CHATTANOOGA-HAMILTON COUNTY AIR POLLUTION CONTROL BUREAU

Statement of Basis
Part 70 Permit No. 47-065-3070

Signal Mountain Cement Company
dba Buzzi Unicem USA – Signal Mountain Plant
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Sydney Spencer, E.I.T.
Engineering Department
December 24, 2009

Permit/EU Number	Description	Expiration	Fee
47-065-3070	Part 70 Permit	5/14/2009	$66,299.34
010	Precalciner/Kiln		
011	Raw Material Handling and Preparation		
012	Clinker Handling and Storage		
013	Fuel Handling and Storage		
014	Product Finishing and Handling		
015	Finish Materials Storage and Handling		
016	Miscellaneous Haul Roads		

Compliance Status

Description	Date	Status
Annual compliance certification	Received: April 20, 2009	In full operational and enforcement compliance
Full compliance evaluation	Completed: December 17, 2009	
Onsite Annual Inspection	Performed: December 15, 2009	
Semi-annual compliance	Received: May 20, 2009	
Semi-annual compliance	Received: December 3, 2009	

Purpose

Signal Mountain Cement Company has applied for the renewal of their Part 70 permit. The Part 70 permit expired on May 15, 2009 but will remain in effect until the new permit is issued. The new Part 70 permit will cover the operating period from February 15, 2010 through February 14, 2015. This statement of basis includes discussions of the operation of the permitted equipment and the applicable regulations. It has been adapted from the Bureau annual inspection report for Signal Mountain Cement dated December 17, 2009.

Process Description

The basis of the original portland cement, as patented in England in 1824 by a mason named Joseph Aspdin, was pulverization of a select proportion of limestone and clay, followed by burning the mixture to form cement "clinker" and then grinding it to a powdery consistency. The name was given because of its similarity in color to stone quarried on the British Isle of Portland. Prior to this development, and for some time after, large amounts of cement were produced using a naturally occurring mixture of clay and lime. This "natural cement," unlike portland cement, varied in consistency with nature. During the industrial age and beyond, cement-making became increasingly refined, however crude its origins. The chief benefit was consistently high quality product.

Signal Mountain Cement's local portland cement plant was formerly a wet mix operation, which centered around two long wet kilns. In April of 2001 the company began operating its single dry precalciner/kiln and retired the two wet kilns. Long wet kilns usually exceed 400 feet in length and the raw material mix is wet slurry. Dry systems are typically more compact– less than half the length of wet systems, and the raw mix contains no added water. The shorter horizontal length of the dry system at Signal Mountain Cement is offset in part by the height of the preheater/precalciner "tower." Many of the existing storage and related features at Signal Mountain Cement remain as part of the new system.

The production of portland cement is a four-step process: (1) acquisition of raw materials, (2) preparation of these materials, (3) firing or pyroprocessing of the raw materials to form cement clinker, and (4) grinding or finishing clinker to produce portland cement. The following is a general description of the process employed at Signal Mountain Cement. The discussion is based on plant observations and information from the *Air Pollution Engineering Manual*, Air and Waste Management Association, First Edition, Van Nostrand Reinhold, New York, 1992.

Raw Materials Acquisition

Portland cement is composed chiefly of calcium, silicon, aluminum and iron. A small fraction of magnesium is supplied by the raw materials. Gypsum also supplies reduced sulfur as calcium sulfate. The most prevalent of the starting minerals is calcium. The principle source of calcium is **limestone**, which is received by barge from Signal Mountain Cement's quarry in Marion County. Limestone accounts for about 86% of the dry raw mixture. Limestone is unloaded from the river barge by a clamshell crane. The crane loads the material into a conveyor system feed hopper. The conveyor system transports the limestone from the river dock to raw material storage silos.

Silica, aluminum, and iron are the next most prevalent materials in portland cement. These are supplied to the process via rail, truck, and barge in the form of **slate, sand and iron ore**, respectively. A portion of **clay or bauxite** is often used to supply aluminum silicates or aluminum oxide. These materials account for the balance of the dry raw mixture. The company stores these materials in the river yard located to the west of the plant. A fraction of **gypsum** is often added to the finished cement to control concrete set time. These materials are received by truck and stored in the dry material storage area.

Preparation of Materials

The second step in the process is the combining of the select raw materials and conveyance for milling. Weighing and continuous chemical analysis is performed as materials enter the raw mill. The raw mixture is ground to a fine consistency prior to being conveyed to the top (entry) of the preheater tower. Air and process gases flow counter-current to the flow of raw materials, as system gas flow begins at the firing end of the kiln, opposite the raw material entry.

Firing of Raw Materials

The principle step in cement production is firing, or pyroprocessing, of the raw mix. Raw materials are conveyed to the top of the preheater tower (a staged tower of specially designed ducts), opposite the firing end of the "L-shaped" precalciner/kiln system. As materials flow against the hot gas stream, which originates at the firing end, they move down the preheater tower picking up heat and undergoing chemical changes. The initial phase of clinker production at the highest stages of the tower is referred to as calcining (molecular dissociation and initial elemental fusion). Raw materials cascade downward, against the flow of hot gas, through the preheater series, finally turning nearly horizontal into the kiln section. Production flow through the kiln remains gravity induced as the kiln is slightly tilted toward the firing end. Clinker exits the kiln at the fuel/firing end and begins its passage through the clinker cooler. In the opposite direction air initially enters via fans at various points, predominantly at the firing end, of the system. Several fans provide air to cool the hot clinker, which continues through the kiln and preheater. System gas flow is sustained also by the baghouse exhaust system. Hot gas flows through the kiln, up the preheater tower, back down parallel to the tower, through the baghouse and is exhausted atop the preheater tower. The exhaust exits the highest point in the system.

The continuous temperature increase as the raw materials move down the preheater tower results in a series of physical and chemical changes: (1) calcination of magnesium carbonate ($MgCO_3$ $MgO + CO_2$), (2) calcination of calcium carbonate ($CaCO_3$ $CaO + CO_2$), and (3) combining of lime and clay oxides at the firing end of the kiln. These changes result in the formation of cement clinker. Clinker is comprised of four major compounds: tricalcium silicate [$(CaO)_3SiO$], dicalcium silicate [$(CaO)_2SiO_2$], tricalcium aluminate [$(CaO)_3Al_2O_3$], and tetracalcium alumino-ferrite [$(CaO)_4Al_2O_3Fe_2O_3$]. Limited quantities of other elements and compounds bond to form solids with the available calcium, silicate, and metals under optimum operating conditions.

As mentioned, clinker is discharged from the kiln into the clinker cooler where the material is red-hot. During cooling, clinker temperatures drop from about 2,700°F to 300°F. Clinker is gray-colored, glass-hard, spherical-shaped nodules of one inch nominal diameter.

Finishing

The final step in cement production is milling of clinker to a fine powder. Fineness is critical because it determines the available surface area on which chemical reactions can occur when cement is hydrated and concrete is made. The new finish mill, which is housed as a single area, is understood to be more effective at reaching fineness levels that produce quality cement and overcome the adverse impacts of such constituents as sulfur and magnesium. A single baghouse, which is located inside the finish mill building, controls emissions from this process.

Part of the finishing process following milling is dilution of the ground clinker with a fraction of gypsum, which extends curing time in portland (concrete) mix, or limestone in masonry mix where less strength is required. This process is followed by storage and/or packaging and/or loading.

Evaluation

Signal Mountain Cement is subject to local rules as well as requirements imposed at the time of the PSD (Prevention of Significant Air Quality Deterioration) analysis for their new system (1997). In addition, they are subject to the aforementioned NESHAP under Title 40 Part 63, Subpart LLL. Select process points remain subject to Title 40 Part 60, Subparts F and Y as indicated in the permit.

EU010 Precalciner/Kiln

The 1998 PSD analysis applied to carbon monoxide (CO) emissions from the single exhaust covering the precalciner/kiln. Limits for this pollutant and particulate matter (PM), volatile organic matter (VOC), nitrogen oxides (NOx) and sulfur oxides (SOx) were imposed upon completion of the analysis. The requirements of Part 63, Subpart LLL impose further standards for PM, opacity and dioxins/furans. As an ongoing dioxin/furan emissions indicator, kiln baghouse inlet temperatures are limited to those temperatures measured during stack testing ($\leq 187.4^{\circ}$C with mill operating, $\leq 225^{\circ}$C with mill not operating). Signal Mountain Cement demonstrated initial compliance with these standards by stack testing in September of 2001. Subsequent stack sampling of a range of hazardous air pollutants demonstrated the source's classification as an area source under Subpart LLL. Local Rules 2.6 (NOx), 13.1 (SOx), 15 (NSPS), 18 (PSD), 25.3 (VOC) and 27 (PM) and Title 40 *CFR* Part 60 Subpart F also apply to this emission unit.

This kiln was built without a bypass feature, though the original design included it. Therefore, the as-built configuration retains all materials, with the exception of emissions out the main stack, within the process stream, which eliminates the generation of cement kiln dust. The sole exhaust follows baghouse #5 and also covers the clinker cooler and raw mill. Backend kiln oxygen is monitored on a continuous basis pursuant to the control of NOx emissions (4.5% O_2 limit). Baghouse inlet temperature is monitored to ensure compliance with §63.1343(b)(3), which limits this temperature to 204°C. The source must also monitor the temperature to ensure the longevity of costly bags and other components.

EU011 Raw Material Handling and Preparation
EU012 Clinker Handling and Storage
EU014 Product Finishing and Handling
EU015 Finish Materials Storage and Handling

These emission units consist of process points that only emit PM. Quantitative emission limits exist for most of these and opacity standards are in place for all of them. Established limits, the bulk of which were in existence following the aforementioned PSD analysis, apply to each of these process points. Nearly all of these are controlled by fabric filters.

Subpart F has been supplanted for the most part by Subpart LLL. Subpart F remains applicable for certain points that existed prior to construction of the new plant. However, this only imposes an opacity limit of 10%, much the same as Subpart LLL. PM emissions are also subject to local Rule 26.14 (Portland Cement Plants) or 27.1 (PM).

EU013 Fuel Handling and Storage

Only PM emissions are generated here and fabric filters control these emissions. Quantitative emission limits are given for select emission points and opacity limits apply in accordance with Subpart Y. Local Rules 15 (NSPS), 18 (PSD), and 27.1 (PM) also apply to this emission unit.

EU016 Miscellaneous Haul Roads

The addition of an emission unit to account for PM emissions from haul roads was previously requested and granted. Only PM emissions are generated from this emission unit. Wet suppression and sweeping of select roadways are practical ways to ensure effective emissions control of the haul roads. Logging of wet suppression and sweeping demonstrates compliance with these requirements. Local Rules 11 (Transporting and Material Handling), and 27 (PM) apply to this emission unit.

Table 1	***Plant-wide Emissions (tons/yr)***	
Pollutant	Estimated Actual	Allowable
PM	205	501*
NO_x	1,027**	1,763
SO_2	0.843***	392
VOC	22.2***	47
CO	332***	1,085

* 80 tons of this quantity is allowed at the kiln exhaust.
** Based on 244.9 ppmv and 365.4 lb/hr as tested in January 2007 and an estimated 5,620 hours of operation.
*** Based on 0.3 lb/hr SO_2, 7.9 lb/hr THC, and 118 lb/hr CO as tested in November 2001 and an estimated 5,620 hours of operation.

Conclusions

The Precalciner/Kiln (Emission Unit 010) was determined to be in compliance with §4-41 Rules 2.6 (NO_x), 13.1 (SO_x), 15 (NSPS), 18 (PSD), 25.3 (VOC), and 27 (PM) of the Chattanooga-Hamilton County Air Pollution Control Ordinance (the Ordinance), Title 40 *CFR* Part 60 Subpart F, and Title 40 *CFR* Part 63 Subpart LLL.

Raw Material Handling and Preparation (Emission Unit 011) was determined to be in compliance with §4-41 Rules 18 (PSD) and 27.1 (PM) of the Ordinance, Title 40 *CFR* Part 60 Subpart F, and Title 40 *CFR* Part 63 Subpart LLL.

Clinker Handling and Storage (Emission Unit 012) was determined to be in compliance with §4-41 Rules 18 (PSD) and 27.1 (PM) of the Ordinance, Title 40 *CFR* Part 60 Subpart F, and Title 40 *CFR* Part 63 Subpart LLL.

Fuel Handling and Storage (Emission Unit 013) was determined to be in compliance with §4-41 Rules 15 (NSPS), 18 (PSD), and 27.1 (PM) of the Ordinance and Title 40 *CFR* Part 60 Subpart Y.

Product Finishing and Handling (Emission Unit 014) was determined to be in compliance with §4-41 Rules 18 (PSD) and 27.1 (PM) of the Ordinance, Title 40 *CFR* Part 60 Subpart F, and Title 40 *CFR* Part 63 Subpart LLL.

Finish Materials Storage and Handling (Emission Unit 015) was determined to be in compliance with §4-41 Rules 15 (NSPS), 18 (PSD), 26.14 (Portland Cement Plants), and 27 (PM) of the Ordinance, Title 40 *CFR* Part 60 Subpart F, and Title 40 *CFR* Part 63 Subpart LLL.

Miscellaneous Haul Roads (Emission Unit 016) were determined to be in compliance with §4-41 Rules 11 (Transporting and Material Handling), and 27 (PM) of the Ordinance.

Baghouse # 2, 3, 4, 6, 13, 14, 15, and 16 are subject to §4-68(d) (Compliance Assurance Monitoring [40 CFR Part 64 (§64.1-10)]) of the Ordinance and were determined to be in compliance.