

1.4.2 where particulate emissions exceed the limit specified under sub paragraph 1 of this condition, take all reasonable and practicable immediate action to reduce particulate emissions to below that limit;

1.4.3 provide notification to the EPA as soon as reasonably practicable of any exceedance of the limit specified under sub paragraph 1 of this condition and include the reason(s) for the exceedance, and the corrective actions implemented to reduce particulate emissions to below that limit.

1.5 PREMISES STORMWATER MANAGEMENT (S - 160)

The Licensee must:

1.5.1 take all reasonable and practicable measures to prevent contamination of stormwater resulting from prescribed activities undertaken at the Premises; and

1.5.2 implement appropriate contingency measures to contain the contaminated stormwater at the Premises unless and until the contaminated stormwater is treated to remove the contamination, or is disposed of at an appropriately licensed facility.

1.6 SITE NOISE MINIMISATION (U - 1551)

The licensee must:

1.6.1 take all reasonable and practicable measures to minimise noise generated at the Premises;

1.6.2 develop a Noise Management Plan to the satisfaction of the EPA by the compliance date listed below;

1.6.3 ensure that the Noise Management Plan includes but need not be limited to:

a detailed action and response strategies that will be undertaken by the Licensee to prevent and minimise noise generated at the Premises;

b a methodology and framework for providing public access to the Noise Management Plan (or any revised plan approved by the EPA) and to quarterly and annual reporting;

1.6.4 submit a quarterly report to the EPA by the 15th day of February, May, August and November of each year that includes but need not be limited to:

a a summary of action and response strategies undertaken during the quarter to minimise noise generated at the Premises;

b a review and analysis of noise related complaints received and recorded during the quarter pursuant to condition U-1553;

1.6.5 submit an annual report to the EPA by the 15th of February of each year, that includes but need not be limited to:

a a review of the effectiveness of all action and response strategies identified pursuant to this condition;

b a review and analysis of noise related complaints received and recorded pursuant to condition U-1553;

c identification of potential opportunities for improvement in noise management at the Premises; and

1.6.6 implement the Noise Management Plan approved in writing by the EPA (or any revised plan approved in writing by the EPA).

Compliance Date: 30-Jun-2023

1.7 WASTEWATER (S - 18)

The Licensee must take all reasonable and practicable measures to prevent wastewater or contaminated stormwater from discharging onto land and/or into waters.

---

2 WASTE MANAGEMENT

2.1 LISTED WASTE AND/OR CONTROLLED WASTE PRODUCER (S - 166)

The Licensee must:

2.1.1 prior to the interstate transport of any waste specified in the Listed Waste attachment and/or Controlled Waste attachment to this licence, obtain a Consignment Authorisation from the relevant authority in the state or territory of destination of that waste;

2.1.2 ensure a WTC is generated for any waste specified in the Listed Waste and/or Controlled Waste attachments to this licence before that waste is transported to a Destination Facility in South Australia or interstate;

2.1.3 provide a copy or copies of the WTC to the transporter of the waste and the EPA; and

2.1.4 retain a copy of all manually generated WTC's for not less than 12 months.

---

3 OPERATIONAL MANAGEMENT

3.1 ALTERNATIVE FUEL AND/OR RAW MATERIAL MANAGEMENT (U - 703)

The Licensee must:

3.1.1 ensure that the only types of AFRM to be burned in the industrial fuel burning equipment on the Premises are those defined in Schedule X-1 of this licence, at the approved rates identified in that schedule;

3.1.2 ensure that where the AFRM is a Refuse Derived Fuel (RDF), only receive RDF which complies with a Recovered Products Plan approved by the EPA in writing;

3.1.3 provide public access to the Recovered Products Plan (or any revised plan approved by the EPA);

3.1.4 comply with the requirements of sub paragraphs 1 and 2 of this condition, except during the events of trial burning of AFRM in the industrial fuel burning equipment on the Premises whereby the trial is undertaken in accordance with Schedule W-1 of this licence.

3.2 ALTERNATIVE FUELS - OPERATIONAL REQUIREMENTS (U - 725)

The Licensee must ensure that:

3.2.1 all alternative fuels listed in Schedule X-1 of this licence are:

a completely combusted in a certified Type B gas appliance;

b not admitted into the certified Type B gas appliance during start-up, shut-down, or where the gas flame is not under stable operating conditions;

3.2.2 the following parameters are monitored and recorded whenever alternative fuels listed in Schedule X-1 of this licence are used:

a the alternative fuel type and usage rate;

b the temperature in degrees Celcius of the combustion gases exiting the Type B gas appliance;

c the composition of the combustion gases exiting the Type B gas appliance, including but not limited to the percentage of oxygen, carbon monoxide and methane;

d the temperature in degrees Celcius of the combustion gases entering the electrostatic precipitators;

3.2.3 records relating to this condition are kept for the term of the Licence, and are made available to an Authorised Officer upon request.

3.3 CLEAN UP OF SPILLS (S - 218)

The Licensee must, as soon as practicable, cause any material spilt onto the wharf, dock, loading or work area to be removed and reused, or disposed of to an appropriately licensed facility.

NOTES

Material is as described in Clause 7(1) of Schedule 1 of the Environment Protection Act 1993.

3.4 COMMUNITY ENGAGEMENT PLAN (U - 1552)

The Licensee must:

3.4.1 develop and implement a Community Engagement Plan in consultation with key stakeholders; and

3.4.2 provide public access to the Community Engagement Plan (and any subsequent amended version) by the compliance date listed below.

Compliance Date: 31-Mar-2023

3.5 COMPLAINTS REGISTER (U - 1553)

The Licensee must:

3.5.1 prepare and maintain a register of all complaints received concerning environmental issues that includes:

a the date and time that the complaint was made;

b details of the complaint, including the likely cause of the events giving rise to the complaint;

c the contact details of the complainant (if permitted by the complainant);

d an estimate of the temperature, wind speed, wind direction and rainfall at the time of the events giving rise to the complaint;

e the date, time and details of any action taken by the Licensee in response to the complaint and to prevent a recurrence of the events giving rise to the complaint;

3.5.2 respond to the complainant within 72 hours; and

3.5.3 ensure that a summary report of complaints received is made publically available.

3.6 EMERGENCY SPILL KIT (S - 22)

The Licensee must ensure that an appropriate emergency spill kit is kept on the Premises at all times in locations where listed wastes are stored, loaded or unloaded and is appropriately used in the event of a spill.

3.7 ENVIRONMENT IMPROVEMENT PROGRAMME (U - 1554)

The Licensee must:

3.7.1 develop and submit to the EPA an Environment Improvement Programme (EIP) to the satisfaction of the EPA by the compliance date listed below;

3.7.2 undertake public consultation in the course of developing the EIP;

3.7.3 ensure that the EIP includes, but need not be limited to:

a a summary of the results of public consultation undertaken in the course of developing the EIP;

b detailed actions, timeframes and milestones to be undertaken by the Licensee to fully implement the preferred noise mitigation option(s) identified pursuant to condition U-1559 of this licence;

c detailed actions, timeframes and milestones to be undertaken by the Licensee to fully implement the preferred air particulate mitigation option(s) identified pursuant to condition U-1560 of this licence;

d a methodology and framework for reporting to the EPA, including frequency, to demonstrate progression and completion of the EIP actions;

e a methodology and framework to assess the effectiveness of the actions detailed in the EIP; and

f a methodology and framework for providing public access to the EIP, quarterly and annual reporting;

3.7.4 implement the EIP upon approval in writing by the EPA.

Compliance Date: 28-Feb-2024

3.8 IMPLEMENT APPROVED DOCUMENTS (U - 1568)

The Licensee must implement the following approved documents:

3.8.1 Environment Improvement Programme, Document Number 1126 EIP Version 7, 26 August 2021 (approved by the EPA on 15 October 2021)

3.8.2 Dust Management Plan, June 2018 (approved by the EPA on 27 June 2018);

3.8.3 Ground Level Particulate Monitoring and Reporting Plan, June 2018 (approved by the EPA on 18 June 2018);

3.8.4 Noise Management Plan, August 2018 (approved by the EPA on 16 August 2018); and

3.8.5 Stack Particulate Management Plan, June 2018 (approved by the EPA on 18 June 2018).

NOTES

NOTE - Each document specified in this condition must be implemented by the Licensee until the EPA's approval of equivalent documents pursuant to conditions U-1554, U-1549, U-1555, U-1551 and U-1556.

3.9 MINAMATA CONVENTION ON MERCURY (U - 1571)

The Licensee must ensure that mercury emissions are assessed, controlled and, where feasible, reduced, consistent with the Minamata Convention on Mercury, where changes to site operating processes are proposed, that:

3.9.1 have the potential to increase or alter the nature of mercury emissions generated by the Licensee;

3.9.2 have the potential to increase the risk of environmental harm; or

3.9.3 would relocate the point of discharge of mercury emissions at the Premises.

3.10 POLLUTION CONTROL EQUIPMENT REGISTER (S - 2)

The Licensee must:

3.10.1 maintain all Pollution Control Equipment to ensure that pollution is minimised; and

3.10.2 keep a written record of all inspections of Pollution Control Equipment, which includes:

a the name of the recording officer;

b the date of each inspection of the equipment;

c details of the equipment that was inspected;

d an assessment of whether the equipment was working effectively; and

e the action taken (if required) to rectify any faults or failures.

---

4 MONITORING AND REPORTING

4.1 AIR POLLUTANT EMISSIONS INVENTORY (U - 1566)

The Licensee must:

4.1.1 engage a suitably qualified expert to:

a undertake an assessment of air pollutants emitted from all sources at the Premises;

b prepare a comprehensive air pollutant emissions inventory for the Premises;

4.1.2 develop and submit a report to the satisfaction of the EPA, by the compliance date listed below, which includes but need not be limited to:

a the methodology, parameters and assumptions used in undertaking the detailed assessment of air pollutants pursuant to paragraph 1 of this condition; and

b the results of the detailed assessment of air pollutants undertaken pursuant to paragraph 1 of this condition with reference to the requirements of the Environment Protection (Air Quality) Policy 2016; and

c a comprehensive air pollutant emissions inventory.

NOTES

The EPA will assess the suitability of the engaged expert against the EPA's 'Ambient Air Quality Assessment' Guideline

Compliance Date: 30-Jun-2023

4.2 ASSESSMENT OF AIR PARTICULATE MITIGATION OPTIONS (U - 1560)

The Licensee must:

4.2.1 engage a suitably qualified expert to:

a undertake a detailed assessment of options that can be undertaken to prevent or minimise particulate emissions from the Premises;

b determine the predicted effectiveness of the options assessed under paragraph 1 of this condition, with reference to the air pollutant emissions inventory prepared in accordance with condition U-1566;

4.2.2 develop and submit a report to the satisfaction of the EPA, by the compliance date listed below, which includes but need not be limited to:

a the details of, and predicted environmental outcomes and effectiveness of, the option(s) assessed under paragraph 1 of this condition;

b a feasibility assessment of each option(s) including the methodology used, considerations made and clear rationale for selection of the Licensee's preferred option(s);

c the intended timeframe(s) to be taken to implement the preferred option(s).

NOTES

The EPA will assess the suitability of the engaged expert against the EPA's 'Ambient Air Quality Assessment' Guideline

Compliance Date: 30-Dec-2023

4.3 ASSESSMENT OF NOISE MITIGATION OPTIONS (U - 1559)

The Licensee must:

4.3.1 engage a suitably qualified Acoustic Engineer to identify and assess noise mitigation options that effectively minimise noise emissions from the Premises;

4.3.2 develop and submit a report to the satisfaction of the EPA, by the compliance date listed below, which includes but need not be limited to:

a details of the assessment of noise mitigation options undertaken pursuant to paragraph 1 of this condition;

b noise modelling, prepared by a suitably qualified Acoustic Engineer, which includes the predicted effectiveness of each noise mitigation option assessed;

c identification of the Licensee’s preferred noise mitigation option(s);

d the methodology used, considerations made and clear rationale for selection of the Licensee's preferred noise mitigation option(s); and

e intended timeframe(s) for implementation of the Licensee’s preferred noise mitigation option(s).

Compliance Date: 30-May-2023

4.4 GROUND LEVEL PARTICULATE MONITORING AND REPORTING PLAN (U - 1555)

The Licensee must:

4.4.1 develop and submit to the satisfaction of the EPA by the compliance date listed below a Ground Level Particulate Monitoring and Reporting Plan;

4.4.2 ensure that the Ground Level Particulate Monitoring and Reporting Plan includes, but need not be limited to:

a measurement and monitoring of ground level particulate concentrations (as TSP, PM10 and PM2.5) at various locations within the Premises and outside the Premises;

b a methodology and framework for the provision of public access to real-time monitoring data of PM10 and PM2.5 from monitoring stations located outside the Premises;

c a methodology for providing public access to an explanation within 48 hours of why the following particulate limits are exceeded at monitoring locations outside the Premises;

i a PM10 concentration of 50 micrograms per cubic metre over a 24 hour averaging period; and

ii a PM2.5 concentration of 25 micrograms per cubic metre over a 24 hour averaging period;

d a methodology and framework for providing public access to the Ground Level Particulate Monitoring and Reporting Plan (or any revised plan approved by the EPA) and to quarterly and annual reporting;

4.4.3 submit a quarterly report to the EPA by the last day of January, April, July and October of each year;

4.4.4 submit an annual report to the EPA by the last day of October of each year; and

4.4.5 implement the Ground Level Particulate Monitoring and Reporting Plan approved in writing by the EPA (or any revised plan approved in writing by the EPA).

Compliance Date: 30-Jun-2023

4.5 STACK EMISSION TESTING (U - 748)

The Licensee must:

4.5.1 test emissions from all exhaust stacks, by the last day of April and October of each year for the following:

a substances included in Schedule Y-1 of this licence;

b temperature;

c moisture;

d pressure; and

e exhaust velocity

4.5.2 ensure that the emission testing programme is undertaken when the plant is under stable operating conditions;

4.5.3 carry out the emission testing programme in accordance with the methods specified in the EPA document entitled 'Emission Testing Methodology for Air Pollution Manual version 2', dated August 2012; and

4.5.4 submit a report to the EPA within 90 days after the conclusion of the emission testing programme,which includes but is not limited to:

a an assessment of whether the tested emissions comply with Schedule Y-1 of this licence;

b the type and mass feed rate of any utilised alternative fuels and/or raw materials listed under Schedule X-1 of this licence that were used during the testing that is required under sub paragraph 1 of this condition; and

c how the requirements outlined in Section 2.6 of the EPA document entitled 'Emission Testing Methodology for Air Pollution Manual version 2', dated August 2012 were complied with.

4.6 STACK PARTICULATE MANAGEMENT PLAN (U - 1556)

The Licensee must:

4.6.1 develop and submit a Stack Particulate Management Plan to the satisfaction of the EPA by the compliance date listed below;

4.6.2 ensure that the Stack Particulate Management Plan includes, but need not be limited to:

a details of continuous monitoring of particulate emissions from Kiln Stack 4A and Precalciner Stack 4B in accordance with the EPA document entitled "Emission Testing Methodology for Air Pollution Manual Version 2" dated August 2012;

b details regarding calibration, to ensure that the continuous monitors are calibrated in accordance with Appendix B of the EPA document entitled "Emission Testing Methodology for Air Pollution Manual Version 2" dated August 2012;

c details of the actions that will be taken by the Licensee when stack particulate emissions exceed the limits specified in conditions U-1550 and U-1565;

d a methodology and framework for providing public access to the Stack Particulate Management Plan (or any revised plan approved by the EPA) and to quarterly and annual reporting;

4.6.3 submit quarterly reports to the EPA on the last day of January, April, July and October of each year. Ensure that the quarterly reports include, but need not be limited to:

a a summary of all exceedance notifications made to the EPA pursuant to conditions U-1550 and U-1565, including:

i the date, time and duration;

ii the cause;

iii the measured particulate concentration;

iv immediate actions taken to reduce particulate emissions;

v corrective actions taken to prevent future events of the same kind; and

vi reporting of particulate concentrations as milligrams per cubic metre at STP, dry basis;

4.6.4 submit an annual report to the EPA on the last day of October of each year, which includes but need not be limited to:

a a trend analysis of notifications and associated details provided under sub paragraph 3 of this condition;

b a trend comparison of information analysed under sub paragraph 4(a) of this condition with:

i community complaints recorded under condition U-1553; and

ii the preceding 12 months of stack emission data;

c identification of any opportunities for improvement in order to decrease the frequency, duration and magnitude of any notified events; and

4.6.5 implement the Stack Particulate Management Plan approved in writing by the EPA (or any revised plan approved in writing by the EPA).

NOTES

The Licensee must ensure that any exceedence event that results in environmental harm as defined under Sections 79 and 80 of the Environment Protection Act 1993, is notified pursuant to Section 83 of the Environment Protection Act 1993.

Compliance Date: 31-May-2023

4.7 TOTAL SUSPENDED PARTICULATE (TSP) COMMUNITY ASSESSMENT (U - 1562)

The Licensee must:

4.7.1 develop and submit a plan, to the satisfaction of the EPA, by the compliance date listed below, which includes but need not be limited to:

a a methodology and framework for a TSP community assessment to be undertaken by the Licensee that ensures that the nature and composition of TSP material at locations within the residential community adjacent to the Premises is assessed by the Licensee;

b a methodology and framework that ensures that the TSP community assessment includes a comparison and correlation of materials used at, and emissions from, the Premises with the nature and composition of TSP material assessed at locations within the residential community adjacent to the Premises; and

c proposed timeframes and duration of the TSP community assessment.

Compliance Date: 30-Jun-2023

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5 ADMINISTRATION

5.1 ANNUAL RETURN AND PAYMENT OF ANNUAL FEES (A - 4)

For the purposes of section 48(2)(a) of the Act, the date in each year for the lodgement of the Annual Return is no later than 90 days before the anniversary of the grant or renewal of the Licence; and

5.1.1 For the purposes of section 48(2)(b) of the Act, the date in each year for the payment of Annual Authorisation Fee is the anniversary of the grant of the Licence.

5.2 APPROVAL OF OPERATING PROCESSES (A - 6)

The Licensee must not undertake changes to operating processes conducted pursuant to the Licence at the Premises without written approval from the EPA, where such changes:

5.2.1 have the potential to increase emissions or alter the nature of pollutants or waste currently generated by, or from the licensed activity; or

5.2.2 have the potential to increase the risk of environmental harm; or

5.2.3 would relocate the point of discharge of pollution or waste at the Premises.

5.3 APPROVAL OF WORKS (A - 5)

The Licensee must not construct or alter a building or structure, or install or alter any plant or equipment, for use of an activity undertaken pursuant to the Licence at the Premises without written approval from the EPA, where such changes:

5.3.1 have the potential to increase the emissions or alter the nature of pollutants or waste currently generated by, or from the licensed activity; or

5.3.2 have the potential to increase the risk of environmental harm; or

5.3.3 would relocate the point of discharge of pollution or waste at the Premises.

5.4 CHANGE OF LICENSEE DETAILS (A - 3)

If the Licensee's name or postal address (or both) changes, the Licensee must inform the EPA within 28 days of the change occurring.

5.5 IMPOSE OR VARY CONDITIONS (U - 1567)

The EPA may, at any time during the term of this licence, impose new conditions on this licence or vary the conditions of this licence by notice in writing to the licensee. Conditions may be imposed, or varied, in response to the EPA's receipt of any of the following plans or reports, or information supplied to the EPA pursuant to any of the following plans or reports:

5.5.1 air particulate management plan and its reports (Condition U-1549);

5.5.2 ground level particulate monitoring data and information (Condition U-765)

5.5.3 ground level monitoring plan and its reports (Condition U-1555)

5.5.4 stack monitoring data and information (Conditions U-1550, U-1565, U-748)

5.5.5 stack management plan and its reports (Condition U-1556)

5.5.6 noise management plan and its reports (Condition U-1551)

5.5.7 Environment Improvement Programme (EIP) and its reports (Condition U-1554)

5.5.8 noise mitigation options assessment report (Condition U-1559)

5.5.9 air pollutant emissions inventory (Condition U-1566)

5.5.10 air particulate mitigation options assessment report (Condition U-1560)

5.5.11 TSP community assessment report (Condition U-1562)

5.6 LICENCE RENEWAL (A - 2)

For the purposes of section 43(3) of the Act, an application for Renewal of the Licence must be made no later than 90 days before the expiry date of the Licence.

5.7 OBLIGATIONS TO EMPLOYEES, AGENTS AND CONTRACTORS (A - 1)

The Licensee must ensure that every employee, agent or contractor responsible for undertaking any activity regulated by the Licence, is informed as to the conditions of the Licence.

Attachments

CONTROLLED WASTE.pdf"

LISTED WASTE.pdf"

SCHEDULE Y-1.pdf"

SCHEDULE W-1.pdf"

Schedule X1_November2021.pdf"

Controlled Waste Attachment

Controlled Waste
– per the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998, requiring provision of Waste Transport Certificate (WTC) from State or Territory where waste originates

Waste stream or wastes having as constituents:

Acidic solutions or acids in solid form
Animal effluent and residues (abattoir effluent, poultry and fish processing waste)
Antimony; antimony compounds
Arsenic; arsenic compounds
Asbestos
Barium compounds (excluding barium sulphate)
Basic solutions or bases in solid form
Beryllium; beryllium compounds
Boron compounds
Cadmium; cadmium compounds
Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos
Chlorates
Chromium compounds (hexavalent and trivalent)
Clinical and related wastes
Cobalt compounds
Containers which are contaminated with residues of substances referred to in this list
Copper compounds
Cyanides (inorganic)
Cyanides (organic)
Cyanides (organic) / nitriles
Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list
Ethers
Filter cake contaminated with residues of substances referred to in this list
Fire debris and fire washwaters
Fly ash, excluding fly ash generated from Australian coal fired power stations
Grease trap waste
Halogenated organic solvents
Highly odorous organic chemicals (including mercaptans and acrylates)
Inorganic fluorine compounds excluding calcium fluoride
Inorganic sulfides
Isocyanate compounds
Lead; lead compounds
Mercury; mercury compounds
Metal carbonyls
Nickel compounds
Non-toxic salts

Controlled Waste Licence Attachment (continued)

– per the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998, requiring provision of Waste Transport Certificate (WTC) from State or Territory where waste originates

Waste stream or wastes having as constituents:

Organic phosphorus compounds
Organic solvents excluding halogenated solvents
Organohalogen compounds - other than substances referred to in this list
Oxidising agents
Perchlorates
Phenols, phenol compounds including chlorophenols
Phosphorus compounds excluding mineral phosphates
Polychlorinated dibenzo-furan (any congener)
Polychlorinated dibenzo-p-dioxin (any congener)
Reactive chemicals
Reducing agents
Residues from industrial waste treatment/disposal operations.
Selenium; selenium compounds
Soils contaminated with a controlled waste
Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials
Tannery wastes (including leather dust, ash, sludges and flours)
Tellurium, tellurium compounds
Thallium; thallium compounds
Triethylamine catalysts for setting foundry sands
Tyres
Vanadium compounds
Waste chemical substances arising from research and development or teaching activities including those which are not identified and/or are new and whose effects on human health and/or the environment are not known
Waste containing peroxides other than hydrogen peroxide
Waste from heat treatment and tempering operations containing cyanides
Waste from the manufacture, formulation and use of wood-preserving chemicals
Waste from the production, formulation and use of biocides and phytopharmaceuticals
Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish
Waste from the production, formulation and use of organic solvents
Waste from the production, formulation and use of photographic chemicals and processing materials
Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives
Waste from the production and preparation of pharmaceutical products
Waste mineral oils unfit for their original intended use
Waste oil/water, hydrocarbons/water mixtures or emulsions
Waste pharmaceuticals, drugs and medicines
Waste resulting from surface treatment of metals and plastics
Waste tarry residues arising from refining, distillation, and any pyrolytic treatment
Waste, substances and articles containing or contaminated with polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs), polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Waste of an explosive nature not subject to other legislation
Wool scouring waste
Zinc compounds

Listed Waste Attachment

Listed Waste
– per part B of Schedule 1 to the Environment Protection Act 1993, requiring provision of Waste Transport Certificate (WTC) for all transport movements

Waste stream or wastes having as constituents:

Acids and acidic solutions
Adhesives (excluding solid inert polymeric materials)
Alkali metals and alkaline earth metals
Alkalis and alkaline solutions
Antimony and antimony compounds and solutions
Arsenic and arsenic compounds and solutions
Asbestos
Barium compounds and solutions
Beryllium and beryllium compounds
Boron and boron compounds
Cadmium and cadmium compounds and solutions
Calcium carbide
Carbon disulphide
Carcinogens teratogens and mutagens
Chlorates
Chromium compounds and solutions
Copper compounds and solutions
Cyanides or cyanide solutions and cyanide complexes
Cytotoxic wastes
Dangerous substances within the meaning of the *Dangerous Substances Act 1979*
Distillation residues
Fluoride compounds
Halogens
Heterocyclic organic compounds containing oxygen, nitrogen or sulphur
Hydrocarbons and their oxygen, nitrogen and sulphur compounds (including oils)
Isocyanate compounds (excluding solid inert polymeric materials)
Laboratory chemicals
Lead compounds and solutions
Lime sludges or slurries
Manganese compounds
Medical waste consisting of—

(a) a needle, syringe with needle, surgical instrument or other article that is discarded in the course of medical*, dental or veterinary practice or research and has a sharp edge or point capable of inflicting a penetrating injury on a person who comes into contact with it; or
(b) human tissue, bone, organ, body part or foetus; or
(c) a vessel, bag or tube containing a liquid body substance; or
(d) an animal carcass discarded in the course of veterinary or medical* practice or research; or
(e) a specimen or culture discarded in the course of medical*, dental or veterinary practice or research and any material that has come into contact with such a specimen or culture; or
(f) any other article or matter that is discarded in the course of medical*, dental or veterinary practice or research and that poses a significant risk to the health of a person who comes into contact with it.

medical practice *includes the practice of pathology and the operation of an immunisation clinic.*

Listed Waste Licence Attachment

– per part B of Schedule 1 to the Environment Protection Act 1993, requiring provision of Waste Transport Certificate (WTC) for all transport movements

Waste stream or wastes having as constituents (*continued*):

Mercaptans
Mercury compounds and equipment containing mercury
Nickel compounds and solutions
Nitrates
Organic halogen compounds (excluding solid inert polymeric materials)
Organic phosphates
Organic solvents
Organometallic residues
Oxidising agents
Paint sludges and residues
Perchlorates
Peroxides
Pesticides (including herbicides and fungicides)
Pharmaceutical wastes and residues
Phenolic compounds (excluding solid inert polymeric materials)
Phosphorus and its compounds
Polychlorinated biphenyls
Poisons within the meaning of the *Drugs Act 1908*
Reactive chemicals
Reducing agents
Selenium and selenium compounds and solutions
Silver compounds and solutions
Solvent recovery residues
Sulphides and sulphide solutions
Surfactants
Thallium and thallium compounds and solutions
Vanadium compounds
Zinc compounds and solutions

Schedule Y-1

Adelaide Brighton Cement Ltd – EPA Environmental Authorisation 1126

SUBSTANCE	AVERAGING TIME	MAXIMUM DESIGN CRITERIA mg/m^3 [1]	MAXIMUM DESIGN CRITERIA ppm [2]
Carbon monoxide	1-hour	per the limits specified in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*	per the limits specified in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*
Nitrogen dioxide	1-hour		
Sulphur dioxide	1 hour		
Antimony and compounds	3-minute	per the limits specified in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*	per the limits specified in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*
Barium (soluble compound)	3-minute		
Chlorine	3-minute		
Chromium (III) compounds	3-minute		
Copper fume	3-minute		
Fluoride	24-hours 7-days 90-days		
Hydrogen chloride	3-minute		
Iron oxide fume	3-minute		
Lead (as particles)	3-minute		
Magnesium oxide fume	3-minute		
Manganese and compounds	3-minute		
Mercury **- organic** **- inorganic**	 3-minute 3-minute		
Zinc oxide fume	3-minute		

Schedule Y-1 (continued)

Adelaide Brighton Cement Ltd – EPA Environmental Authorisation 1126

SUBSTANCE	AVERAGING TIME	MAXIMUM DESIGN CRITERIA mg/m^3 [1]	MAXIMUM DESIGN CRITERIA ppm[2]
Arsenic and compounds	3-minute	per the limits specified in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*	per the limits specified in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*
Benzene	3-minute		
Beryllium and beryllium compounds	3-minute		
Cadmium and cadmium compounds	3-minute		
Chromium VI compounds	3-minute		
Nickel and nickel compounds	3-minute		
PAH (as BaP)	3-minute		
Particles (as PM10)	24 hour		
Particles (as PM2.5)	24 hour		

SUBSTANCE	MAXIMUM STACK CONCENTRATION	UNITS
Chlorinated dioxins and furans	0.1 ITEQ[3]	nanograms per cubic metre, STP, dry basis

[1] STP, dry basis

[2] parts per million (volume/volume)

[3] ITEQ: International Toxic Equivalent

Schedule W-1 AFRM Trial Management

Adelaide Brighton Cement Ltd – EPA Environmental Authorisation 1126
W-1.1 Pre-Trial Report

The Licensee must:

1. prepare a pre-trial report for the use of AFRM, which must contain, but not be limited to, the following:

- **1.1** demonstration of beneficial purposes;
- **1.2** demonstrated support for the waste management hierarchy, as outlined in the Environment Protection (Waste to Resources) Policy 2010;
- **1.3** the purpose of the trial;
- **1.4** the physical and chemical specifications of the AFRM;
- **1.5** an assessment of the risks associated with the use of the AFRM and risk mitigating measures including, but not limited to:
  - **1.5.1** the predicted mass balance of the AFRM including predicted emissions to air and baseline emissions for comparison;
  - **1.5.2** the results of previous stack emissions testing using the AFRM, if available; and
  - **1.5.3** any risks associated with on-site storage, handling and feed into the process.
- **1.6** tests proposed to be undertaken during the trial (for example stack emissions testing, including the analytes to be tested);
  Note: It is recommended that, as a minimum, the stack emissions testing is consistent with licence condition U-748. If the Licensee proposes to exclude any of the analytes and properties in licence condition U-748 from testing, the Licensee must highlight this and provide justification in the pre-trial report for EPA approval.
- **1.7** records to be kept and duration that records will be kept during and after the trial; and
- **1.8** the proposed dates for trial commencement and completion;

2. submit the pre-trial report to the EPA, at least 30 days before the commencement of a trial, for approval.

3. if the pre-trial report submitted in accordance with paragraph 2 is not acceptable to the EPA, resubmit a revised version of the pre-trial report (incorporating any additions or alterations that are required by the EPA) within the time period advised by the EPA in writing.

W-1.2 Trial Record

The Licensee must:

1. keep a record at the Premises of the details listed in the pre-trial report and any records required by EPA condition of approval.

2. ensure that the records, described in paragraph 1 hereof, are made available to an Authorised Officer upon request at any time during or after the trial taking into account the duration that records will be retained as specified in the pre-trial report.

Schedule W-1 AFRM Trial Management (continued)

Adelaide Brighton Cement Ltd – EPA Environmental Authorisation 1126
W-1.3 Post-Trial Report - Summary of AFRM Trial

The Licensee must:

1. prepare a post-trial report 'Summary of AFRM Trial' including, but not limited to, the following information:
- **1.1** the total quantity of AFRM used during the trial;
- **1.2** the dates and times when the trial commenced and concluded;
- **1.3** the results of stack emissions testing for the analytes and properties specified in any relevant pre-trial reports and baseline emissions for comparison, where applicable;
- **1.4** a final proposed chemical and physical specification of the material based on the trial results; and
- **1.5** an assessment of the suitability of the AFRM for ongoing use.

2. submit the 'Summary of AFRM trial' post -trial report to the EPA within 90 days of the completion of each trial, within 30 days after receipt of stack emissions or modelling results, whichever is greater.

3. if the post-trial report submitted in accordance with paragraph 2 is not acceptable to the EPA, resubmit a revised version of the post-trial report (incorporating any additions or alterations that are required by the EPA) within the time period advised by the EPA in writing.

W-1.4 Post-Trial Report - Summary of AFRM Trial

If the AFRM has been found to be suitable for ongoing use, the Licensee must:

1. prepare a post-trial report 'Request for Ongoing Use of AFRM' for EPA approval. The Report must contain, but is not limited to, the following information:

- **1.1** demonstration of beneficial purposes;
- **1.2** demonstrated support for the waste management hierarchy as outlined in the Environment Protection (Waste to Resources) Policy 2010; and
- **1.3** an assessment of the risks associated with the use of the AFRM and risk mitigating measures including, but not limited to:
  - **1.3.1** the results of stack emissions testing for the analytes and properties specified in any relevant pre-trial reports and baseline emissions for comparison;
  - **1.3.2** air dispersion modelling and ground level concentrations for each substance analysed, as specified in any relevant pre-trial reports, as well as ground level concentrations for baseline emissions for comparison;
  - **1.3.3** any risks associated with on-site storage and handling; and
  - **1.3.4** any relevant complaints or enquiries received during the trial.

2. submit the 'Request for ongoing use of AFRM' post -trial report to the EPA at least 60 days before requiring approval.

3. if the post-trial report submitted in accordance with paragraph 2 is not acceptable to the EPA, resubmit a revised version of the post-trial report (incorporating any additions or alterations that are required by the EPA) within the time period advised by the EPA in writing.

Note 1: Where any ‘ARFM’ to be trialed fits the definition of ‘refuse derived fuel’, the EPA 'Standard for the production and use of refuse derived fuel' dated February 2010 is also considered to apply.

Note 2: In the event that any AFRM proposal fits the criteria specified in Schedule W-1 and a request for the ongoing use is to be sought a submission to the EPA under Conditions A-5 and/or A-6 of this licence is required.

Schedule X-1

Adelaide Brighton Cement Ltd – EPA Environmental Authorisation 1126

AFRM	Approved Feed Rate
Carbon Powder (processed anodes)	Maximum – 2.5 tonnes per hour
Refuse Derived Fuel	25 tonnes per hour (Note: Maximum 20% plastic contamination by weight)
Black Sand (processed Blast Furnace Slag)	Maximum – 20 tonnes per hour
Blast Furnace Slag (processed from One Steel)	Maximum – 15 tonnes per hour
Blended Mill Scale (iron oxide by-product from the recycling of scrap steel)	Maximum – 15 tonnes per hour
Alox	Maximum 1 tonne per hour
Used Foundry Sand	Maximum – 4 tonnes per hour

Appendix B Pre-Trial Report (JBS&G 2022)

Adelaide Brighton Cement Ltd

an ADBRI company

Adelaide Brighton Cement Limited
Increased Alternative Fuel Substitution
Pre-Trial Report

19 July 2022

62579/145,940 (Rev 3)

JBS&G

www.jbsg.com.au

Adelaide Brighton Cement Limited
Increased Alternative Fuel Substitution
Pre-Trial Report

19 July 2022

62579/145,940 (Rev 3)

JBS&G

Table of Contents

List of Tables

List of Figures

Abbreviations

Term	Definition
ABC	Adelaide Brighton Cement Limited
BaP-TEQ_{PAH}	Benzo(a)pyrene Toxic Equivalence Quotient
CLG	Community Liaison Group
EPA	South Australian Environment Protection Authority
GC/MS	Gas Chromatography Mass Spectrometry
GLC	Ground Level Concentration
ITEQ/$NATO_{89}$ I-TEQ	International Toxic Equivalent for PCDDs and PCDFs, (NATO 1989 basis)
LIMS	Laboratory Information Management System
LOD	Limit of Detection
NEPM	National Environmental Protection Measure
PAH(s)	Polycyclic Aromatic Hydrocarbons
PCDDs	Polychlorinated Dibenzo-p-Dioxins
PCDFs	Polychlorinated dibenzofurans
RDF	Refuse Derived Fuel – processed fuel produced from waste materials generated by construction, demolition, commercial and industrial sources
RDF Standard	SA EPA Standard for the production and use of Refuse Derived Fuel, 2010
RPP	Recovered Products Plan
SCADA	Supervisory Control and Data Acquisition (a control system that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management)
USEPA	United States Environmental Protection Agency

Glossary

Term	Definition
g/h	Grams per hour
m^3	Cubic metres
µg	Microgram (10^{-6} gram)
µm	Micrometre (10^{-6} metre)
mg	Milligram (10^{-3} gram)
ng	Nanogram (10^{-9} gram)
Nm^3	Gas volume in dry cubic metres at STP dry basis
$PM_{2.5}$	Particulate matter with a nominal aerodynamic diameter ≤2.5µm
PM_{10}	Particulate matter with a nominal aerodynamic diameter ≤10µm
ppm	Parts per million
t/h	Tonnes per hour

1. Introduction

Adelaide Brighton Cement Limited (ABC) operates within the Cement and Lime division of Adbri Ltd, which has over 1600 employees with operations in all Australian states and territories. Adbri Ltd originated in 1882 and is an S&P/ASX 100 company whose main activities include the production of clinker, cement and lime products, premixed concrete and aggregates and concrete masonry products.

ABC has been a key employer in South Australia for over 110 years. ABC is one of South Australia's biggest manufacturers, with operations at Birkenhead, Angaston in the Barossa Valley and Klein Point on Yorke Peninsula. ABC's world class cement and clinker manufacturing plant at Birkenhead has been a part of Port Adelaide and South Australia for more than 100 years, providing employment opportunities for the community and producing approximately 1.6 million tonnes of cement annually. As a fully integrated cement manufacturing facility, the Birkenhead plant adds value to the South Australian mining and resources sector—particularly limestone and shale—which are manufactured into clinker and then ground to produce cement. In addition to the Birkenhead plant's supply to the South Australian market, ABC also exports cement to Victoria to service the Melbourne metropolitan market.

JBS&G Australia Pty Ltd (JBS&G) is currently supporting ABC in seeking approval from the South Australian Environment Protection Authority (EPA) to conduct an alternative fuel trial at the EPA Licenced Birkenhead plant. The intent of the trial is to determine and demonstrate the ability and benefit of the Birkenhead plant to achieve 100% replacement of fossil fuel input to the calciner with alternative fuel. The proposed trial comprises three main stages as indicated in Table 1.1 below, throughout which an integrated stakeholder engagement and communications plan will be applied and followed.

Table 1.1: Proposed Trial Structure

Trial Stage	Description of Proposed Activity
Stage 1	**Engineering Trial.** Optimisation of engineering and operational parameters for maintenance of process at RDF rates > 25 t/h, including ongoing in-process monitoring for particulate opacity, carbon monoxide (CO), methane (CH_4), oxygen (O_2) and nitrogen oxides (NOx), as presently carried out for plant operation.
Stage 2	**Process Tuning. (If required)** Longer duration trials at higher RDF rates (up to 100%) including additional stack emissions monitoring for nitric oxide (NO), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).
Stage 3	**Complete Stack Testing.** Independent emissions testing of all parameters.

ABC will notify EPA and other stakeholders of the commencement and completion of each stage of the trial with (if available) advice on the preliminary outcomes.

It is anticipated that, following completion of the trial, a Process Change application will be prepared to increase the maximum Refuse Derived Fuel (RDF) feed rate into the calciner from the current approved 25 t/h, up to a new anticipated maximum of 35 t/h, pending the results of the engineering trial. It is anticipated that an average RDF feed rate of 27.5 t/h would allow the Birkenhead plant to achieve 100% thermal substitution of natural gas in the calciner, rendering RDF as the control fuel and able to 'float' according to process requirements in the way natural gas does at present. The actual RDF rate is dependent on the calorific value of the RDF which is largely driven by the fuel moisture. In wetter months the RDF rate may achieve a short term maximum of 35 t/h however the RDF rate on a dry basis is expected to remain at 23.5 t/h. The composition of RDF to be utilised in the trial will be consistent with the EPA approved Recovered Products Plan.

2. Background

Since 2004, ABC has been using RDF as a partial substitute for natural gas in its clinker manufacturing process. The calciner currently utilises an approved RDF product manufactured to comply with the EPA's Standard for the Production and Use of Refuse Derived Fuel (RDF Standard). The RDF is sourced from construction and demolition (C&D) and commercial and industrial (C&I) waste. Schedule X-1 of EPA Licence 1126 for the Birkenhead plant currently permits RDF usage rate to the calciner of 25 t/h.

As part of ABC's ongoing commitment to constructive and inclusive community engagement, the company is dedicated to developing and investing in new products and processes to minimise environmental impacts, divert waste materials from landfill into beneficial re-use and contribute to a low-carbon circular economy. These ambitions are in pursuit of industry best practice and aligned with Cement Industry Federation (CIF) targets for Australia's cement and clinker manufacturing sector to pursue net-zero carbon emissions by 2050. ABC undertakes continuous monitoring of the Birkenhead plant and operates a 24-hour community feedback and complaints hotline, in addition to the Birkenhead Community web portal (www.birkenheadcommunity.com.au). In addition, quarterly Community Liaison Group (CLG) meetings are held to facilitate higher levels of dialogue between ABC and its stakeholders, to address concerns raised by the community. ABC is committed to conducting its business responsibly and in a manner designed to protect the environment, adjacent communities and employees.

Initial trials of RDF as a substitute for natural gas in the clinker manufacturing process began in 2003, with ongoing use of RDF commencing in 2004. ABC acknowledges that clinker, cement, concrete, masonry and lime production are energy-intensive processes, and has continually sought to ensure the application of industry leading best practice across all sites, including the Birkenhead plant, in pursuit of the company's Sustainability Strategy. Since 2010, ABC has achieved a 32% reduction in emissions across all of its sites. The company is working towards the goal of net zero emissions by 2050.

A significant part of the company's Sustainability Strategy is the Net Zero Emissions Roadmap[1], which indicates that substitution of alternative fuels in clinker manufacturing is a key stratagem in achieving substantial emissions reductions.

3. Current Situation

3.1 Current Process under Licence 1126

The current EPA Licence No. 1126 for the Birkenhead plant allows for the combustion of RDF under Schedule X-1 with a maximum content of 20% plastics by weight for a maximum feed rate of 25 t/h.

A combination of RDF and natural gas is consumed in the calciner, with natural gas primarily used as the control fuel. Flow rates of natural gas are manipulated to control exit temperature from the calciner, the key parameter of this stage of the cement clinker manufacturing process. Normal fluctuations in process chemistry and operating conditions necessitate this variance in fuel input. At present, RDF is consumed in the calciner at a relatively consistent rate. During periods of lower fuel demand, the calciner at the Birkenhead plant has been observed to operate sustainably with 100% use of RDF, when process requirements for fuel use have been within the approved RDF feed rate under the present EPA licence.

Previous process changes undertaken by ABC have been subject to rigorous trialling and monitoring frameworks established under the *Environment Protection Act 1993* and administered by the EPA,

[1] https://www.adbri.com.au/sustainability/net-zero/

the most recent of which referred to an increase in RDF usage from 15 t/h to the present maximum of 25 t/h. This trial was undertaken in October 2019.

3.2 Stakeholder Engagement

Due to its metropolitan location and proximity to residential areas on the LeFevre Peninsula, ABC's Birkenhead operation places a high priority on working with local communities and key stakeholders. Engagement will be undertaken via the Community Liaison Group and other key stakeholders including Members of Parliament, Local Council and the EPA. A stakeholder communications plan designed to maximise community engagement in connection with the proposed trials will be developed prior to Stage 1 as an integrated part of the trial plan.

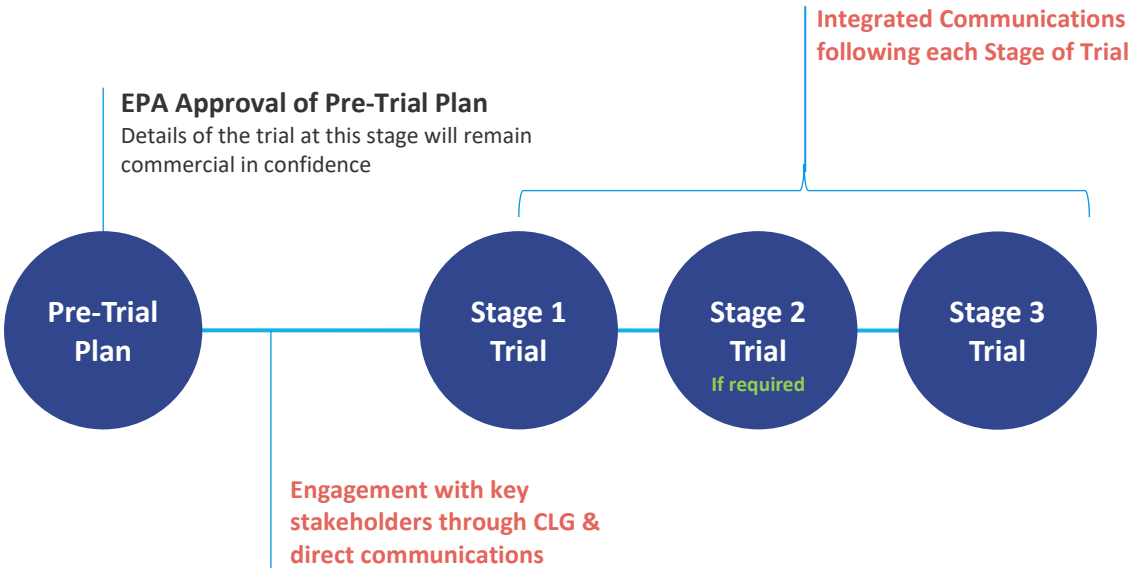

Figure 3-1: Stakeholder Engagement Timeline

3.3 Alternative Fuel Substitution in Cement Clinker Manufacture

In parts of Europe and North America, full substitution of fuel with RDF is a well-established practice. In Australia cement manufacture processes are similarly heading in the same direction. This is in part due to an industry recognition of the energy intensiveness of cement and lime manufacture, and that it is imperative for companies to improve their sustainability practices with regards to fuels used and emissions generated, in line with environmental policy and international best practice.

ABC has committed to a Sustainability Strategy and Net Zero Emissions Roadmap that seeks to increase the use of alternative fuels, in preference to a finite resource intensive source, such a natural gas. This forms a key strategic pillar in reducing the emissions intensiveness of cement clinker manufacture.

Around 60% of the total fuel requirement for plant operations is used in the calciner, with the remaining 40% used in the kiln. Predicted ground level concentrations of stack emissions from ABC Birkenhead operations at 10 to 25 t/h RDF feed to the calciner have historically been below ambient air quality standards. An analysis of those stack emissions data has been carried out to identify the potential for an increase in emissions from an increase in RDF feed from 25 t/h to an average of 27.5 t/h and maximum of 35 t/h. Process and emissions mass balance data have also been utilised to assess the potential for increases in emissions. A plant trial is proposed to confirm the predicted emissions profile.

4. Proposal for Trial

Following discussions with the EPA, ABC are seeking approval from the EPA to conduct trials at the Birkenhead plant, with the intent of increasing the RDF fuel usage within the calciner to 100% of thermal demand. That will include operation of up to 35 t/h RDF feed rate for short periods of time. It is anticipated that, following the trial, this will result in a Process Change application to the EPA to increase the maximum RDF feed rate into the calciner from the current approved 25 t/h, up to a maximum of 35 t/h. The composition of the RDF will remain consistent with the currently approved RPP and EPA Licence.

The proposed feed rate is expected to increase from the current 25 t/h to an average of 27.5 t/h with a shorter term maximum of 35 t/h, during normal operations which include ongoing variance in process requirements. Critically, it has been designed to allow ABC to use RDF as the control fuel in the Birkenhead calciner, and to replace the use of natural gas for that purpose.

Cement clinker manufacture is controlled by kiln and calciner exit temperatures rather than fuel input, which means that a variable energy input is critical to the maintenance of process chemistry. It is anticipated that under normal operating conditions, the feed rate of RDF as the total fuel (including the control fuel) into the calciner will vary according to process requirements, in the same manner as natural gas input varies currently. ABC has determined from consideration of current operating conditions at nominal 25 t/h RDF that an average of 27.5 t/h and a short term maximum RDF feed rate of 35 t/h is required for operation without input from natural gas.

ABC expect that the RDF feed rate during ongoing operations will average around 27 t/h to 32 t/h, with momentary peaks of up to 35 t/h. A feed rate of 35 t/h is only expected to be reached for short periods of time and only when the conditions require. It is not expected that the plant will consume this quantity of RDF on a consistent basis, however in order to achieve 100% RDF substitution in the calciner on an ongoing basis, the feed rate of RDF will vary according to process requirements.

During regular operations, ABC has, on occasion, utilised the RDF fuel inputs into the calciner at 100% RDF within the parameters of the current EPA Licence, however this is only possible during periods where process fuel requirements into the calciner are comparatively low and the RDF calorific value has been high.

To account for variations in the composition and calorific value of RDF, ABC is seeking approval to conduct trials utilising up to 100% RDF in the calciner. These trials are intended to:

- Determine the maximum capacity of the calciner operating under normal conditions at 100% RDF,
- Determine the feed rates of RDF required to sustain normal operating conditions at 100% thermal substitution,
- Conduct stack emission testing using 100% RDF in the calciner to demonstrate acceptable emissions performance, and
- To pursue formalisation of use of 100% RDF through a Process Change application for an amendment to EPA licence 1126.

It is anticipated a maximum RDF feed rate of no more than 35 t/h would be required to support the ambition of 100% alternative fuel usage in the calciner with an average of 27.5 t/h. This allows for variance in process thermal demand and will enable the plant to operate within licence parameters at all times, while using 100% RDF on an ongoing basis in the calciner. To that end, the present trial is proposed.

ABC has an active consultation program established with the local community near the Birkenhead plant and other stakeholders. The company acknowledges that concerns have been raised by

members of the community around previous RDF trials. Efforts are underway to continue to improve the company's relationship with stakeholders including the local community, such that the proposed trial and any resultant change to ongoing operations at the Birkenhead plant achieve the best possible outcomes for all stakeholders.

4.1 Strategic Context

ABC through its Board has made a commitment to continue to seek to increase the sustainability of its operations and reduce its environmental footprint. In pursuit of this, ABC has committed to the Net Zero Emissions Roadmap[2] which includes a series of iterative 5-year Sustainability Plans[3]. Under the 2019 5 Year Sustainability Plan, ABC has committed to 50% alternative fuel substitution across clinker kilns and an absolute reduction in CO_2 emissions of 7%.

In addition to this the State and Federal Government through South Australia Waste Strategy and the application of the *Environment Protection Act 1993* seeks to:

- Promote the principles of ecologically sustainable development.
- Protect, restore and enhance the quality of the environment.
- Regulate all aspects of waste management, and activities and products that cause environmental harm through the production of waste.
- Apply the waste management hierarchy.
- Promote the beneficial reuse of materials to contribute to a circular economy
- Support a strong market for recovered resources.

The decision to move towards the use of RDF has been a strategic one by ABC. This decision along with the application of the waste management hierarchy aids in:

- Ensuring the best and safest use of recovered resources,
- Enabling the commercial separation of plastics for higher-use recycling,
- Reducing the amount of waste going to landfill and ending up in our environment, and
- Supports South Australia's circular economy.

In do so ABC is aligning with EPA policies that actively promote the circulation of materials and a strong resource recovery market.

4.2 Demonstration of Beneficial Purposes

Historically, input materials in the manufacture of RDF have been disposed to landfill. When processed appropriately and in compliance with the requirements of the Standard, ABC has been able to demonstrate over almost twenty years of continuous use that RDF can be used as a substitute for fossil fuels in its cement clinker manufacturing process. Use of RDF in this way reduces natural resource use and is a major contribution to the Government's zero waste philosophy, demonstrating tangible support for the waste hierarchy and contributing to a circular economy.

At present, RDF is combusted in the calciner within the limitations of the licence up to a maximum rate of 25 t/h. Natural gas is used as the primary control fuel in the calciner, although ABC have utilised 100% RDF at times within the calciner. This represents approximately a 45% substitution of the plant's total natural gas requirement (which includes natural gas usage in the kiln), and approximately a 75% substitution for natural gas used in the calciner.

Increasing RDF usage presents further environmental and raw material conservation benefits commensurate with previous licence amendments and increases, as follows;

[2] https://www.adbri.com.au/sustainability/net-zero/
[3] https://www.adbri.com.au/sustainability/sustainable-future/

- Beneficial re-use of a material with no other current viable use. The current maximum addition of RDF does not displace South Australia's total generation of construction, demolition, commercial and industrial waste, which means there is still a significant surplus sent to landfill.
- The previous process change to utilise up to 25 t/h of RDF (an additional 10 t/h) accounted for the additional consumption of 50,000 tonnes per annum of construction, demolition, commercial and industrial waste.
    - It is anticipated that any further increase in RDF use will provide a scalar increase in solid waste diverted from landfill to beneficial reuse in cement manufacturing.
    - Actual usage of RDF under the proposed increased maximum is anticipated to vary between 27 to 32 t/h, depending on process energy requirements.
- The approved RDF product contains 15% ash (annual average), which is primarily sand and clay minerals. These are useful raw materials in cement manufacture. Each 10 t/h increase in RDF consumption in the calciner represents a substitution of approximately 10,000 tonnes per annum of mined clay.
- It has been observed through regular operations that an RDF consumption rate of 15 t/h in the calciner represented in excess of 25% displacement of the plant's total natural gas requirement, based on an average RDF calorific value (CV) of 13 GJ/t.
    - An additional 10 t/h of RDF consumption (up to 25 t/h) displaced a further 20% of natural gas requirement.
    - Correspondingly, a further increase to achieve a full substitution of RDF fuel in the calciner represents up to a 60% displacement in the plant's total natural gas requirement
        - In the precalciner kiln system of cement clinker manufacture used by ABC at the Birkenhead plant, 60% of total thermal input occurs into the calciner, with the remaining 40% used in the rotary kiln.
        - Correspondingly, increase from the current 25 t/h to an average of 27.5 t/h with a shorter term maximum of 35 t/h of RDF facilitates 100% thermal substitution of natural gas input into the calciner on an ongoing basis, allowing the fuel input to 'float' according to process requirements within the parameters of the licence.
- Table 4.1 summarises the scalar benefits to natural resource conservation – natural gas, beneficial reuse of waste and substitution of mined mineral resources – associated with RDF use.

Table 4.1: Natural Resource Benefits of RDF

Maximum RDF Consumption	Thermal Substitution – Fuel Conservation		RDF Used from Landfill	Waste Diverted from Landfill	Mined Resource Substitution (Sand & Clay)
	Total kiln and calciner	Calciner			
15 t/h	Approx. 25%	Approx. 45%	95 ktpa (14.6 t/h average RDF use)	≈ 190 kpta	≈ 15 ktpa
25 t/h	Approx. 45%	Approx. 75%	145 ktpa (22.3 t/h average RDF use)	≈ 290 ktpa	≈ 21-25 ktpa
35 t/h (Predicted)	≥ 60%	100%	175 ktpa – 208 ktpa (27 – 32 t/h average RDF use)	≈ 390 ktpa	≈ 30-39 ktpa (scaled)

4.3 Demonstrated Support for the Waste Hierarchy

The increase in RDF proposed is an extension of the existing approval for use in the Birkenhead plant. The RDF has an average calorific value of 13 GJ/t (range 11 to 15 GJ/t) which reflects compositional variance, particularly moisture, and so displaces a predictable quotient of the natural gas traditionally used for cement clinker manufacture.

Cement production is a carefully controlled process, where exact product specifications must be met for quality reasons. Consequently, cement kilns are not utilised as “incinerators” for disposal of general waste, with fuels used required to meet defined quality specifications. Combustion of RDF in cement production is primarily an energy and mineral recovery activity. When assessed against the waste hierarchy, this is preferable to disposal into landfill. If ABC were not to use RDF, disposal to landfill would continue and use of a fossil fuel (natural gas) would continue along with the need to mine additional limestone and shale. Waste is therefore diverted from landfill to a more sustainable and useful purpose, displacing a thermal requirement which would otherwise continue to be derived from finite fossil fuel resources and reducing mineral extraction requirements.

Further to this, the production method of the approved RDF effectively segregates and separates materials and components recyclable through established pathways, meaning that waste that is otherwise recoverable is not being consumed as RDF, and the RDF comprises only waste materials which are not otherwise recoverable. Technologies in this space have advanced since ABC undertook the company’s first trials of RDF in 2003, reflected in process changes undertaken in the intervening years. The use of the non-higher-order recyclable waste stream to produce an RDF is a commercial enabler of higher-order waste recycling. ABC recognises that perceptions of the combustion of otherwise recoverable and recyclable materials has been a point of concern raised by stakeholders, including communities adjacent to the Birkenhead plant.

ABC concludes that extending the use of RDF in this manner demonstrates support for the waste hierarchy.

4.4 Purpose of the Trial

In 2016, ABC installed additional storage and firing equipment on the Birkenhead site to support an increased feed rate of RDF into the calciner. Storage and feed capacity exists to support the currently proposed increase of the maximum, and discussions with external RDF processing companies have indicated that there is more than enough capacity in the SA waste market to continuously supply that maximum rate. A trial is required to ascertain the operational limits of the calciner in the process, and to determine the maximum achievable RDF feed rate. The trial aims to provide evidence that any application to increase in RDF consumption at the Birkenhead plant is achievable, sustainable and will not result in adverse impacts on the environment or adjacent communities.

Discussions with the EPA have established the EPA’s requirement to demonstrate the feasibility and acceptable environmental performance for the proposed increase in RDF use in the calciner. As a result, ABC is seeking approval to carry out a series of trials according to the trial management protocol described in Schedule W-1 of EPA Licence 1126. The trials involve combusting only RDF in the calciner to determine the capacity of the calciner operation and the associated upper limit required for production requirements.

The trial is proposed to be undertaken in stages with appropriate hold points in the process where operations will return to those set by the current EPA Licence 1126. Stage 1 will allow ABC to determine the maximum capacity of the calciner to operate only using RDF. Once this is understood a detailed trial plan will be prepared to allow ABC to prove the operation of the process, and to undertake stack emissions testing.

In particular, the trials will:

- Ascertain the feed rate of RDF required by normal production requirements to enable the calciner to operate on 100% RDF on an ongoing basis. Process tuning will be required to ensure appropriate operating parameters in the calciner are determined, set and proven to be achievable.
- Allow for an extended period of operation at the higher proposed RDF addition rate. This ensures that process tuning is completed and stable operations are achieved, so that appropriate quantities of product can be collected for quality testing and that adequate time is available for the required stack testing to be undertaken.
- Confirm the capacity of the RDF supplier to maintain the maximum proposed delivery rate determined at stage 1 on a consistent basis.
- Determine procedures for controlling RDF usage during periods of abnormal or unusual process conditions, including emergency response and shutdown events.

4.5 Physical and Chemical Specifications of RDF

"Refuse Derived Fuel" is a generic name used to describe a processed fuel produced from various waste materials generated by construction, demolition, commercial and industrial sources. The major combustible components of the RDF utilised by ABC at the Birkenhead plant are wood, paper, cardboard, textiles, plastic and rubber. Notably, these components constitute materials which are unable to be recycled through conventional resource recovery methods. Recyclable materials are recovered in the processing of RDF and do not form part of the fuel. Additionally, RDF contains up to 15% ash, which is predominantly sand and clay. As discussed above, ash contributes beneficially to the clinker manufacturing process by reducing the input requirement for mined sand and clay resources. To be suitable as a fuel the materials are blended to improve consistency and shredded to produce an appropriate particle size. ABC has consistently demonstrated over many years that RDF is a suitable substitute for non-renewable fossil fuels in its clinker-making process. This trial is not intended to revisit that issue, it is only required to demonstrate the increase in RDF usage rate is operationally favourable with acceptable environmental impacts.

ABC has an EPA-approved Recovered Product Plan (RPP) for the RDF presently in use that confirms the composition, supply and use of this material complies with the EPA Standard for the Production and Use of Refuse Derived Fuel.

No change to the composition of RDF is proposed; the material used by ABC at the Birkenhead plant will remain consistent with that currently approved under the RPP.

4.5.1 Analysis of Air Emissions from Previous Trials

The stack testing proposed for the trial will provide data on emissions for operations up to the maximum RDF feed rate of 35 t/h. Interpretation of this data in respect of identifying changes (in particular increases) in emissions is dependent on a range of factors including:

- natural variability in the emissions from normal operating conditions;
- uncertainty in the sampling procedures; and
- uncertainty in the analysis.

The uncertainties in sampling and analyses are provided by the (NATA accredited) stack testing company. These range from ±6% for oxygen and carbon dioxide to ±40.6% for dioxins and PAHs (as BaP equivalents). These measurement uncertainties are taken into consideration when the overall variability in the measured emission rates are assessed to determine if any differences in emission rates determined for operation at 100% RDF substitution are statistically significant.

Analysis of historical stack emissions data for operation at RDF feed rates from 10 t/h to 23 t/h informs the inherent variability in emissions rates that occurs as a consequence of measurement uncertainty and process variability. That information will assist in the interpretation of results from emissions testing conducted at the higher rates. The most significant emissions parameters in respect of the percentage of air quality limits for the incremental maximum predicted GLCs are NOx (73% of the 1-hour EPP criteria for October 2021)[4] and chlorine (29% of the 3-minute criteria). The remainder of emissions parameters are less than 20% of the respective criteria. Dioxins and furans GLCs, which are a pollutant of community concern, are predicted to be 1.2% of the 3-minute criteria from the October 2021 emissions testing. The calciner was operated at RDF feed rates of 23 t/h for those stack tests.

The relationship between RDF feed rates and emission rates of these pollutants are illustrated in Figure 4-1 for NOx emissions, Figure 4-2 for chlorine emissions and Figure 4-3 for dioxin emissions.

At the Birkenhead plant, the 4A stack is associated with the rotary kiln, while the 4B stack is associated with the calciner and is the stack relevant to the trial measurement results.

[4] The Ambient Air Quality National Environment Protection Measure for NOx (as NO_2) has been updated by the revision to the NEPM (15 April 2021), which now has a limit of 150 µg/m^3 for a 1-hour average. This has not yet been reflected in the Environment Protection (Air Quality) Policy 2016 which is used to manage air quality in South Australia.

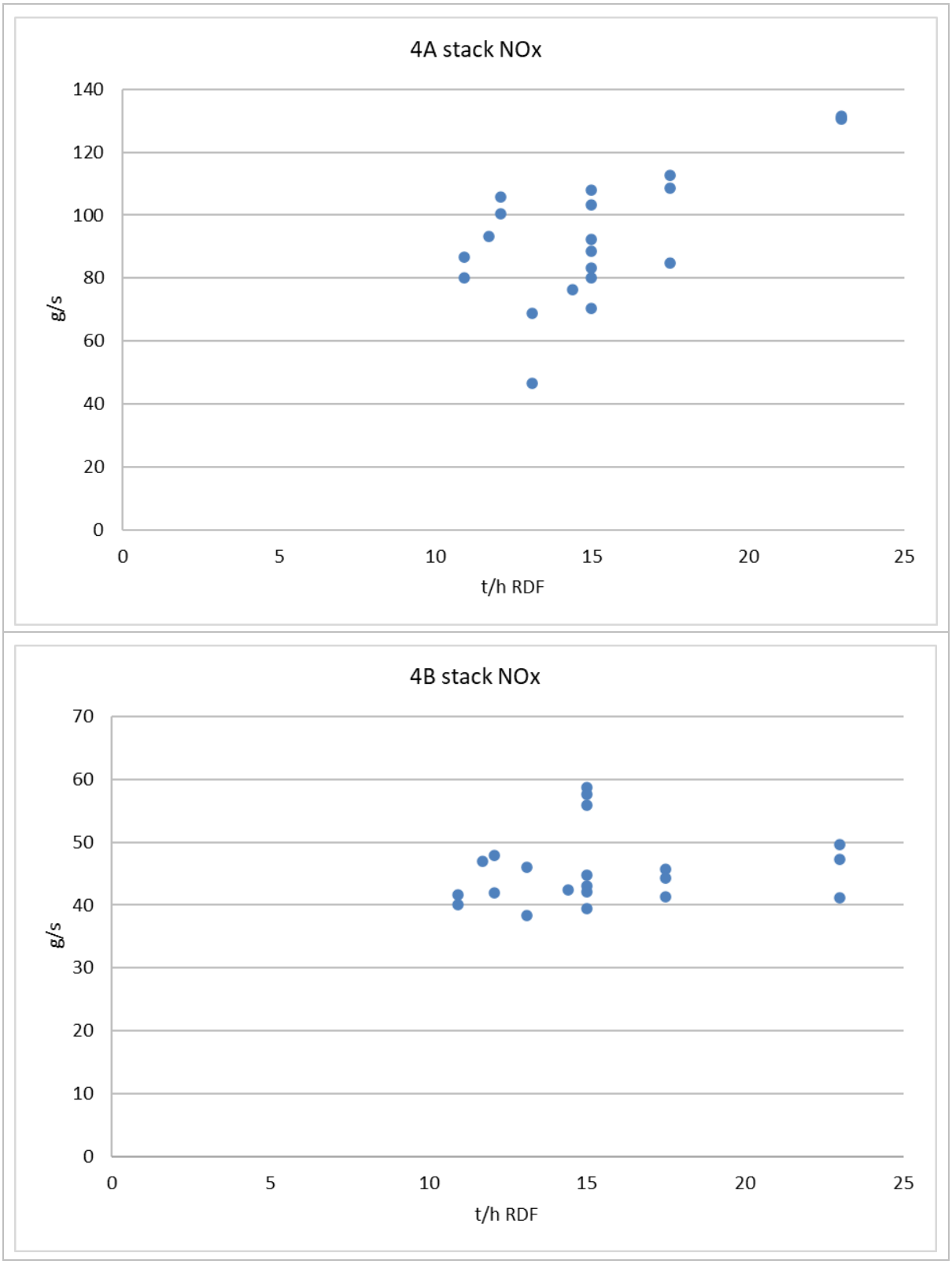

Figure 4-1: NOx Emission Rate vs RDF Feed Rate

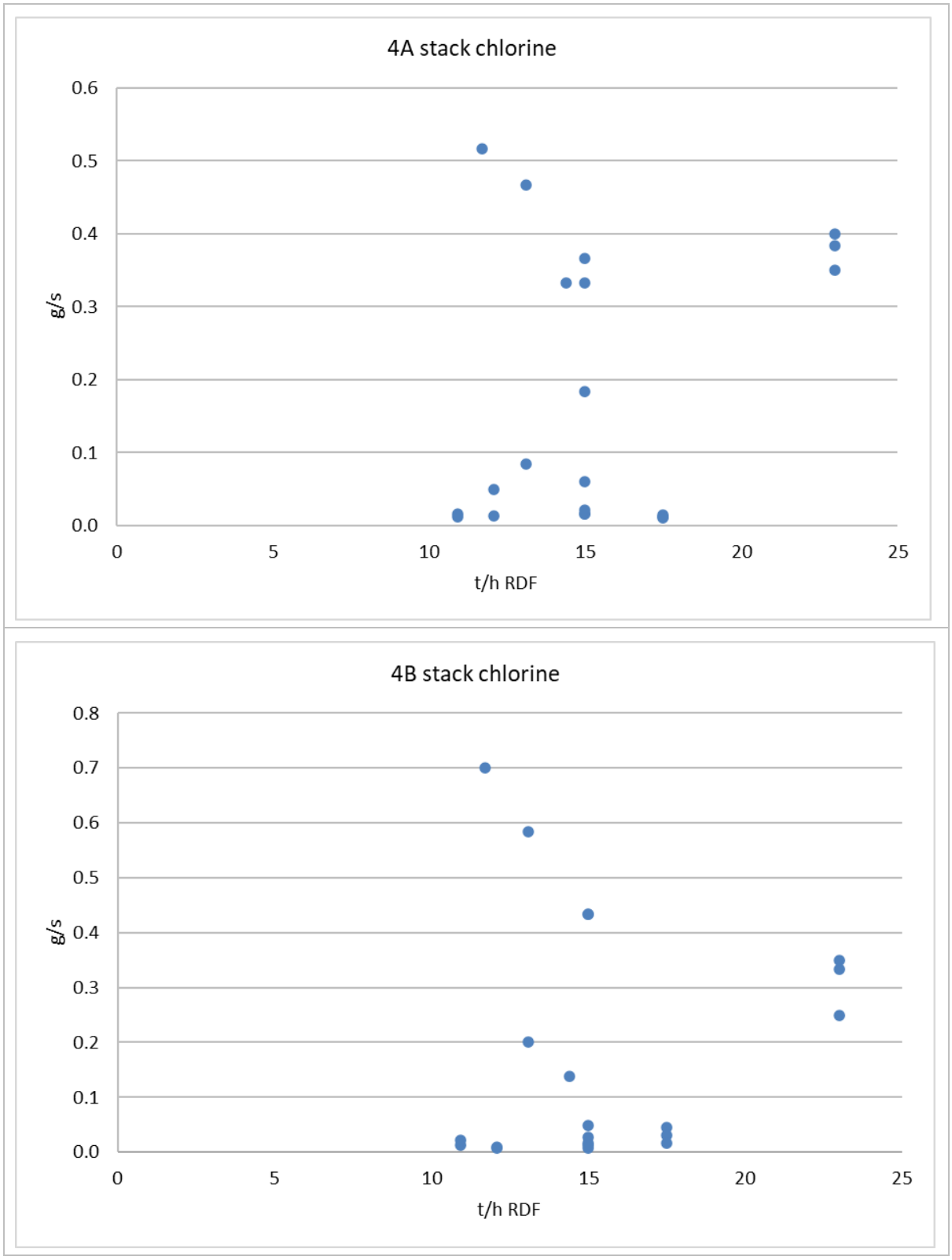

Figure 4-2: Chlorine Emission Rate vs RDF Feed Rate

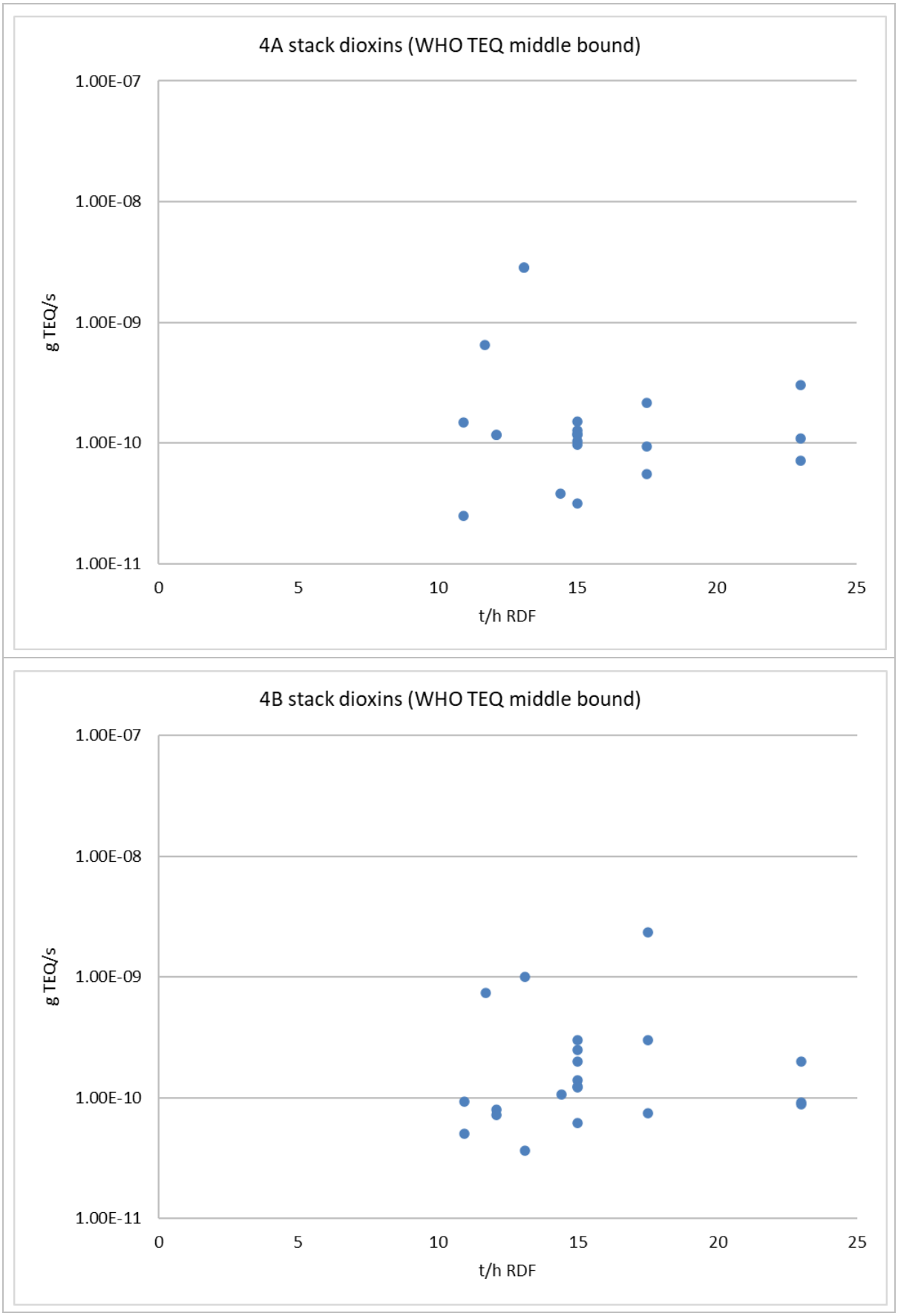

Figure 4-3: Dioxins Emission Rate (log scale) vs RDF Feed Rate

Correlation coefficients (r^2) from regression of emission rates of all parameters with RDF feed rates are shown in Table 4.2.

Table 4.2: Correlation coefficients for regression of emission rates and RDF feed rates

Emission parameter	r^2 for 4A stack	r^2 for 4B stack
Total Solid Particulates	0.0622	0.0003
PM_{10} Particles	0.2432	0.0327
$PM_{2.5}$ Particles	0.2963	0.0124
Sulfur Dioxide	0.0016	0.0148
Carbon Monoxide	0.2118	0.0021
Oxides of Nitrogen (as NO_2)	0.4858	0.0141
Hydrogen Chloride	0.0198	0.0224
Chlorine	0.0936	0.0142
Fluoride (as HF)	0.0000	0.0335
Total VOCs (n-propane equivalent)	0.0057	0.0031
Benzene	0.0928	0.0039
Chromium VI and Compounds	0.0228	0.0372
Polycyclic Aromatic Hydrocarbons BaP-TEQ	0.0354	0.0908
PCDDs and PCDFs total	0.0299	0.0687
PCDDs and PCDFs WHO TEQ Middle bound	0.0491	0.0011
PCDDs and PCDFs I-TEQ Middle bound	0.0430	0.0001
Antimony and its compounds	0.0019	0.0174
Arsenic and its compounds	0.0123	0.5247
Barium (soluble compounds)	0.0069	0.0036
Beryllium and its compounds	0.0326	0.0033
Cadmium and its compounds	0.1119	0.1956
Chromium (III) and its compounds	0.0200	0.4215
Copper oxide fume (as CuO)	0.1964	0.1547
Iron oxide fume	0.1146	0.2102
Lead and its compounds	0.1245	0.2576
Magnesium oxide fume	0.0095	0.0440
Manganese and its compounds	0.2307	0.1917
Mercury and its compounds (as Hg) - organic	0.0306	0.0120
Mercury and its compounds (as Hg) - Inorganic:	0.0011	0.0006
Mercury and its compounds (as Hg) - Total:	0.0011	0.0006
Nickel and its compounds	0.0098	0.0812
Zinc oxide fume	0.0131	0.0031

The most significant correlations are observed for the following parameters:

- As from stack 4B (r^2 0.5247)
- NOx from stack 4A (r^2 0.4858)
- Cr(III) from stack 4B (r^2 0.4215)

These are poor correlations and do not provide strong evidence for a significant correlation of emission rates with increasing RDF rates. As such, it is unlikely that an increase in these emissions would occur from an increase in RDF rates from 25 t/ to 35 t/h.

The above findings suggest that combustion of higher amounts of RDF in the calciner is unlikely to result in significant increases in emissions rates from both stacks.

Notwithstanding that finding, an analysis of the potential size of an increase in emissions rates of pollutants which arise from precursors analysed in raw materials and RDF (i.e., metals, sulfur oxides, HCl, Cl_2 and fluoride (as HF)) has been carried out to confirm the finding that an increase in RDF rate to 35 t/h will not give rise to detectable increases in emissions from a trial.

4.5.2 Predicted Emissions rates for 35 t/h RDF

As discussed above, the emissions rates for all parameters appear to be invariant with RDF feed rates to the calciner. In other words, the inherent variability in emission rates is greater than any increase in emission rates that may occur as a consequence of increased RDF combustion. Further evidence in support of that finding can be obtained from consideration on the increase in inputs of emissions precursors including metals, sulfur and chlorine into the process from increase RDF rate to 35 t/h. A comparison of the predicted increase in emission rates of these parameters can be made with the natural variability of emissions to confirm that increases are not materially significant.

The predicted emission rates of these parameters for 35 t/h RDF feed rate were determined utilising process mass (materials) balance data for the last three reported stack testing events.

A key assumption in the estimation of emissions from 35 t/h RDF combustion in the calciner is that the increase in the inputs of metals, sulfur, chlorine (as chloride) and fluorine (as fluoride) with the increased RDF rate will result in a commensurate increase in emissions of metals, SO_2, HCl, Cl_2 and fluoride (as HF) for both the kiln stack (4A) and calciner stack (4B). This reflects the overall increase in the metals, sulfur and chloride introduced in the RDF via the calciner that ultimately reports to the kiln and the clinker. This provides a worst-case scenario for increase in emission rates, since as discussed above, the data for operation at 10 to 23 t/h RDF feed to the calciner do not show such an increase in emissions with increase in RDF feed rate.

Details of the calculations carried out to predict emission rates from 35 t/h RDF combustion in the calciner are shown in Table 4.3, with a worked example for Chromium (III) shown in Table 4.4

Table 4.3: Emissions predictions calculations for 35 t/h RDF

Item	Details	Calculations and values	Comment
Data sources	Stack testing data from Oct 2020, April 2021 and Oct 2021. Raw materials analyses for each stack testing event. Process data for materials feed rates.		
Raw materials composition	Analytical data from raw materials sampled for each stack testing event	Metals composition in ppm (dry basis) Chloride and sulfur (as SO_3) composition in wt% (dry basis)	Chloride data obtained from 2019 sampling program
RDF composition	Analytical data from RDF sampled for each stack testing event.	Metals composition in ppm (dry basis) for ash content. Chloride and sulfur (as SO_3) composition in wt% (dry basis) for ash content.	Chloride data obtained from 2019 and 2021 sampling programs
Raw materials feed rates	Process data from each stack testing event	Rates adjusted for moisture to provide dry basis	
RDF feed rates	Process data from each stack testing event (15, 17.5 and 23 t/h for the respective events).	Rates converted for ash content	RDF composition reported for ash
Stack emissions	Emission rates obtained from Airlabs reports.	Emission rates calculated as g/min. Average emission rates from multiple stack testing runs used for prediction of rates from higher RDF usage rate.	Half detection limit emission rates were used for the calculations for non-detect results.

Item	Details	Calculations and values	Comment
Emissions predictions - assumptions	Emission rates of metals, HCl Cl_2 and SO_2 for both 4A and 4B stacks increase on a linear basis with increase in RDF rate.		Only metals, SO_2, HCl and Cl_2 emissions predicted from mass balance.
Emissions predictions – calculations	Calculated input of emission parameter for each raw material	Input (g/min) = feed (t/h) x 1000 (g/t) x 0.0167 (h/min) x concentration (ppm)	
	Calculated input of emission parameter for RDF	Input (g/min) = RDF feed (t/h) x ash content (% w/w) 1000 (g/t) x 0.0167 (h/min) x concentration in ash (ppm)	Calculated for actual feed rate and future (35 t/h) feed rate
	Total inputs	Total (g/min) = raw materials input (g/min) + RDF input (g/min)	
	Predicted 4A emissions for 35 t/h RDF	Predicted 4A emissions (g/min) = measured 4A emissions x input for 35 t/h RDF ÷ input for actual RDF rate	Only metals, SO_2, HCl and Cl_2 emissions predicted from mass balance.

Table 4.4: Example emissions calculations – Chromium (III)

Item	Input/output	Feed rate (t/h, dry)	Chromium (ppm)	Chromium (g/min)
Current operation (23 t/h to calciner)				
Limestone	Input	91.7	20	83.9
Moculta Shale	Input	5.7	90	23.4
Bauxite	Input	1.4	474	29.3
Black Sand	Input	1.3	800	45.9
RDF	Input	23	532	33.1
Total Cr(III)	Input			215.6
4A stack emission	Output	-	-	0.049
4B stack emission	Output	-	-	0.053
Future operation (35 t/h RDF to calciner)				
Limestone	Input	91.7	20	83.9
Moculta Shale	Input	5.7	90	23.4
Bauxite	Input	1.4	474	29.3
Black Sand	Input	1.3	800	45.9
RDF	Input	35	532	50.4
Total Cr(III)	Input	-	-	232.9
4A stack emission	Output	-	-	0.052
4B stack emission	Output	-	-	0.057
Difference (35 t/h vs 23 t/h RDF)				8.0%
Historical variance (%RSD) – 4A stack				95%
Historical variance (%RSD) – 4B stack				80%

In this example, the difference in the predicted Cr(III) emission rate for 35 t/h RDF compared with the emission rate for 23 t/h RDF is 8.0%. The historical variabilities (% RSD) in the emission rates from 4A stack (95%) and the 4B stack (80%) are significantly greater than the difference, which means that difference is unlikely to be detected by the emissions testing that would be carried out during the trial.

A summary of the predicted emission rates for all metals, SO_2, HCl, Cl_2 and fluoride (as HF) for 35 t/h RDF usage is shown in Table 4.5.

Table 4.5: Predicted metals, SO_2, HCl, Cl_2 and HF emissions for 35 t/h RDF

Parameter	Difference in emission rates - RDF 23 to 35 t/h (Oct 2021)	Difference in emission rates - RDF 17.5 to 35 t/h (April 2021)	Difference in emission rates - RDF 15 to 35 t/h (Oct 2020)	RSD for 4A stack	RSD for 4B stack
As	4.4%	9.1%	15.3%	79.4%	65.7%
Ba	7.8%	12.3%	7.6%	401.6%	330.2%
Be	1.4%	2.7%	0.0%	37.7%	45.1%
Cd	10.4%	12.4%	69.5%	237.5%	70.3%
Cr	8.0%	14.1%	13.8%	95.3%	80.0%
Cu	18.5%	32.9%	9.1%	132.0%	107.9%
Hg	0.0%	0.5%	0.0%	166.3%	103.1%
Mn	0.8%	3.1%	1.6%	79.5%	147.6%
Ni	2.1%	10.3%	5.8%	185.2%	91.1%
Pb	22.0%	53.1%	27.6%	187.6%	41.2%
Sb	7.7%	65.3%	52.6%	55.8%	70.3%
Zn	4.3%	17.0%	6.6%	203.1%	316.0%
SO_2	18.9%	25.3%	32.5%	108.9%	31.3%
HCl	52.2%	100.0%	133.3%	116.4%	394.9%
Cl_2	52.2%	100.0%	133.3%	105.9%	122.6%
HF	0.0%	3.0%	2.2%	49.3%	278.4%

Aside from HCl from the 4A stack and Cl_2 from both stacks from the Oct 2020 testing, the difference in predicted emission rates for the indicated parameters for the three test events are within the inherent variance in emission rates. The predicted increase in HCl emissions (133%) for the 4A stack is greater than the variance (116%) for Oct 2020 testing, with predicted increase in Cl_2 emissions (133%) is greater than the variance for both 4A (106%) and 4B (123%) stacks for that test program. The implication of the HCl and Cl_2 results for Oct 2020 are discussed below.

4.5.3 Impacts of predicted increased emission rates of HCl and Cl_2

Dispersion modelling conducted since 2019 using measured emission rates has shown all predicted ground level concentrations (GLCs) are below the SA EPA air quality criteria. This means that similar outcomes are predicted for all parameters that have predicted emission rates within the natural variability in emissions.

The predicted increase in HCl and Cl_2 emission rates (based on scaling of Oct 2020 emissions data for increase in chlorine inputs) are greater than the natural variance for those parameters. The potential impacts of those higher emission rates is assessed from consideration of dispersion modelling carried out for each stack testing event. Regression of the predicted GLCs (maximum 3-minute averages) from modelling conducted since 2019 with the combined emission rates from both stacks provides an estimation of the GLCs for the emission rates for 35 t/h RDF combustion in the calciner. The results are shown in Table 4.6, with comparisons made against the SA EPA air quality criteria.

Table 4.6: Predicted maximum 3-minute average GLCs for HCl and Cl_2 for 35 t/h RDF

Parameter	Maximum GLC (µg/m³)	Air quality criteria (µg/m³)	% of criteria
HCl	11.9	270	4.4%
Cl_2	40.2	110	36.5%

The predicted GLCs are below the air quality criteria which suggests a low risk of adverse impacts at nearby receptors from HCl and Cl_2 emissions from the trial.

These findings confirm that any changes in emissions from increase in RDF combusted in the calciner to 35 t/h present a low risk of adverse impacts to neighbouring residents.

4.5.4 NOx emissions impacts

As discussed in Section 4.5.1, NOx emissions from the 4A and 4B stacks show poor correlations with RDF feed rate to the calciner. That suggests factors other than the nitrogen content of RDF (which gives rise to fuel NOx formation) influence the NOx formation rates. In isolation, the highest NOx emissions rates observed for operation at the highest RDF rate tested (23 t/h) suggests some change may have occurred with the combustion conditions in the kiln, that may have been required to balance the energy input from the higher RDF rate. The assessment of NOx emissions will be a key component of the trial when RDF rates reach 35 t/h.

The potential risk from any materially significant increases in measured NOx emissions from the trial is informed by dispersion modelling of historical emissions up to 23 t/h RDF feed to the calciner. The predicted maximum 1-hour and annual average GLCs in the modelling domain are shown below (Table 4.7), with a comparison made of the predicted GLCs against the SA EPA criteria (from the EPP) and the NEPM (AAQ). Note that the EPP criteria for NOx predate the NEPM, which was revised in 2021.[5]

Table 4.7: NOx GLCs

Stack test	RDF rate (t/h)	Averaging period	NOx GLC (µg/m³)	EPP criteria (µg/m³)	% of EPP criteria	NEPM (µg/m³)	% of NEPM
October 2021	23	1-hour	182.8	250	73.1%	150	121.9%
		Annual	1.2	60	2.1%	28	4.5%
April 2021	17.5	1-hour	147.9	250	59.2%	150	98.6
		Annual	1.0	60	1.7%	28	3.6%
October 2020	15	1-hour	162.2	250	64.9%	150	108.1%
		Annual	1.1	60	1.8%	28	3.9%
March 2020	15	1-hour	132.5	250	53.0%	150	88.3%
		Annual	0.9	60	1.5%	28	3.3%
October 2019	15	1-hour	123.9	250	49.5%	150	82.6%
		Annual	0.9	60	1.4%	28	3.2%
April 2019	12	1-hour	149.6	250	59.8%	150	99.7%
		Annual	1.0	60	1.7%	28	3.6%

The maximum predicted 1-hour average GLCs are below the EPP criteria, however they exceed the NEPM for October 2020 and 2021, and are essentially at the NEPM for April 2019 and 2021. An increase in NOx emissions from combustion of 35 t/h RDF in the calciner has the potential to result in exceedance of the NEPM on a 1-hour basis. However, that would require worst-case meteorology to prevail at the times that an increase in NOx emissions might occur, which represents a relatively low probability event.

A formal risk assessment will be carried out once NOx (and other) emissions data are obtained from stack testing. The assessment will consider the frequency of any exceedances of air quality criteria and the probability that those exceedances will occur from continuous operation at the higher RDF rates.

At this time, the predicted NOx GLCs are compliant with the EPP criteria and associated Licence conditions. However, it is anticipated that in the future, the EPP may be amended to adopt the current NEPM limits (for all NEPM pollutants). If the NOx emissions exceed any revised EPP limits then ABC may be required to implement an improvement program to reduce NOx emissions. That is not a matter to address in the RDF trial.

[5] The NEPM (AAQ) NO_2 1-hour average limit has been reduced from 0.12 ppm to 0.08 ppm, and the annual limit from 0.03 ppm to 0.015 ppm. The current 1-hour average limit is converted to mass per volume concentration of 150 µg/m³ at 25 °C and the annual limit to 28 µg/m³ at 25 °C.

4.5.5 Storage, Feed Method and Feed Rate

In the course of normal operations, RDF is delivered to the site in enclosed walking floor trucks and is fed into the kiln process through an established feed system. No change to this operation will occur, outside of the expected increase in truck movements from 22 per day to 26 per day and the increase in feed rate from 25 t/h to a maximum rate of 35 t/h.

4.5.6 Risk Mitigation During Trials

From the above discussion, ABC does not expect that an increase in RDF addition up to a maximum of 35 t/h in preference to natural gas will have any adverse impact on stack emissions, i.e., stack emission rates at the higher RDF rates will be within the ranges previously observed for firing of the calciner using RDF and natural gas. Nonetheless, the process will be monitored and controls implemented during the trials as follows:

1. **Combustion conditions**
   Carbon monoxide is continuously measured at two locations downstream from the combustion zone in the calciner to monitor the combustion efficiency. These measurements provide an ongoing indication to the plant operators that combustion is proceeding satisfactorily. The complete and efficient combustion of fuels has safety, environmental, quality assurance and economic implications for ABC. Alarms and automatic controls built into the burner management system ensure that the process is shut down if carbon monoxide levels rise to unacceptable levels due to mechanical failure or process upset. During the proposed trials, carbon monoxide levels will be monitored as a surrogate variable indicating the efficiency of RDF combustion. If levels rise unacceptably, then it will be assumed that the combustion conditions have become less efficient. If this occurs, either the RDF feed rate will be reduced to a previously determined acceptable level and natural gas fired to maintain required heat input for continued operation, or the trial will be terminated while the issue is assessed. More specifically, both the calciner RDF feed system and the burner have independent management controls, which will initially pause the delivery of RDF if carbon monoxide levels exceed 1.2%. If carbon monoxide levels exceed 3% for 2 seconds, then a shutdown of the RDF combustion system may be initiated and natural gas firing recommenced.
2. **Emission Levels**
   As discussed previously, ABC does not expect that increasing RDF combustion rate will have any impact on particulates emission levels. In particular, the particulate loadings on the ESPs are almost entirely from the processing of raw materials and the relatively small increase in particulates and non-volatile metals in those particulates from increased RDF combustion is within the inherent variability of the process. Importantly, the electrical properties (resistance) of any additional particulates generated from the increase in RDF combustion are unchanged from the particulates generated at the current rate.
   Although the mass balance predicts a small increase in emissions of some parameters for the higher RDF rates, the increase is within the variability observed from historical operation using RDF as fuel for the calciner. In other words, any increase in emissions is unlikely to be detectable within the inherent variability of the process.
   Nonetheless, ABC propose to conduct continuous monitoring of gaseous pollutants for Stage 1 of the RDF trials using the in-process particulate (opacity), CO, CH_4, O_2 and NOx analysers. These data will assist in optimising the operating conditions and to provide the first indication of potential for significant increase in emissions (if that occurs).
   Semi-continuous emissions testing will also be carried out from the Stack sampling locations for Stage 2 of the trial, using combustion gas analysers to measure NO, NO_2, CO, SO_2, O_2 and

CO_2) with the analysers calibrated beforehand to USEPA method specifications. These measurements will inform the potential risks from actual stack emissions from the higher RDF combustion rates in the calciner.

In the event of increases in emissions of these parameters occur that are outside the normal range observed for combustion of RDF, then either RDF feed rate will be reduced to determine if the emission rates decrease, or the trial will be terminated if the abnormally high emissions persist.

3. **Trial Control Strategy**

   To minimise the impact on process and to ensure safety and the avoidance of external impacts, RDF feed rate will be increased gradually from the presently approved maximum level of 25 t/h, rather than introducing a large step-change in feed rate. This is the same methodology as was used during the previous 25 t/h trial. This allows for process tuning to ensure stability and safety of the process, and to prove that the process can be operated steadily and sustainably at any particular increased feed rate to a maximum of 35 t/h. This approach allows the full process to be assessed and any bottlenecks identified, before reaching a point where the process may risk a loss of stability and/or emissions rates increase beyond historical limits. This methodology ensures safety and the effective early detection of process upsets and prevention of any adverse impacts through the trial process.

4.6 Testing Proposed Under Trial

When sustainable operating conditions have been determined for increased RDF rates, then comprehensive stack testing will be undertaken to assess the emissions concentrations and rates of all pollutants listed in Schedule Y-1 of the Birkenhead site licence. This testing will be performed in triplicate, to ensure compliance with EPA testing requirements defined in the *Emission Testing Methodology for Air Pollution, Version 2* published August 2012.

4.7 Records of Trial

The Birkenhead plant utilises the Citect SCADA Historian system. All plant operating data is automatically retained for five years. This system retains several thousand operating parameters, including critical data relating to RDF operation. These include, but are not limited to, operating times, temperatures, pressures, gas flows and feed rates. It also includes records of combustion data such as levels of oxygen, carbon monoxide and methane. Logistics information, trial reports and laboratory results are also retained as described in **Table 4.8** below.

Table 4.8: Trial records

Record Type	Retention Duration and Commentary
Plant Operating Data	Citect SCADA Historian automatically retains operating data for 5 years. This includes all plant operating data, which is timestamped for ease of reference. This data includes all operating parameters relating to both kiln performance and supply and combustion of RDF.
Logistics Information	All information relating to RDF delivery dates and volumes, together with supplier and transporter details, is retained for 10 years.
Trial Reports	All documentation relating to this proposal, including stack emission reports and EPA communications, is retained in the company electronic database for no less than 10 years.
Material Analyses	All quality data relating to raw material inputs and kiln outputs, including RDF quality, is retained in the Adelaide Brighton Cement Ltd electronic database (LIMS) for no less than 10 years.

4.8 Proposed Trial Dates and Schedule

As previously discussed, a three-stage trial is proposed as follows:

- Stage 1. Optimisation of engineering and operational parameters at higher RDF rates, including in-process monitoring of particulate opacity, CO, CH_4, O_2 and NOx.
- Stage 2. Longer duration operation with expanded emissions monitoring from stack sampling locations for NO, NO_2, SO_2, CO, CO_2 and O_2 using combustion gas analysers.
- Stage 3. Longer duration operation with monitoring of all Schedule Y-1 parameters as part of comprehensive independent stack emissions testing.

It is anticipated that trials would commence within one month of receiving EPA approval to proceed.

Details of each stage are as follows:

Stage 1:

RDF feed rates will be increased from the current 25 t/h to a point where 100% of fuel requirements are provided by the RDF. The feed system and calciner operation will be tuned and kiln operation stabilised. Process parameters including particulate opacity, carbon monoxide (CO), methane (CH_4), oxygen (O_2) and NOx will be monitored for analysis at the completion of this stage. The findings from this stage will be reported to EPA along with a decision to proceed to Stage 2 or immediately to Stage 3 testing.

Stage 2:

If Stage 1 does not yield the results needed Stage 2 will seek to further the optimised conditions for the higher RDF rates and will maintain these for longer durations to assess the ability of the plant to operate under those conditions ahead of the full emissions testing program in Stage 3. A key consideration is the ability of 100% RDF substitution to provide the entire energy input for the calciner. If this Stage is undertaken the findings from this stage will also be reported to EPA before Stage 3 commences.

Stage 3:

Stack emissions testing for Schedule Y-1 parameters will be carried out for the optimised conditions at the 100% RDF substitution rates. Emissions testing is anticipated to be carried out over 2-3 days, to accommodate the numbers of parameters, triplicate sampling runs and the sampling durations required for the respective parameters. The findings from this stage will be reported to EPA along with the findings from Stages 1 and 2 in a formal report.

Proposed timelines for the trial program are shown in Table 4.9. Major equipment modification being required to support the process would delay this timeline, but this is not anticipated to be necessary. A high degree of communication and liaison between ABC and the EPA is proposed throughout the trial, to maximise transparency and engagement.

Table 4.9: Predicted Trials and Timeline

Trial Stage	Details of Trial Activities
Stage 1: Short-term proving trial	Up to three trials, each lasting for approximately two days, are proposed to determine machinery and supply capacity, and to establish process parameters for achieving 100% fuel substitution for an extended period. The time between each trial may be as long as one month, if modifications to equipment are required to support operations at higher RDF feed rates. Otherwise, the three trials will be conducted as soon as possible. **Total time in 'trial' phase: 3 x 2 days.** **Maximum time elapsed: up to 3 months from trial commencement**
	HOLD POINT – at the conclusion of short-term testing, community and EPA liaison will be held to ensure transparency and feedback can be shared. Confirmation as to whether stage 2 is required will be confirmed at this point.
Stage 2: Longer-term process tuning trials	Where required, up to three trials, each of up to five days' duration, are proposed where there is a need to tune the addition of RDF at 100% substitution rates and to assess impacts on process performance. It is anticipated that this stage could be completed within one month, as required modifications will only be operational in nature. During these trials, all quality assessment samples will be taken. Expanded gaseous emissions

Trial Stage	Details of Trial Activities
	testing will also be carried out. **Total time in 'trial' phase: 3 x 5 days** **Maximum time elapsed: up to 4 months from trial commencement**
	HOLD POINT – Where stage 2 is progressed, further liaison with EPA and the community is proposed to be undertaken to discuss the ongoing trials, and to address concerns that may have arisen in the intervening period.
Stage 3: Stack test trials	With operating parameters established and confirmed, a further five-day trial would be carried out, during which all stack-testing would be completed. Depending on the viability of maintaining feed rates at 100% substitution some variation to stack-testing trials may be required commensurate with the sampling duration requirements for each analyte group. It is anticipated that feed rates for 100% substitution will range between 27 to 35 t/h. Emissions testing will be carried out once 100% substitution is achieved and is maintained for the duration of each test. **Total time in 'trial' phase: 5 days** **Maximum time elapsed: up to 5 months from trial commencement**
Stack test results	Delivery of stack test results and the accompanying assessment of predicted ground level concentrations is anticipated to take up to two months from completion of sampling.[6] **Total time for results to be received: 2 months** **Maximum time elapsed: up to 7 months from trial commencement**
Submission of post-trial report to EPA	Upon receipt of stack results, preparation and submission of the results of the trial will proceed, according to the requirements of Schedule W-1 of the Birkenhead site licence **Total time to prepare report: 1 month** **Maximum time elapsed: up to 8 months from trial commencement**

5. Suitability for Continued Use of RDF in Calciner

Modelling of emissions and ongoing monitoring of ABC's Birkenhead plant over the course of regular operations at 25 t/h usage rate of RDF has shown ground level concentrations of all Schedule Y-1 pollutants to be well below the relevant criteria in the Environment Protection (Air Quality) Policy 2016.

Based on technical reports from similar operators, and experience gained from previous trials and approved increases in RDF combustion rate, ABC consider that combustion of RDF up to a short-term maximum 35 t/h in the calciner with a maximum content of 20% plastic by weight is a viable option to operate the calciner at RDF 100% thermal substitution on an ongoing and sustainable basis, further reducing natural gas and raw material requirements for manufacturing clinker. Operating the calciner at RDF 100% thermal substitution supports the State Government waste hierarchy objectives by utilisation of a waste stream which would otherwise be destined for landfill. Further to this objective, the use of RDF has the effect of reducing ABC's carbon footprint by reducing its reliance on fossil-derived fuels.

ABC therefore seeks approval from the SA EPA to conduct an alternative fuel trial at the Birkenhead plant to determine engineering parameters required to achieve 100% alternative fuel substitution for the calciner and demonstrate the plant's capacity to operate under these conditions on an ongoing basis.

[6] Dioxins analyses can take upwards of 8 weeks from submission of samples to the laboratory.

6. Net Zero Outcomes

Adbri's goal is to operate all its operations at net zero emissions by 2050 in line with the Paris Agreement. Adbri has works towards this goal through the Net Zero Emissions Roadmap that has been adopted by the company.

The increase in calciner natural gas fuel substitution from the current 80% to the proposed 100% will reduce ABC's reportable CO2 emissions against the Adbri NZE 2050 Roadmap by more than 30,000 tonnes per year.

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