Berrima Cement Works Planning Consent Modification 7

Environmental Assessment

Use of Granulated Blast Furnace Slag in K6 at Berrima

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Executive Summary

This application is to store and use approximately 3,000 tonnes of Granulated Blast Furnace Slag (GBFS) on site at Berrima for the purpose of process improvement trials. In this trial, GBFS will be added in the raw meal to the kiln at 7-10%.

In the construction industry and cement manufacture, various slag products are one of the significant raw material sources, minimising consumption of virgin non-renewable materials. If the trial is successful, the anticipated usage of GBFS will be in the range of 150,000 tonnes per annum.

GBFS currently is exempt from waste regulations in NSW for the application to land. Therefore, consent modification for storage or stockpiling of GBFS may not even be required if compliant with the Exemption specifications.

No environmental impacts are anticipated to arise from the proposed process modification:

- This material has already undergone processing through heat treatment and as such most of the volatile metals and organics have been removed from the slag. Any contribution to stack emissions will be negligible.
- Non-volatile trace metals will drop out to become part of the clinker matrix where they will be immobilised. The added heavy metal quantities are negligible in comparison with the bulk of the cement material. GBFS is a common additive in cement and concrete mixes worldwide.
- GBFS use in the kiln is also a common industry practice (used e.g. in Boral Cement's kiln in Maldon) and air quality impacts are not an issue.
- Since slag contains calcined lime, total CO_2 emissions from the kiln will decrease.

I. Introduction

This report supports an application made pursuant to Section 96 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act), seeking modification of the current consent.

Boral Cement Limited (Boral) operates the Cement Works at New Berrima (the Works) in the Wingecarribee Local Government Area.

Various raw materials are used to manufacture clinker in the cement kiln at the Works. Raw materials are currently supplied to the Works from a range of suppliers in various locations.

This modification (MOD 7) seeks approval to trial Granulated Blast Furnace Slag (GBFS) supplied from Australian Steel Mill Services (ASMS), Port Kembla, in Berrima Works' Kiln 6 as an alternate raw material in order to optimise the clinker manufacture process.

The proposed changes are minor and will not alter the operation of the cement works. Activities in this proposed modification will take place at Boral Cement – Berrima Works.

II. Background

A. Location

The Works are immediately south of New Berrima in the Southern Highlands of NSW in the Wingecarribee local government area. The Works are approximately 2.5 km from the Hume Highway.

B. Proponent

The proponent and owner of the Works is Boral Cement, formerly known as Blue Circle Southern Cement, which is a wholly owned subsidiary of Boral Limited.

C. Existing Operations

The Works has been operating since 1929 and produces cement products (cement and clinker) for sale in NSW, ACT and for export. The Works currently produce 1.4 million tonnes per annum of cement products but have consent to produce up to 1.56 million tonnes per year [DoP (2009) Determination of a Development Application for State Significant and Integrated Development under Section 80 of the Environmental Planning and Assessment Act, 1979. NSW Department of Planning, 12 May]. These products are dispatched to domestic customers by train and truck.

III. The Reasons for Proposed Modification

Due to the Federal Government's carbon tax as well as the lower cost of clinker import from overseas competitors, Boral Cement - Berrima Works' clinker production is likely to become uneconomic if the cost of clinker manufacture cannot be reduced. Alternate raw materials are currently being investigated to determine their suitability in clinker manufacture. Granulated blast furnace slag is one such material under investigation.

Australian Steel Mill Services (ASMS) is a Joint Venture contractor to BlueScope Steel who processes slag from steel milling operations and supplies slag-based products to a wide customer base. Approximately 2,000,000 tonnes of slag by-product are recovered by ASMS and reused annually in the construction industry and cement manufacture. Indeed, various slag products are one of the significant raw material sources for these industries.

The DA No. 401-11-2002-i for Kiln 6 at Berrima includes Conditions 3.17 and 3.17A that prohibit storage, treatment or processing on site of any external waste (if this waste requires a licence) unless explicitly allowed by the Authority. Therefore, this application for Modification of Development Approval has been prepared to get permission for process trials with the use of GBFS at Berrima.

IV. Material Description

Granulated Blast Furnace Slag is a by-product of iron making and is formed during the separation of molten iron from impurities during the tapping of the blast furnace. The slag is a molten layer floating on the surface of molten iron and is a complex solution of silicates and oxides that solidify upon cooling.

The process is as follows. Iron ore, coke and crushed limestone (calcium carbonate) or burnt lime (calcium oxide) are added to the blast furnace. The iron ore is converted to iron through reduction at high temperatures. The limestone/lime combines with the impurities in the ore to form slag. If the limestone is used, due to high temperatures in the furnace, it undergoes calcination: the carbon dioxide molecule is liberated and calcium oxide is formed. If burnt lime is used, the CO_2 molecule was previously liberated in a lime kiln and the material no longer adds to the carbon footprint.

It is the CaO mineral that is so attractive to cement industry; the same conversion of calcium carbonate to oxide takes place in the kiln to form clinker so slag contains this essential clinker component that has already been processed. Therefore, no virgin limestone needs to be consumed and no CO_2 is generated in the manufacture of clinker, corresponding to a volume of slag feed.

After separation from pure iron, the final form of the blast furnace slag is dependent on the method of cooling – if water quenching is used, granulated slag is obtained, while air cooling produces air cooled slag. Both forms are widely used in cement manufacture either as a raw material (added to the kiln) or as a supplement to cement as is, without thermal treatment (post-kiln admixture).

Both air cooled slag and granulated blast furnace slag are classified as inert wastes. Both have General Waste Exemptions in NSW for application to land. Blast Furnace Slag exemption is dated December 2010 (Attachment 1).

A. Advantages of GBFS

Granulated blast furnace slag is the subject of this Application. From the point of view of cement manufacture, GBFS has several advantageous properties:

- It has cementitious properties therefore can replace virgin limestone which allows to conserve a non-renewable resource
- It has already gone through heat treatment and is pre-calcined therefore will not release carbon dioxide as raw limestone does
- It has already gone through very high temperature treatment therefore will not release volatile air pollutants such as VOC and volatile heavy metals
- The material is composed of Calcium-, Silica- and Aluminium- oxides, is yellow in colour with a uniform size and shape, properties ideal in the manufacture of clinker.

B. Proposed Activities

Clinker Production rates at Boral Cement - Berrima Works typically vary from 4,300-4,600 tonnes per day.

A 3-day trial (subject to kiln's uninterrupted operation) incorporating granulated blast furnace slag is proposed in which approximately 2,000 tonnes of GBFS will be used. The proposed modification for the purposes of a trial includes the following components:

- Quantities of GBFS from 7% to 10% of the raw mix (up to 2000t to be used during the trial period).
- Material will be introduced to the kiln via raw material feeders, where it will be combined with other raw materials and milled prior to being introduced to the kiln.
- Coal usage and kiln output will be adjusted/modified during the trial.
- Stack testing will be conducted during the trial to determine concentrations of heavy metals. However as this material is pre-calcined we don't anticipate any increase in either organic or metallic emission compared to current emissions using standard raw materials.

If this trial confirms that GBFS is suitable for the process at the feed rates tested, the use of this material will create an opportunity to reduce costs of clinker manufacture and also reduce the amount of carbon dioxide generated in clinker production, avoiding some of the upcoming carbon tax and therefore strengthening competitiveness of Boral Cement – Berrima Works in the international market.

If successful, the estimated full-scale production details will be as follows:

- Approximately 150,000 tpa of this material will be required ex Australian Steel Mill Services, Port Kembla.
- Delivery of this material will be via truck and as per Boral Cement standard acceptance criteria procedures. We anticipate that majority of the material will be delivered using back trips from clinker haulage out of Berrima.

Also, transport of other raw materials to Berrima will be reduced, as GBFS will be replacing a proportion on them. As a result we do not expect any noticeable changes in truck movements to Berrima works.

- We anticipate storing 1-2 weeks' worth of material at Boral Cement – Berrima Works, in the area currently used for other raw material stockpiling. Since this material reduces the use of other materials like blue shale and yellow shale, we expect that the total amount of material stockpiled will be similar in quantities to the current stock levels.
- This material has 5-10% moisture and as a result does not generate fugitive dust.
- Handling – as per MSDS (Attachment 2). For external stockpiles, material should be kept damp during handling to prevent dispersion by wind. Front end loaders will be used on site for filling raw material hoppers.
- Emergency procedures – there are no specific fire or emergency procedures or equipment required for slag formulations.

C. Process Trial Description

The Description of the process modification subject to this trial is presented in Appendix 3. Summary data of the current and proposed material mix are shown in Table 1.

Table 1 – Raw Material Usage – Current vs. Proposed

Raw Material	Current Mix [%]	Proposed Mix [%]
Limestone	81-82	75-78
Yellow Shale	2-3	3.9-4.5
Blue Shale	12-13	4-7.5
Steel Slag	2-3.0	4-5.1
SS:Gypsum	1.0	-
GBFS	-	7-10

In the new process configuration, there will no longer be a requirement for a SS:Gypsum mix and the amount of virgin blue shale will decrease significantly. The amount of virgin limestone will also decrease while the amount of yellow shale and steel slag required will increase.

V. Statutory Framework

A. Current Planning Approvals and Recent Modifications

The Works have been operating since 1929, and currently operate under two development consents that were granted by Department of Planning in 2003 and 2005. Boral Cement is permitted to produce up to 1.56 million tonnes of cement a year at the facility. These consents have been amended as follows:

- amendments made by MOD 2-1-2004-i (Non-Standard Fuels) modified 26 September 2005;
- amendments made by MOD 109-9-2006-i (remove prohibition of hazardous wastes) modified 22 September 2006;
- amendments made by MOD 12-2-2007-I (trial use of tyre chips) modified 13 February 2007;

- amendments made by MOD 4 (variation to usage rate of coke fines) modified 24 April 2008; and
- amendments made by MOD 5 (coal deliveries by rail) modified 31 August 2009.
- currently, an Application for Modification 6 for coal stockpiling for external sales is being assessed under s75W by DoPI, decision pending.

B. SW Environmental Planning and Assessment Act 1979

DA No. 401-11-2002-i was approved under Section 76A(7) of the EP&A Act. The type of development (minerals processing) was listed in Schedule 1 of *State Environmental Planning Policy No. 34 – Major Employment Generating Industrial Development* (SEPP 34).

A modification application must be lodged under s96 for approval by the Minister if the project as modified is not consistent with the existing approval but the environmental impact is assessed as minimal. The terms of an existing approval can be modified by revoking or varying a condition or imposing a new condition. The proposed modification is potentially not consistent with the existing approval as there will be changes in raw material composition in the kiln.

C. Protection of the Environment Operations Act 1997

Section 48 of the *Protection of the Environment Operations Act 1997* (POEO Act) requires that the occupier of a premises at which a 'scheduled' activity is carried on must hold an Environment Protection License (EPL). Environment Protection Licence 1698 currently applies to the Works, however, this EPL does not cover GBFS use in the kiln. Therefore, the proposal may require modification of the existing EPL.

VI. Full-scale Process Considerations

A. Composition and Contaminants

Granulated Blast Furnace Slag consists of a mixture of calcium silicates and aluminates, and other calcium and magnesium compounds. Many of these compounds are the same as those formed during cement manufacture. The typical ranges of the main components (based on in-house analysis) are presented in Table 2.

Table 2 – Typical Chemical Composition of Granulated Blast Furnace Slag

Component	Range of Composition (%)
CaO	39 - 44
SiO_2	32 - 38
Al_2O_3	12 - 16
FeO	0.0 – 1.5
MgO	4 - 8
TiO_2	0.4 – 2.0
MnO	0.2 – 1.5
K_2O	0.1 - 0.5
P	0.0 - 0.04

S	0.5 – 1.5

B. Commercial Specification

The Commercial specification, based on in-house analysis, in Table 3 is for Boral Cement's internal quality assurance and supply agreement purposes. This specification is subject to change for commercial, operational and quality purposes.

Table 3 – Commercial Specification for Granulated Blast Furnace Slag

Parameter	Units	Test method	Typical Values
a) General			
Particle Size	mm	Dry Sieve	< 20
b) Oxides			
SiO_2	% by wt	XRF	35
Al_2O_3	% by wt	XRF	14
FeO	% by wt	XRF	1.0
CaO	% by wt	XRF	42
MgO	% by wt	XRF	5.0
TiO_2	% by wt	XRF	0.7
MnO	% by wt	XRF	0.5
P	% by wt	XRF	0.01
S	% by wt	XRF	1.2
K_2O	% by wt	XRF	0.3

C. Environmental Specification

The Environmental specification in Table 4 is showing typical measured contaminant levels compared to approved environmental criteria. In absence of specific guidance in relation to maximum contaminant levels in the material under heat treatment, values from the NSW General Exemption for Application to Land were adopted.

This specification cannot be changed without the approval of the Office of Environment and Heritage.

This also means that GBFS that complies with the maximum limits is an exempt waste in terms of land application therefore its storage and stockpiling should not require Consent or Licence modifications.

Table 4 – Environmental Specification for Blast Furnace Slag

Impurity	Units	Typical Values*	Max Allowed**
Arsenic (As)	mg/kg	0.8	10
Beryllium (Be)	mg/kg	3	20
Cadmium (Cd)	mg/kg	0.6	1
Chromium Total (Cr)	mg/kg	2.6	100
Copper (Cu)	mg/kg	1	20
Lead (Pb)	mg/kg	0.9	20
Manganese (Mn)	mg/kg	3000	N/A
Mercury (Hg)	mg/kg	0.03	1
Nickel (Ni)	mg/kg	1.8	20
Selenium (Se)	mg/kg	0.9	5
Vanadium (V)	mg/kg	300	N/A
Zinc (Zn)	mg/kg	7	50

* Measured (Boral or ASMS data)
** Blast Furnace Slag Exemption for Application to Land, 2010

D. Material Safety Data Sheet

The material safety data sheet for Granulated Blast Furnace Slag is attached to this document in Appendix 2.

E. Material Variability

GBFS slag is only supplied by ASMS from BlueScope Steel. There is therefore no between-supplier variability.

Iron manufacture is a carefully controlled process. This, together with the stockpiling and blending operations performed at ASMS, minimises the within-batch and between-batch variation of the material. The nature of the process ensures that there are minimal seasonal variations in the chemical composition on the material. There may be some changes in the moisture content during periods of wet weather.

The small variability of the GBFS together with the carefully control of the feed of the material to the kiln by weigh/feed proportioning ensures stable kiln performance and emissions.

F. Transport and Delivery

The arrangements described below that are currently used for other slag formulations (steel slag, BOS fines) will be used if GBFS is approved for use in the kiln.

- The material is delivered to the Berrima Works in 22-35 tonne bulk tippers.
- Transport and delivery arrangements are confirmed by the Production Manager to meet production requirements.

- Records of deliveries are through the Berrima weighbridge system. On entry the truck driver enters the product code and load details and the system records the gross weigh of the delivery. After unloading, the driver completes the delivery transaction by re-entering the load details into the weighbridge system. The system records the details of the delivery for stock control and material usage.

G. Storage and Handling

No special site facilities are required for blast furnace slag.

In Berrima, GBFS will be stockpiled on site in the open stockpile area or under cover in the additive building feed area. The granular nature of the material, together with the moisture content of the material, its relative heavy particles and the lack of fines means that fugitive dust generation from the stockpile should be minimal.

H. Quality Control

Granulated blast furnace slag is produced at BlueScope in batches when the blast furnace is tapped. BlueScope provide ASMS with the daily analysis of the batches for quality control purposes.

ASMS has procedures for sampling and testing of GBFS. These are used to monitor the quality of the material and are used in the blending of the material to customer requirements.

The sampling, sample handling and sample storage procedures and requirements for raw materials are included in the Berrima Laboratory Quality Manual. The testing procedures for the samples are included in the Berrima Laboratory Quality Manual.

The Quality Manager compares the results of analyses against the specifications and reports any non-conformances to the Production Manager for action.

I. Quality Assurance and Auditing

BlueScope Steel and ASMS both operate quality management systems (QMS) certified to ISO 9001:2008. The QMS is used to ensure the quality of raw materials and products and hence ensures that the material supplied is suitable for use as a raw material in cement manufacture.

Boral Cement operates a quality management system certified to ISO 9001:2008 by SAI Global.

The procedures for raw materials are included in the routine auditing of the system and the results of the audits are included in the management review.

Any non-compliances are reported through the QMS Non-conformance System.

J. Emergency procedures

Both air cooled slag and granulated blast furnace slag are classified as inert wastes.

There are no specific fire or emergency procedures or equipment required.

General procedures for fire, spills and vehicle incidents are included in the Site Emergency Procedures Manual.

K. Procedures for Off-spec Deliveries

The careful control of iron manufacturing and stockpiling minimises the potential for the production and despatch of the off-specification material. Off-spec material can be used in the production process as the ratios of raw material can be adjusted to maintain raw mix chemistry.

If off-specification material is detected the incident will be reported to ASMS for investigation and action. The incident will be reported and investigated through the Boral Cement QMS non-conformance system.

L. Records

The following records will be kept, and the following personnel responsible for record maintenance:

- Delivery Details – these are recorded in the computerised weighbridge system. This information is held within the computer system and is available through the information system. The records are used to check and verify deliveries and raise invoices. The information recorded includes (Table 5):

  Table 5 – GBFS Delivery Information

Record	Comment
Docket no.	Generated by computer
Customer:	Entered by driver
Fleet:	Generated by computer if truck registration is in the system
Registration no:	Entered by driver
Carrier	Generated by computer if truck registration is in the system
Date	Generated by computer
Time In	Generated by computer
Product	Entered by driver
Gross Weight	Generated by weighbridge
Tare Weight	Generated by weighbridge
Net Weight	Generated by computer

- Routine Sample Analyses – Quality Manager (Laboratory Analyst)
- Audit Results – Quality Manager (Technical Manager)
- Non-conformance Reports – Quality Manager

VII. Environmental assessment

A. Stack Emissions

This material has already undergone processing through heat treatment and as such most of the volatile organics and volatile metals have been removed from the slag. Contribution to stack emissions should be minimal. GBFS use in the kiln is a standard industry practice (used e.g. in Boral Cement's kiln in Maldon) and air quality impacts are not an issue.

Since slag already contains calcined lime, we expect total CO_2 emissions from the kiln to reduce.

Non-volatile trace metals will become part of the clinker matrix. It is a standard industry practice, and is not considered in any way harmful to the environment, to add GBFS as is, together with its contaminant contents, to various cement formulations (as a cold additive to pulverised clinker). Firstly, the added heavy metal quantities are minute in comparison with the bulk of the cement material; secondly, they will be perfectly immobilised in the concrete. The identical outcome will be achieved if GBFS is first passed through the kiln.

B. Proposed Emission Testing

The proposed Consent Modification No. 7 is for the trial of a potential raw material.

This material partially replaces other raw materials. Table 6 presents an assessment of trace metals in the current and proposed mixture fed to the kiln. The values were obtained for current mix from the lab analysis of the raw meal, and for proposed mix by theoretical calculation based on mixing proportions and contaminant contents of each individual component of the mix.

Table 6 – Comparison of Typical Levels of Trace Contaminants in the Current Mix and the GBFS Mix (calculated at 10% addition)

Component	Current Mix* [mg/kg]	Proposed Mix** [mg/kg]	Max Allowed under Waste Exemption [mg/kg]
Antimony	0.6	0.5	N/A
Arsenic	2.9	1.7	10
Beryllium	0.3	0.5	20
Cadmium	0.6	0.3	1
Chromium (Hexavalent)	≤0.5	≤0.5	N/A
Chromium (Total)	16.0	53.3	100
Cobalt	4.1	2.4	N/A
Copper	Not currently tested	Not currently tested	20
Lead	11.1	5.5	20
Manganese	720	2040	N/A
Mercury	0.2	0.1	1
Nickel	7.2	4.9	20
Selenium	<1.0	1.1	5
Thallium	40	0.1	N/A
Tin	0.3	1.0	N/A
Vanadium	69	248	N/A
Zinc	Not currently tested	Not currently tested	50

* Based on analytical results of raw meal in 2011
** Calculated proportionally from individual raw material data in 2011
*** N/A – Not Applicable

Chromium, manganese and vanadium increases are due to the increased content of steel slag (an approved raw material in Berrima), not GBFS. All three metals are not volatile and will drop out in the clinker. Therefore, we do not anticipate any major increases in either trace metal emissions as a result of GBFS use.

To confirm the logical assumption that the high temperature-treated material does not contain volatile residues in quantities that are likely to exceed acceptable emissions levels at Berrima at the anticipated raw mix additions, stack testing will be conducted during the trial to confirm actual trace element emissions.

We envisage that testing will be conducted on Day 2 or Day 3 of the trial, allowing the process to stabilise (at least partially). The following parameters will be measured:

- Continuous emission monitoring system (CEMS) data:
    - Total particulate
    - NOx
    - SOx
    - VOC
- Samples collected by a stack testing consultant:
    - Total particulate
    - Volatile metals: Hg, Pb, Cd
    - Total Hazardous Substances (As, B, Cd, Cr, Co, Hg, Mn, Ni, Pb, Se, Sn, V)

All data will be corrected to STP and 10% oxygen.

A summary report presenting data from both sources will be presented to DoPI and OEH for assessment and approval in terms of the full-scale operation.

C. Dust

GBFS generally does not generate much dust as the particle are large, heavy and do not contain fines. The potential for dust creation at the GBFS stockpile and along haul roads will be further minimised using the management measures detailed below. The proposed modification is a continuation of the existing activities and will have a similar dust generation profile. Therefore, potential dust impacts from the external stockpiles are not likely to increase due to the proposed modification.

The Works implemented a Dust Management Plan dated September 2011. The following dust management measures are already undertaken at the Works and will continue to be implemented during the proposed modification:

- Drainage from the stockpile areas is collected in the works drainage system. Sediments are collected in the drains and the two main dams, Lake Quality and Lake Breed. These are periodically cleaned to maintain capacity and the material recovered is recycled back into the cement manufacturing process.
- The raw material stockpile areas are regularly watered
- Material handling activities are restricted in high winds
- Stockpile access roadways are watered (unsealed roads) or mechanically swept (sealed roads) to limit dust generation
- Unsealed haul roads are being progressively sealed
- Speed restriction on unsealed roads is 20 km/h
- Loads are required to be covered at all times in transit.

D. Traffic

Clinker is hauled by trucks to Port Kembla for dispatch and currently most trucks return to the Cement Works empty. We plan to use these empty trucks to bring back slag from Port Kembla so we don't anticipate any noticeable increase in truck movement to and from Berrima due to GBFS use.

E. Noise

Since the number of truck movements is not likely to increase (back load arrangements) and deliver times are proposed to be similar to current practice we don't anticipate increase in traffic noise levels.

This material is processed in the existing mills and therefore there will be no additional noise generation.

F. Water

The Works operate under the Water Management Plan, the latest revision is dated September 2011. The current management arrangements will continue during the proposed modification.

Stormwater from the existing raw material stockpile and surrounding areas flows via surface drains into the shale quarry &/or the drain to settling ponds. From here, the water is pumped to two settling ponds adjacent to Lake Breed and is eventually released into that lake. The water is then pumped into Lake Quality, treated with a biocide, and is used in production processes at the Works. During heavy rainfall, Lake Quality can fill and overflow into Stony Creek that flows into the Wingecarribee River. Overflows occur only few times per year. Generally, the sufficient availability of water for the Works is of greater concern than the discharge of excess water.

Grab sampling is conducted at the discharge point from Lake Quality into Stony Creek when discharge is occurring In accordance with the EPL 1698. Water is also tested monthly even in absence of overflow. The EPL requires sampling for biochemical oxygen demand, oil and grease, total suspended solids and pH. Boral also samples for potassium, magnesium, sulphate, chloride, sodium and calcium. Quarterly, a comprehensive analysis is undertaken including testing for a range of heavy metals, fluoride, cyanide, and oil and grease.

Slag is very inert & does not leach any substantial quantities of heavy metals etc as confirmed in the Australasian (iron and steel) Slag Association Inc. Material Classification (Iron and Steel Slag) Monitoring Program 2008/9, April 2009, prepared by HBM Group Pty Ltd (supplied by ASMS). This low leachability was also taken in consideration when GBFS received a waste exemption for application to land.

The proposed modification is for the continuation of an activity that already occurs at the Works, that is, raw material stockpiling. Given that there have been no significant breaches of EPL water quality conditions; it is unlikely that the slag stockpiling impacts water quality. Any deterioration in water quality in Lake Quality will be quickly identified by means of the routine sampling schedule.

G. Resource Recovery Opportunity

Blast furnace slag is widely used as an aggregate material in concrete, road construction and other civil construction projects.

Blast furnace slag is also used in the production of finished cement in the cement milling stage. Ground dried slag is added to finished cement both as a mineral additive and as a pozzolanic material to improve cement performance and other properties.

Blast furnace slag has a significant advantage to the cement industry as a source of calcium and silica essential to the cement making process.

The use of blast furnace slag in the kiln replaces the use of the virgin raw materials including limestone, blue shale and yellow shale. In addition the calcium in the blast furnace slag exists in the form of oxides and silicates which

already have been thermally processed. This reduces the thermal energy required for cement making, saving coal and other fuels and significantly reduces greenhouse gas emissions.

VIII. Conclusions

GBFS is a foundry by-product that is widely used as raw material in the construction industry and cement manufacturing. The recovery of this resource prevents landfilling and conserves virgin materials therefore presents an overall positive environmental outcome.

The proposed GBFS stockpiling and use as a raw material in the Berrima kiln will not have significant adverse impacts on the environment for the following reasons.

- Air and water quality will not be impacted by the proposal because of the inert nature of the material and existing management measures that will continue to be implemented during the proposal.
- There will be no noticeable change in existing truck movements due to back trip arrangements. Therefore, there will be no impact on traffic in New Berrima and at the freeway intersection.
- Noise will not be increased over the current levels.

Boral requests that the following modification to the existing consent be undertaken:

- Modification of DA No. 401-11-2002-i (MOD 7) to include Trial of Granulated Blast Furnace Slag as a raw material ingredient in No.6 Kiln at Berrima Cement Works

Pending a forthcoming review of this document by the OEH, the following amendment to the EPL may apply:

- Amendment of EPL 1698 to include GBFS as an Alternative Raw Material for the kiln use.

IX. References

ASA 2009, *Material Classification (Iron and Steel Slag) Monitoring Program 2008/9*

Boral Cement 2011, *Berrima Works: Water Management Plan.*

Boral Cement 2011, *Berrima Works: Dust Management Plan*

NSW Department of Planning (DoP) 2009, *Determination of Development Application for State Significant and Integrated Development under Section 80 of the Environmental Planning and Assessment Act 1979*, State of NSW.

NSW Office of Environment and Heritage 2011 [accessed 29/09/2011], *Action for Air: What's the problem?* http://www.environment.nsw.gov.au/air/actionforair/actionforair-05.htm.

APPENDIX 1

Blast Furnace Slag Exemption 2010

APPENDIX 2

Material Safety Data Sheet

APPENDIX 3

Process Trial Description