Appendix 3

Determination of Baseline Ammonia Emission Levels

Proposal to Establish Baseline Ammonia Emissions for BAT Conclusion 20

At the MPA / UK Regulator meeting on the 15th September 2014 there was a discussion on the need for some of the MPA member companies to establish background levels for Ammonia emissions. The Padeswood plant was identified as one of the plants to undertake this. The MPA requested that kilns are permitted to operate for three months with the SNCR run on a two week on and two week off cycle i.e. the SNCR will not be used for a total period of 6 weeks. This would enable a comprehensive response to the BAT conclusion 20 on Ammonia slip. For the two week SNCR off periods the current emission limit would not apply and reporting of high NO_x results would not be required.

A period of 2 weeks on and 2 weeks off has been selected to ensure that variation in raw material composition is fully explored. There is likely to be varying levels of ammonia in the quarried stone and PFA. As there are several days limestone storage on site and at the quarry it will take a number of days for a change in quarried stone to come through the raw material stocks. More importantly ammonia is absorbed in the raw mill thus there is a "reservoir" of ammonia stored in the raw meal silo which will also take several days to consume before the baseline no SNCR conditions can be achieved.

Variables to Consider at Hanson Cement Padeswood

In order to establish the full range of ammonia emission without ammonia slip from the SNCR the plant will be operated under a range of normal operating conditions during the trial period, this will include changes to

Raw materials – Limestone, sand and PFA

Fuels – Coal, Cemfuel, SRF & MBM,

Process – Raw Mill On & Off

Raw Materials

The majority of raw materials are sourced from the Cefn Mawr limestone quarry. In addition to the limestone, PFA and sand are used to adjust the chemistry to the desired composition to produce clinker. It is considered that the major source of Ammonia emitted via the stack (excluding slip from the SNCR system) is derived from the raw materials. The changing of the raw material chemistry takes considerable time due to the size of the blending and homogenising system for the crushed material from the quarry and the ground raw feed to the Kiln. These trails will take at least eight weeks to complete due to the requirement to process the material held in the crushed material store and the material in the finely ground raw meal silo.

The short trial period will only cover a small range of the potential variability of limestone in the quarry, therefore there is the potential for areas of the quarry that will not be exploited until 10 or 20 years in the future could have higher levels on naturally occurring ammonia salts than those encountered during the trial period.

The odour of ammonia or urea has been detected in deliveries of PFA this is believed to be a result of the use of SNCR at power stations producing the ash. It is likely that with the requirement to reduce NOx emissions from power generation through legislation such as the Industrial Emissions Directive and the National Emissions Ceiling Directive the use of SNCR will increase and the quantity of ammonia used at plants already using SNCR will also increase. Therefore it may be necessary to repeat this trial at a later date.

Fuels

Traditionally coal was used to fire the kiln, a range of fuels are now permitted to be fired. Today typically greater than 50% of the heat is sourced from alternative fuels these being Cemfuel, Solid Recovered Fuel (SRF) and Meat and Bone Meal (MBM).

Cemfuel is fired only on the main burner and with the flame temperature achieved is not considered to be a source of Ammonia in the stack. The proposal is to fire this at normal rates throughout the trial period.

SRF is only used in the calciner at present. The material fired in the calciner with the lower temperatures could be a source of Ammonia emissions. SRF is sourced mainly from household refuse and therefore has a potential to be variable. It is therefore proposed that SRF use is maximised on the Calciner throughout the trial to establish the effect, if any, on the level of ammonia emissions apart from one week of SNCR Off when MBM use will be maximised on the calciner.

MBM The MBM fired in the calciner could be a source of Ammonia in the emissions. It is therefore proposed that:-

i) For the first SNCR Off period MBM use is maximised and SRF usage lowered to facilitate this,
ii) For the second SNCR off period SRF is maximised and MBM is fired on the Calciner at a rate determined by process limitations

Coal this is fired on the main burner and the calciner. As for Cemfuel the Coal fired in via the main burner with the inherent flame temperature will not be a source of Ammonia in the stack. The coal fired in the calciner could be a source of Ammonia. It is therefore proposed that for 1 day (or more if necessary) during the trial period when SNCR is not operating that coal only firing is carried out on the Calciner.

Process

The main process variable is the on or off operation of the raw mill. The raw mill is required to run the majority of the time the kiln is operating. This builds up a stock of finely ground raw meal that can be consumed during raw mill off periods due to maintenance or other process or site requirements. An extended period of running without the raw mill is not possible, it is therefore proposed that times of running without the raw mill are collated (when they exceed 1

hour) for each assessment period. Targeting at least two eight hours off times in each assessment period.

Behaviour of ammonia in kiln systems

Ammonia is a volatile substance which can be adsorbed onto the raw meal in the raw mill in the same way as SO_2, consequently operation of the raw mill captures ammonia which is then stored in the raw meal silo, the circulating load of ammonia will build up during periods on operation with the raw mill on. When the mill is stopped for either routine maintenance, or when the meal silo is full or as a result of a breakdown the adsorption of ammonia stops, this ammonia is then released by desorption in the preheater and emitted. In addition to the reservoir of ammonia in the raw meal being released, ammonia entering the kiln system with the raw materials and from the SNCR which does not react with NOx (i.e the NH3 slip) is also emitted without being captured in the raw mill.

It is not clear how long it will take for the ammonia cycle between the kiln, mill and silo to reach a new (no SNCR) steady state thus a trial period of two weeks without SNCR has been proposed to ensure the new equilibrium is achieved to determine the background level of ammonia emissions when the mill is both on and off.

Impact on NO_x emissions and Air Quality

Prior to SNCR being installed the plant was being commissioned so there is limited data on historic NOx emissions without using SNCR. In 2005 and early 2006 the stack emission level was around 800-1200 mg/Nm^3 as a daily average. It is anticipated that the NOx emission level will not exceed1500 mg/Nm^3 as a daily average when the plant is operating without SNCR as since 2006 there has been a significant increase in alternative fuel usage which is known to reduce NOx emissions.

The table below shows the potential impact on air quality assuming emissions at 500, 800 and 1500 mg/Nm^3 for the full year and the potential impact of short term operation at 3000 mg/Nm^3. As the trial is for a short duration the impact on annual average NOx maximum ground level concentrations will be very small. This data is based on modelling work completed for the IPPC permit application report sch4/Padeswood/4.1/Impacts/Sch4 2002.

	Long term	Short term
Emission concentration	Annual mean* NO_x as NO_2 $\mu g/m^3$	99.79th 1 hour mean* NO_x as NO_2 $\mu g/m^3$
Assessment criteria (EQS)	40	200
500 mg/Nm^3	1.3	13.3
1500 mg/Nm^3	3.9	39.9
3000 mg/Nm^3	-	79.8

In all cases the plant contribution to NOx at ground level is significantly below the EQS. It must be stressed that this is a worst case assessment to demonstrate that air quality objectives will not be breached during the trial period. In the event that the NOx emission level exceeds 1500 mg/Nm^3 during the SNCR off trial for a period of more than 4 hours the SNCR system will be restarted to reduce emissions. If this is required on a long term basis then it will be necessary to review this trigger point with NRW to determine another means of determining the background level of ammonia emissions without SNCR.

Impact on habitat sites

Improvement condition IC2 submitted in 2012 assessed the impact of ammonia and NOx emissions on all habitat sites in a 10km radius of the plant. This assessment was done assuming a continuous emission at 500 mg/Nm^3 for the full year. This is very much an over estimate as the plant does not operate for 365 days per year and the annual average emission level in 2013 was 357 mg/Nm^3 (for the hours the plant operated). If the plant operated at 1500 mg/Nm^3 for the full 6 week period without SNCR then this would increase the annual average emission from 357 mg/Nm^3 to 489 mg/Nm^3 thus the assessment of impacts on habitat sites as annual average will be largely unchanged from those assessed in the improvement condition. The improvement condition report demonstrated that the works represented less than 1% of the NOx and NH_3 impacts at most habitat sites. Hanson Cement considers that the short trial is very unlikely to have a measurable impact on the habitat sites within 10km of Padeswood works.

Assessment

Fuels

Ammonia slip with coal and alternative fuels fired on the Calciner being varied.

Process

Ammonia slip assessed with Raw Mill On and Off.

Control of Impacts

Natural Resources Wales will be informed in advance of the start of the 2 week period of operation without SNCR. The SNCR is a secondary control of NOx emissions, throughout the trial period the primary measures used to control NOx will remain operational eg the low NOx burner, normal combustion of fuel in the calciner and the continued use of alternative fuels. The impact assessment above indicates that the long and short term air quality objectives will not be breached at an emission level of 1500 mg/Nm^3, if this level is exceeded for a period of 4 hours then the use of SNCR will be resumed for a short period to reduce the NOx emissions. .

Outcome

The variables of Raw Materials, Fuels and Process are all prone to variability. The proposal is that the Ammonia background level is based on the highest results as determined during the SNCR off periods.

Reporting

The results of the trial will be reported within 2 months of completion of the trial as an annex to the Regulation 60 response.

Period[1]	SNCR	Burner	Cemfuel	SRF	MBM	Coal	Raw Mill [2]
1	Off	Main	On	Off	On	On	On[5]
		Calciner	-	On[3][6]	Off	On [4]	
2	On	Main	On	Off	On	On	On[5]
		Calciner	-	On	Off	On	
3	Off	Main	On	Off	On	On	On[5]
		Calciner	-	On[3]	Off	On [4]	
4	On	Main	On	Off	On	On	On[5]
		Calciner	-	On	Off	On	
5	Off	Main	On	Off	On	On	On[5]
		Calciner	-	On[3][7]	Off	On [4][7]	
6	On	Main	On	Off	On	On	On[5]
		Calciner	-	On	Off		

Notes

1) Each Period lasts 2 weeks,
2) Raw mill on/off will be as normal, with the mill operating most of the time.
3) Apart from 1 day when coal only on Calciner,
4) One day in Week coal only on Calciner
5) Raw Mill off data to be collated, from normal operating conditions depending upon raw meal availability an extended stop may be included in each period.
6) MBM use maximised on kiln and SRF use determined by process
7) SRF use maximised on Calciner use determined by process