Application for variation to Padeswood Works Permit BL1096 Aluminium oxide as a raw material for clinker production and addition of Granulated Blast Furnace Slag (GBFS) to the Cooler

Contents

1. GBFS & Aluminium oxide NTS - Non-Technical Summary

Cement is made to a precise recipe. At Padeswood the principal raw materials are limestone together with sand, pulverised fuel ash (pfa), and shale. The current recipe requires the right proportions of:

- Limestone - the main source of calcium oxide (lime)
- Sand - the main source of silicon dioxide (silica)
- Shale/pfa - the main sources of aluminium and iron oxides.

Additionally, a small amount of iron oxide is also added to ensure the correct chemistry is achieved.

Following delivery to the site, the constituent raw materials are ground together to a fine powder and then heated to about 1450°C in the rotary kiln. This is accomplished by direct heating, the heat source being the kiln flame. At this temperature complex chemical reactions take place, and calcium silicates are formed. The heated material balls up into nodules, which vary in size from 50mm diameter down to dust. This is called clinker. The clinker is cooled, then ground with gypsum and limestone, to make the familiar grey powder, which is cement.

As part of its 2030 sustainability commitments, Hanson is looking for ways to reduce the carbon footprint of its cementitious products. This permit variation is a request to use aluminium oxide in the raw mix following successful trials, and to add Granulated Blast Furnace Slag (GBFS) to the cooler at Padeswood Works. Both materials will reduce the carbon dioxide (CO_2) emissions per tonne of cement without adversely impacting process, quality or the environment. Please refer to the Appendix 6 –GBFS Trial Procedure and Appendix 6a - Aluminium oxide trial report, for details on how the addition of the materials will positively impact the CO_2 emissions of cement production.

Initially the GBFS we will use will be a waste from the Hanson Regen plant at Teesside. The chemical makeup of the GBFS is not suitable for the incorporation into the Regen process. The waste GBFS has been classified under EWC code 10 02 01. This code is not currently listed in Schedule 2 Table 2.2 or Table 2.3 of the Padeswood permit and therefore we require a minor technical variation to use this waste in our operations.

Once supply of the waste GBFS has come to an end, we will then source the GBFS as a raw material from Regen. We are therefore requesting a permit variation initially to use GBFS as a waste and then to use the GBFS as a raw material once the supply of the waste GBFS has come to an end.

The GBFS will be fed into the cooler at a rate of approximately 5% of clinker production. A conveying system has been installed to the east of the cooler building. To control any potential dust emissions, the conveying system and transfer point will be covered, although due to the moisture content of the GBFS this is unlikely to be a dusty operation.

The GBFS will be stored to the rear of the MBM Silo in a covered storage area. From here it will be transferred to the hopper using the site telehandler. The GBFS has a moisture content of 18% so the risk of material becoming airborne during this transfer is minimal. The GBFS will be moved from the storage area to the GBFS hopper on a first in first out basis to prevent the material from drying out.

Aluminium oxide is a direct replacement for PFA and is currently in use at the time of writing this variation. No additional equipment is being requested to use this material, refer to Appendix 6a for details.

2. GBFS EMS Environmental Management System

Hanson Cement operates an integrated management system (IMS). The IMS is certified to the following standards: quality ISO 9001, environment ISO 14001, safety ISO 45001, energy ISO 50001, Responsible Sourcing BES 6001. The introduction of the materials will require no changes to the procedures within the management system that control the operation of the IMS or the Hanson wide corporate procedures. Local procedures have been created for their use – see Appendix 6 – GBFS Trial Procedure as an example.

As part of the operation of the IMS, changes such as the addition of GBFS into the cooler are required to go through a management of change process. The management of change risk assessment for the GBFS is provided in Appendix 4 – Management of Change – adding GBFS to the cooler. Any issues identified in the management of change risk assessment will be addressed prior to commencement.

3. GBFS Environmental Risk Assessment (ERA)

The principal risk assessment methodologies for managing risk are:-

- UKCP05 Environmental Aspect Assessment
- UKCP02 Risk Asessment

The environmental aspect assessments identify the inherent environmental impacts associated with operations and activities such as stack emissions during normal and abnormal operations and emergencies such as a large oil spillage during maintenance work. The risk assessment procedure is used to assess safety, environment, and quality risks of activities e.g. changing a gearbox. A high-level environmental risk assessment of GBFS to the cooler is presented in Appendix 5 - UKCP02.F1 Risk Assessment Form Granulated blast furnace slag to cooler.

4. GBFS Emissions

4.1. Emissions to Air

There are no changes anticipated with the proposal to use GBFS and there is a demonstrated reduction of carbon monoxide emissions associated with the use of aluminium oxide. This reduction of CO when using aluminium oxide is due to the very low carbon content (approx. 1%) of the material. There is a slight increase of ammonia emissions, however, the levels are still significantly below the ELV.

GBFS contains low levels of carbon (0.15%) and sulfur (0.72%). Carbon dioxide generated from the use of GBFS will exit via the kiln stack, emission point A8, and the sulfur in the GBFS will form SO_2 and be absorbed in the calciner which will eventually form sulfates and leave the kiln in the clinker. This is the same chemical reaction that occurs when burning coal. There will be no changes to emissions at the cooler stack.

4.2. Emissions to Water

Neither material will change emissions to water. The process of adding GBFS into the cooler will not utilise water at any stage and the use of aluminium oxide reduces cooling water

usage in the gas conditioning tower due to the lower exit temperature of the gases leaving the preheater tower.

4.3 Emissions to Land

Neither material will cause emissions to land.

5. GBFS Operating Techniques and Process Description

Please see Appendix 6 – GBFS Trial Procedure for details on the operating techniques that will be followed for addition of GBFS to the cooler. Appendix 6a – aluminium oxide trial report details the trial of this material.

6. GBFS Noise and Vibration

There is no change in noise or vibration with the use of aluminium oxide as existing equipment is being used and we do not anticipate any noise impact with the use of GBFS.

The storage area for the GBFS has been chosen due to its central location within the works and close to the feed system to minimise vehicle movements. The equipment installed has been appropriately sized for the task and has been installed in an area where the noise of existing structures and plant will remain dominant over any noise of the new GBFS system.

Movement of GBFS from the storage area to the hopper will be carried out by the existing site telehandler. As this vehicle is already in operation around the plant day and night, we do not expect its movements whilst transporting the GBFS the short distance from the storage area to the hopper to change the offsite noise.

Noise monitoring will be undertaken within one week of the commencement of the addition of GBFS to the cooler. It is not possible to confirm the noise impact of the operation without material being transported along the conveyor. On and off-site noise recordings will be sent to our independent noise specialists, who will assess for any tonal noise coming from the operation.

The table below (from cement and Lime BAT conclusions) is for GBFS only as this is new equipment. Most of the responses are n/a as this is unlikely to be a noisy operation.

Reference	Description	Applied to GBFS
A	Select an appropriate location for noisy operations	N/A
B	Enclose noisy operations/units	N/A
C	Use vibration insulation of operations/units	N/A
D	Use internal and external lining made of impact-absorbent material	N/A
E	Use soundproofed buildings to shelter any noisy operations involving material transformation equipment	N/A
F	Use noise protection walls and/or natural noise barriers	N/A
G	Use outlet silencers to exhaust stacks	N/A
H	Lag ducts and final blowers which are situated in soundproofed buildings	N/A
I	Close doors and windows of covered areas	Yes
J	Use sound insulation of machine buildings	N/A
K	Use sound insulation of wall breaks, e.g., by installation of a sluice at the entrance point of a belt conveyor	N/A
L	Install sound absorbers at air outlets, e.g., the clean gas outlet of dedusting units	N/A

M	Reduce flow rates in ducts	N/A
N	Use sound insulation of ducts	N/A
O	Apply the decoupled arrangement of noise sources and potentially resonant components, e.g., of compressors and ducts	N/A
P	Use silencers for filter fans	N/A
Q	Use soundproofed modules for technical devices (e.g., compressors)	N/A
R	Use rubber shields for mills (avoiding the contact of metal against metal)	N/A
S	Construct buildings or growing trees and bushes between the protected area and the noisy activity	N/A

7. GBFS Odour

There is no odour associated with GBFS. The aluminium oxide has an ammoniacal odour. This becomes more pronounced when the material is exposed to moisture. The aluminium oxide will be stored in the existing crane store which will prevent the material being exposed to moisture and minimize the production of the ammonia odour.

8. GBFS Monitoring

No additional emission monitoring is required however current readings will be monitored closely on initial use at emission points A8 and A9.

Product quality will continue to be monitored as normal to ensure the addition of GBFS does not have an adverse effect. As the GBFS has a chromium content, we will test the clinker to ensure the hexavalent chromium content of the cement does not exceed permitted limits. No change is expected, however, this will this be checked.

Monitoring of the GBFS feed/conveying system will be undertaken by the operator loading the hopper and monitoring of GBFS stock levels / usage will be done via weighbridge tickets and feed rate trends.

Equipment performance, monitoring and maintenance will be carried out by means of preventative maintenance schedules and shift managers daily observational walks.

9. GBFS Energy

Cement manufacture is an energy intensive process, around 90% of the energy consumption is fuel used to fire the kiln. The remaining 10% of energy consumption is electricity. Typically, around 60% of the electricity consumption is used by the kiln line with the remaining 40% consumed in the grinding of cement.

Appendix 6a demonstrates thermal energy savings (top of the preheater tower temperature) when using aluminium oxide and can be referenced for this section.

By adding GBFS to the clinker we will make more cement for the same amount of clinker produced. This addition does not result in a consequence of removal of any material further down the line, this is all additional. Overall GJ, CO_2 and SO_2 per tonne of cement will reduce.

Castle Cement Limited is no longer a participant in the climate change levy agreements. This is because the Government has exempted energy intensive industries in the mineral and metallurgical sectors from climate change levy payments under the taxation of energy products directive. As the company is no longer required to make levy payments it is not possible to remain in the cement sector climate change levy agreement. Hanson UK operations are covered by the Energy Efficiency Directive and energy savings opportunity

scheme. The requirements ESOS are met through certification to ISO50001. Site energy usage is reported monthly at site and Hanson Cement executive level, energy saving opportunities are recorded in a database and progressed by the site energy team.

10. GBFS Waste

As GBFS is additive to clinker there is no process waste arising from its use.

Waste arising from maintenance work will be recovered by the same routes as currently in place on site, summarised in the table below. The quantity of waste produced from site maintenance activities is not expected to change due to the addition of GBFS.

Waste Description	**EWC Code**	**Recovery/Disposal**
Used Lubricants	150110*	Recovery
Oily Rags	150202*	Recovery
Oil Filters	160107*	Recovery
Metal Wear Parts (Iron & Steel)	170405	Recovery
Waste Oils	130205*	Recovery
Waste Cement (inorganic wastes containing dangerous substances)	160303*	Recovery

11. Co-incineration

Kiln 4 at Padeswood is permitted to use waste as fuel in the co-incineration requirements of Chapter IV of the Industrial Emissions Directive, IED. Full details of the how the kiln complies with the technical and operational requirements of IED chapter IV were provided in the original PPC permit application.

This variation application does not require any changes to the operation of the kiln line or the permit conditions relating to the use of waste as a fuel. Appendix 6 of the C3 application form has been completed where necessary to maintain the same conditions that apply in the current permit.