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01 July 2019

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Sally Munk
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Department of Planning Industry and Environment
320 Pitt Street
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Dear Sally,

BERRIMA CEMENT WORKS - DA 401-11-2002-I MOD 11 - USE OF HICAL50
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

I write to you in relation to the request for information, dated 29 May 2019, and subsequent extension letter referring to correspondence received from the EPA date, 6 June 2019. The following provides a response to the matters raised in the request.

Proposed Modifications to Conditions

The DPIE provided a list of additional conditions, and proposed modifications of existing conditions within the currently operating approval, to facilitate the proposed modification.

The recommendations put forward by the DPIE, in Attachment 1 of the initial further information request, are accepted by Boral.

Proposed Earthen Bund

The DPIE has request further details for the earthen bund to be constructed around the HiCal50 stockpiles, including the height, dimensions, source of material and construction timeframe.

It should be noted that the earthern bund and storage of HiCal50 material has already been approved as per the HiCal50 Storage and Handling Procedure (see attached). The site has already commenced receipt and storage of HiCal50 from Hydro.

Source of Hi Cal 50

The DPIE has noted that HiCal50 from other sources must not be used at the site as a Non-Standard Fuel without further consideration by DPIE and NSW Environment Protection Authority (EPA) to ensure any such material meets the required fuel specifications for HiCal50.

It is recognised that delivery of HiCal50 from other sources would need further consideration by the EPA and DPIE, to ensure any such material meets the required fuel specifications for HiCal50.

Energy from Waste Policy

The DPIE has requested further details to outline the HiCal50 material to be received has no higher order waste opportunities. It should be noted that Boral Cement already has approval to accept HiCal50 on site, and this is not the commencement of a new material being received at the site.

The carbon anode material sourced from the Hydro Kurri Kurri site forms part of other wastes on the Hydro site. These wastes have included but are not limited to construction and demolition materials such as metals, concrete, carbon cathode material and carbon anode materials. As part of the site's redevelopment, Hydro has identified all their waste materials for appropriate reuse opportunities.

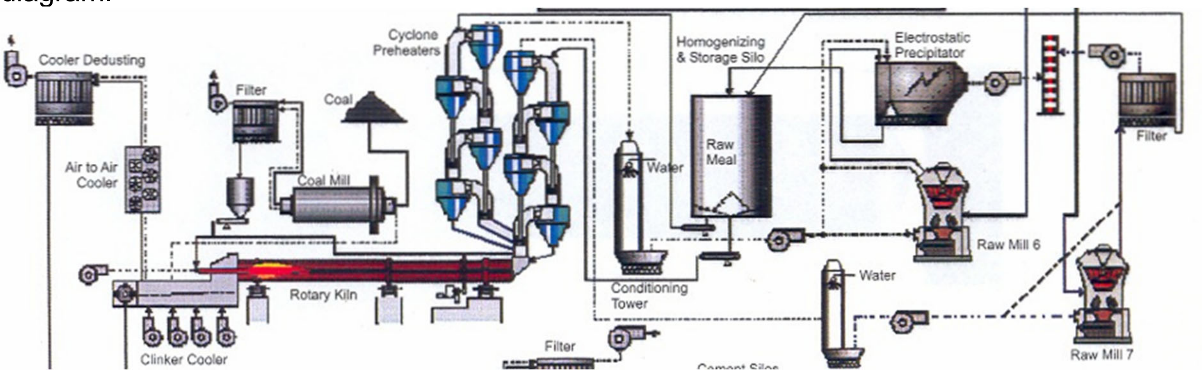
Concrete structures are beings demolished, crushed and recycled for reuse as per the NSW Resource Recovery Recovered Aggregates Order and Exemption. The carbon cathode material is being managed by a third party, to treat and reuse as fuel, or being prepared ready for onsite landfill.

The carbon anode material proposed for use at Berrima has no other higher order use, as it is processed on site to remove metals such as steel and aluminium for recycling, with the remaining high calorific material classified as Restricted Solid waste, and does not meet any current Resource Recovery Orders and Exemptions. If the material is not processed as a non-standard fuel, it will be placed into landfill.

EPA Request – Detail Process Description

The EPA has requested a detailed process description, including temperature profiles and processing rates production process details and potential air emissions impacts, be provided to better understand potential changes in air emissions associated with the proposal.

To aid in the understanding of the process description, please refer to the following diagram.



Coal Storage and Transfer System and Coal Mill

The kiln and precalciner are fired with pulverised coal produced in a ball mill. To ensure sufficient supply of coal is maintained, the raw coal is stockpiled in a circular coal blending system designed to blend the coal, and minimise the effect of variations in coal quality on kiln performance and clinker quality.

The coal particle size determines how fast it burns. The coal mill reduces the size of the coal particles to a size that enables burning to take place very rapidly. It also dries the coal. This gives a very hot, short burning flame necessary to make quality clinker.
Raw coal is unloaded into a receiving hopper. The coal is transferred by the coal transfer system to the coal blending system for storage and reclamation.

Coal is reclaimed from the coal blending system into the raw coal bin. The raw coal is reclaimed from the raw coal bin and fed by a weigh feeder to the coal mill. Hot air from the grate cooler is blown to the mill and drawn through the mill by the coal mill exhaust fan. The hot air dries the coal and carries the pulverised coal to the separator and dust collector. Coarse coal is rejected in the separator and returned to the mill for further grinding. The fine pulverised coal is carried to the coal mill dust collector. The pulverised coal collected in the dust collector is stored in the pulverised coal bin. The pulverised coal from the pulverised coal bin is reclaimed by accurate weigh feeders and fed to both the kiln burner pipe and the precalciner burners.

Clinker Production

In the clinker production process, the raw meal is heated to approximately 1,450°C and converted to a new chemical material - clinker. Clinker is a mixture of synthetically produced calcium silicates, aluminates and ferrites that form and crystallize at high temperature. The formation of clinker is a chemical process involving a series of chemical reactions. These reactions take place at different temperatures so occur at different points in the kiln system.

Pre-heater Cyclones Description

The raw meal from the homogenising silo is fed to the preheater system at two points - the hot gas duct (or 'riser duct') from cyclone 2 to cyclone I in the preheater string 1, and in the hot gas duct from cyclone 2 to cyclone 1 in the preheater string 2.

In the preheater cyclones, raw meal is heated and partially calcined. The hot gases and meal are given sufficient time to mix and transfer the heat from the gases to the raw meal. This heat transfer is very efficient as there is intimate gas-fine particle contact. The fine raw meal is suspended in the rising gas stream, minimizing the amount of coal and other fuels that must be used to provide heat. The cyclones also separate suspended raw meal particles from the gases so the raw meal can be fed from cyclone to cyclone and then on to the precalciner and kiln. The material flow is down the preheater tower while the gas flow is up the tower. During this time the raw material temperature rises rapidly from ambient temperature to approximately 950°C.

Precalciner

The raw meal powder is collected in preheater cyclones 3 and fed to the precalciner where approximately 50% of the total fuel input and very hot (1000°C) tertiary air from the cooler, provides a continuous supply of heat to partially calcine the raw meal. Calcining involves the liberation of C02 from calcium carbonate to form calcium oxide (CaO). The precalciner provides the necessary temperature and retention time for the calcining reaction to occur.

The material temperature rises rapidly in the precalciner to over 850°C, at which the calcining reaction liberates approximately 90% of the C02 from the limestone. The calcined raw meal is collected in the lower cyclone (cyclone 4) of each preheater string and passes into the kiln. The calcined raw meal then passes down the rotating kiln towards the burning zone.

The precalciner vessel acts as a reaction vessel allowing time for the fuel to be completely burnt and chemical reactions to occur. The material and hot gas remain in contact for approximately 10 seconds at approximately 850°C as it passes through the precalciner and the hot gas duct to cyclones 4.

Rotary Kiln Tube

The hot partially calcined raw material from the preheater cyclones and the precalciner is fed to the rotary kiln. The remaining 50% of fuel is fired at the discharge end of the kiln, providing heat to raise the material temperature to approximately 1450°C at which temperature the clinker minerals form. This zone of the kiln is known as the burning zone.

The clinker is then rapidly cooled in the clinker cooler and excess heat from the cooler is recovered to the kiln burning zone. The kiln tube has three main functions; a heat exchange device, a conveyor and a chemical reaction device.

Grate Cooler

Clinker leaves the rotary kiln at a temperature of approximately 1300°C-1350°C and has to be cooled down rapidly to allow further transport and handling. In addition, the clinker must be rapidly quenched in the clinker cooler to ensure clinker quality.

The heat from the clinker is recovered into the kiln burning zone from the grate cooler by blowing air through the clinker bed. This enhances the fuel efficiency of the kiln and reduces heat consumption. Excess air, of that required for the combustion of the fuels in the kiln and precalciner, is exhausted from cooler through the cooler bag filter.

The hot excess air from the grate cooler that contains minor amounts of clinker dust is cooled in an air-to-air heat exchanger. This cools the hot air using cold atmospheric air. The cooled air is cleaned in a bag filter and discharged through the cooler stack.

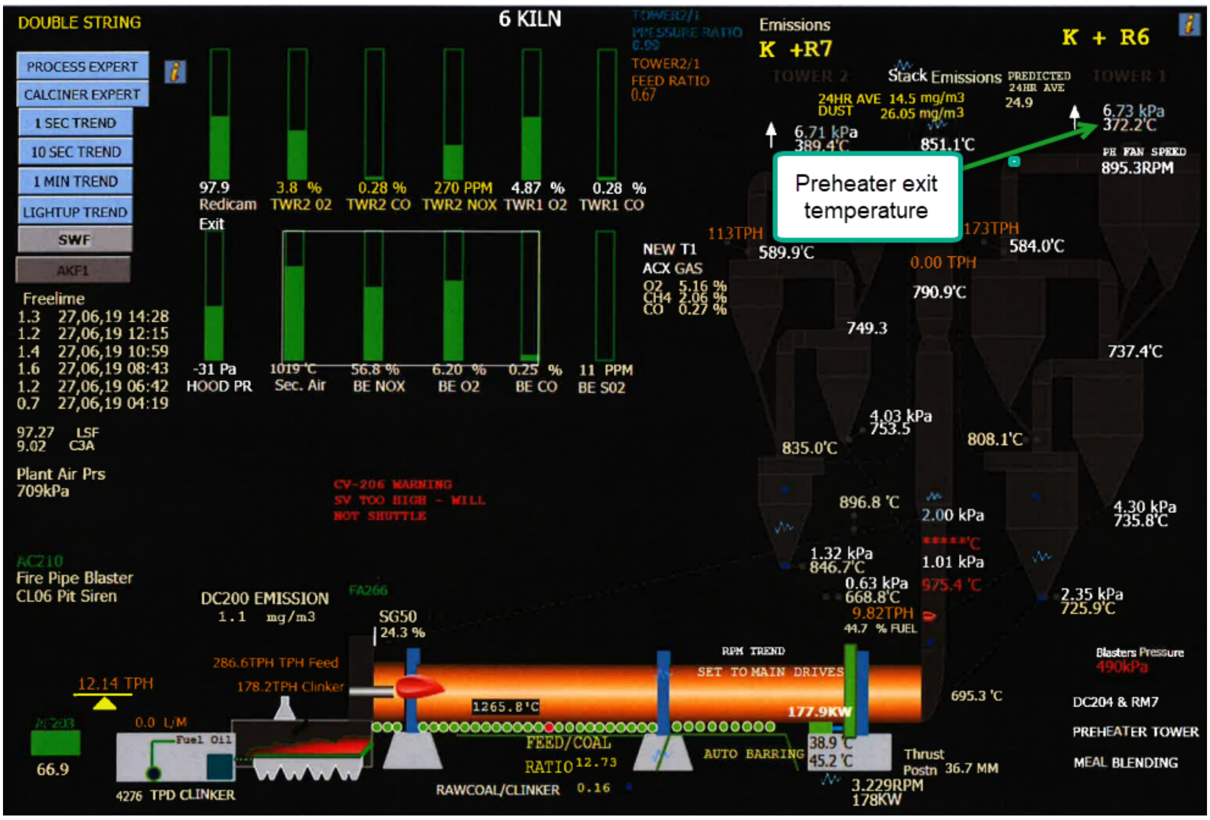
Hot gas de-dusting system

Hot gas exits the preheater at temperatures well above 300 C and is cooled down with water into conditioning towers. The water reduces gas temperature to about 220 C and some of the dust carried over from preheater is separated from hot gas and recovered at the bottom of conditioning tower. This dust is transported back to blending silo.

Hot gas at 220 C enters raw mill where is used to dry out raw materials and help to carry out the fine raw material mix (raw meal). Through the drying process the temperature of gas reduces to 100 C. Gas at 100 C with raw meal in suspension enters an Electrostatic precipitator (ESP) for string 1 and bag filter for string 2. Raw meal is separated from the gas and transported to blending silo to be fed into preheater. Hot gas at 100 C enters the stack.

Temperature profiles through kiln and pre-heater during start up and normal operations

The temperature profile (image below) through the plant for normal operations was captured on 27 June 2018. As you can see, the preheater exit temperature is 372.2^{o} C, while the preheater string temperatures are significantly higher.



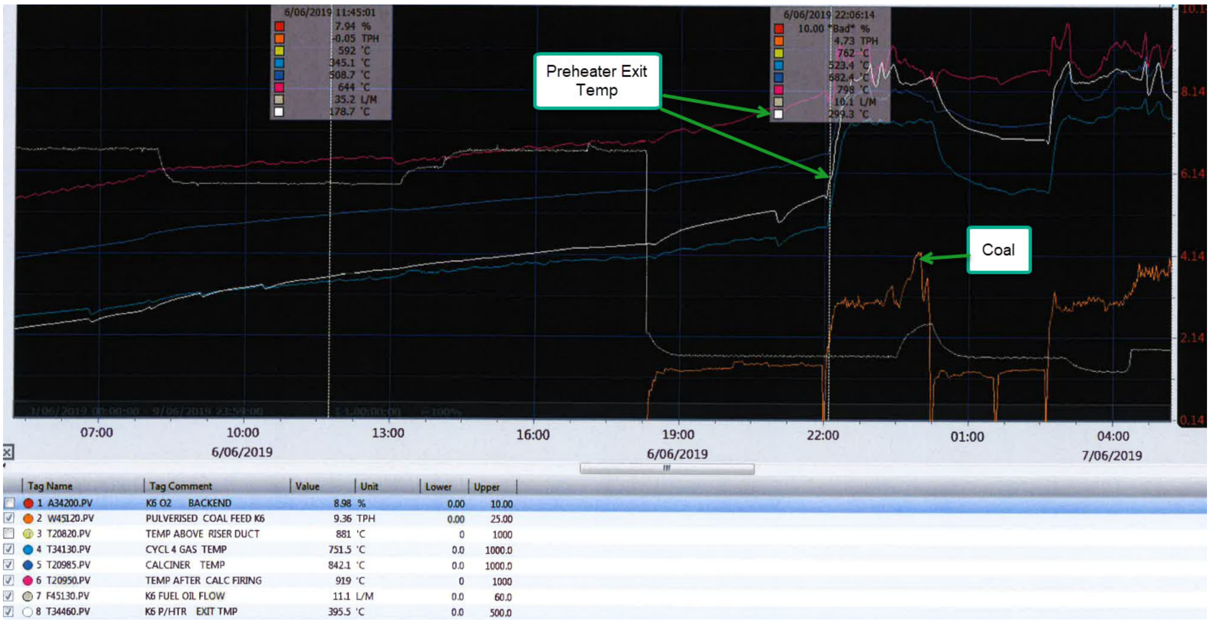
Unfortunately we do not have such an image for a start-up scenario as the software can only allow screen shots during operations. However we are able to supply graphs and supply an example that details the temperature profiles of the kiln during a start-up event on 5-7 June 2019.

As can be seen on the above graph the kiln is starting up cold at approximately 17:00 on 5/06/2019. As previously described the diesel fuel oil is used to heat up the kiln and the preheater strings with the preheater exit temperature progressively increasing.

Typically the diesel rate gets up to 35 litres per minute. In this example at about 18:00 on the 6/06/2019 when the preheater temperature reached 240° C the diesel is reduced to approximately 10L/min and the coal is introduced at a rate of 3.31 t/hr.

This rate is continued for approximately 4 hours. At this point the preheater exit temperature reaches 300°C and the coal usage progressively increases towards >12t/hr via the kiln burner. See graph below. It is interesting to note in this example that there was a minor feed hiccup for coal but the residual temperature in the preheater stayed above the 300°C.

As outlined in the process description when temperatures are reached for calcination, coal is also feed via the calciner which brings total tonnes when system running at full capacity to approximately 26t/hr.



Proposed processing rate Coal/HiCal50 blend during start up and normal operations

The Air Quality review and submission documentation outlined that the HiCal50 product is proposed to be consumed in Kiln 6 at a rate of 1tph and less that 10 000t per year, and blended with coal at a ratio of 96% coal and 4% HiCal50. This rate of use references the use of HiCal50 at normal conditions when the coal consumption would be 26tph.

During start-up conditions, as detailed in the air quality review and outlined above, the use of the coal/HiCal50 blend will progressively increase to a point to enable the commencement of clinker production.

When initially added (if used in the example start-up on the 5-7 June 2019) the coal/HiCal blend at 96% Coal and 4% HiCal50 only would relate to 132kg/hr of HiCal50 for four hours, and progressively increasing as outlined in the graphs.

Process and Engineering Constraints preventing isolation of HiCal50 fuel feed into kiln

Due to its similar physical properties to coal, HiCal50 at a <50mm size fraction, as previously discussed, will be blended with coal within the coal blending plant prior to milling through the coal mill. Grinding of coal/HiCal50 blend to a 10% residue on a 90ucm sieve is essential to enable ignition of the fines within the kiln.

Isolating the HiCal50 from coal would require a separate mill to process the 1t/hr material along with additional storage bins and feeder points into the kiln and upgrades to the control systems linked to the Control room.

The existing coal blending plant, hoppers, bins and grinding plant are approved structures and are all linked appropriately to the Control room. The capital cost of such an option, if required, would exceed any financial benefit is using the HiCal50 as an alternative fuel, with the possible scenario of sending the HiCal50 to landfill.

EPA Request – Composition and Variability of HiCal50

The EPA has requested information in relation to the composition and variability of HiCal50 material. More specifically, the EPA requested details as to the proposed composition of HiCal50 (including but not limited to, sulfur, speciated metals, chlorine and fluorine) and any potential variability in HiCal50 fuel composition

The composition comparison was made against the approved maximum limits outlined in the HiCal50 specification i.e. worst case scenario. A copy of the specification is included below. In regards to the potential variability of the material, please find attached recent analysis of quality control testing (test reports 19-0532-04 and 19-0532-04) of material currently being sourced from Hydro Kurri Kurri. These are well below the maximum concentrations listed in the approved specification.

In comments received, there also concerns regarding potential contaminants and reactions in the preheater. These concerns have previously be discussed within the document titled *Blue Circle Southern Cement Berrima Plant, Proposed Non-Standard Fuels Modification, Additional Information, dated 3 June 2004* as referenced in Condition 1.2 I) ii).

On page 10 in response to a request to discuss the potential for the formation of dioxins and furans during the co-firing of Hi Cal and AKF1, the paper notes that:

> *'The formation of dioxins and furans is not influenced by the use of alternative fuels and materials. The co-firing of Hi Cal or AKF1 will not influence the formation of dioxins and furans.'*

The quick cooling of kiln exhaust gases to a temperature lower than 200^{o}C is considered the most important measure to avoid PCCDD/F emissions. As discussed in the process description, kiln gases at Berrima are reduced to below 200^{o}C, typically around 100^{o}C before their release via the stack which is also the case during start-up conditions.

Appendix 1 – Specification Hi Cal 50 (Carbon anode ex-Hydro Kurri Kurri)

Parameter	Units	Test method	Typical	Max	Min
General					
Gross Calorific Value	MJ/kg			-	15
Carbon Content	% by wt				50
Free Water Content	% by wt			-	-
Total Water Content	% by wt			10*	
Solids Content	% by wt			-	-
Particle Size	mm			<150mm**	-
Oxides					
SiO_2	% by wt	XRF	8-12	-	-
Al_2O_3	% by wt	XRF	20-25	-	-
Fe_2O_3	% by wt	XRF	3-6	-	-
CaO	% by wt	XRF	1-3	-	-
MgO	% by wt	XRF	-	-	-
SrO	% by wt	XRF	-	-	-
TiO_2	% by wt	XRF	-	-	-
$Na_2O + 0.67\ K_2O$	% by wt	XRF	9-13	13	-
Impurities					
Mercury (Hg)	mg/kg			1	-
Cadmium (Cd)	mg/kg			10	-
Thallium (Tl)	mg/kg			-	-
Arsenic (As)	mg/kg			50	-
Beryllium (Be)	mg/kg			10	-
Cobalt (Co)	mg/kg			30	-
Chromium (Cr) Total	mg/kg			250	-
Copper (Cu)	mg/kg			400	-
Manganese (Mn)	mg/kg			500	-
Nickel (Ni)	mg/kg			500	-
Lead (Pb)	mg/kg			250	-
Antimony (Sb)	mg/kg			10	-
Selenium (Se)	mg/kg			20	-
Tin (Sn)	mg/kg			30	-
Vanadium (V)	mg/kg			400	-
Zinc (Zn)	mg/kg			150	-
Polychlorinated biphenyls (PCB)	mg/kg			2	-
Organohalogens (as Chlorine)	% by wt			1	
Sulphur (S) Total	% by wt			4	
Fluorine (F_2) Total	% by wt			12	-
Chlorine (Cl_2) Total	% by wt			0.5	-
Other					
Cyanide	mg/kg			100	-
Vapours	No toxic or harmful vapours are to be released				

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Next Review Date: 11 June 2022	Review Date is 3 years from Issue Date	Page 10 of 12

EPA Request – Continuous monitoring data during start-up/shutdown periods

The EPA has requested that an analysis and discussion on available continuous monitoring data during start-up/shutdown conditions be provided, including but not limited to:

a. Available pollutant concentrations, specifically voes and particulates
b. Discharge parameters, specifically temperature and flowrate.

As noted in Section 5.4 of the Air Quality review, emissions from Kiln 6 during start-up periods are not recorded by Boral and it is not a requirement of the EPL or conditions of consent to do so. Emissions cannot be measured accurately during start-up periods due to variability in flow, temperature and pollutant concentrations and are exempt from the licenced emission concentrations as per Section 56 of the NSW Government Protection of the Environment Operations (Clean Air) Regulation 2010.

Boral does have continuous monitoring data during start-up periods, however any such results would be questionable as the monitoring equipment is calibrated against normal operating conditions. In the interests of advancing discussions on this matter, the attached graph provides real-time emissions for VOC and Particulates along with air flow during the same start up example during the 5-7 June 2019 start up.

As can be seen, during start-up conditions the flow rates are very low being only 56 m3/S when on diesel only and increasing to 91 m3/S increasing the coal to 4.7t/hr. During production the flow rate is approximately 210m3/S.

During these start up periods the particulates are measuring zero on the continuous monitor and the VOC results are also low at 5.3ppm under diesel and 3.7ppm a couple of hours after coal in introduced.

EPA Request – Additional analysis/discussion on potential changes to air emissions

The EPA has requested additional discussion/analysis on the potential for changes in air emissions with consideration of the above requested additional information, be provided.

The additional supporting information contained above informs our original application that the use of coal/HiCal during start-up will not adversely impact on emissions compared to the existing scenario of coal and diesel.

The small amount of HiCal50 relative to coal, the lower volumes of coal typically used while the process heats up and the relatively quick timeframe before the system meets key operating temperatures supports the Air Quality review conclusion.

On this point, we would draw attention to Condition 1.2 I) ii) of the existing approval, and the reference document noted in the condition, being *Blue Circle Southern Cement Berrima Plant, Proposed Non-Standard Fuels Modification, Additional Information, dated 3 June 2004.*

The condition relating to abnormal conditions (ie start up and shut down), is dealt with on page 34, and the conditions which are to be applied for the continuing use of alternative fuels and material, with specific reference made to HiCal50; as illustrated in the following extract from the document:

Abnormal Conditions

During periods of abnormal operations provide additional information on:

- ***Conditions applied for continuing use of alternative fuels and material***

The following operating conditions will apply to the use of alternative fuels:

1. During kiln light ups the use of alternative fuels (other the alternative fuels pre-blended with coal) will not commence until the kiln burning zone temperature is capable of supporting a stable flame. This is when the burning zone in the kiln achieve bright red hot or where the clinker coating surface temperature is greater than 850°C
2. The use of alternative fuels other than those pre-blended with coal will not commence until the kiln output reaches 80 tonnes per hour of clinker and operating conditions are stable.
3. The maximum firing rate of each alternative fuel will be set in the kiln control system and this rate will not be exceeded during operation.
4. The alternative fuels firing will be stopped automatically when the coal firing stops or the plant stops
5. The use of alternative fuels will not recommence till the kiln output reaches an output rate of 80 tonnes per hour of clinker and operating conditions are stable.
6. The firing of alternative fuels (other than those pre-blended with coal) will be stopped if the kiln has not been stabilised or is experiencing upset conditions which continue for more than 1 hour.
7. These control requirements will be programmed into the control system. This will ensure that the operating rules are applied consistently under all circumstances.
8. Kiln system stability is determined by the parameters used in the fuzzy logic control.

Note: Some alternative fuels will be pre-blended with the raw coal. In this case it is not possible to discontinue the use of these alternative fuels during upset conditions. The rate of use for Hi Cal 50 will be a maximum of 5% of total pulverized fuel rate.

If it not possible to maintain emissions below licence limits the use of the alternative fuels will be stopped until the emissions can be reduced below licence limits.

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The above documentation clearly demonstrates that the use of alternative fuels has been contemplated for the site, including during abnormal operations; thereby the use of such materials and any impacts have been already considered.

Notwithstanding, the proposal currently seeks to achieve modifications to existing conditions in the consent, to fully realise these previously considered operations and avoid any possible inconsistencies; as the conditions in the approval would supersede the accommodations provided in the supplementary documentation.

Conclusion

We trust the above information sufficiently addresses the queries raised in the request for information from the DPE and EPA, and look forward to the timely finalisation of the assessment of the proposal.

Should you have any further questions related to the information provided in this letter, please do not to hesitate to contact the undersigned on 0401 897 486, or adnan.voloder@boral.com.au, or alternatively Greg Johnson, Environmental Sustainability Manager - Boral Cement on 0401 893 420 or greg.johnson@boral.com.au.

Yours sincerely,

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