April 9, 2012

The Impact of a Change in the Cement NESHAP PM Limit
On Compliance Strategies and Schedules

EPA has asked the Portland Cement Association to provide its perspective on the impact that a change in the particulate matter (PM) limit[1] under the cement NESHAP rule will have on the selection and implementation of optimal control strategies to bring cement plants into compliance.

PCA has examined the available data on PM emissions and the variability of PM emissions for the best performing cement plants and believes that the correct PM limit will be in the range of 0.06 to 0.08 lbs/ton of clinker or higher, versus the current limit of 0.04 lbs/ton of clinker[2]. Further, in discussions with EPA, PCA has received no information to the contrary.

This paper addresses three impacts that such a change in the PM limit will have:

- The impact on the selection and implementation of the most appropriate control strategy for PM;
- The indirect effect on the selection of the most appropriate control strategy for HCl, mercury and THC under this rule; and
- The time needed to determine and implement the appropriate control strategies, once a revised PM limit is established.

We are also providing the results of a recent survey of PCA members addressing these same topics.

This paper and the results of the survey indicate that a return of the NESHAP PM limit for existing cement facilities to a figure closer to the one in the proposed rule will have a significant impact on the controls selected to conform with the PM limit as well as the controls used to meet the limits for HCl, mercury and THC, even if those limits remained unchanged.

Anticipated Changes to PM Control Strategies

The current PM limit of 0.04 lbs/ton of clinker is very stringent. This standard may be met only by using the most restrictive design of a baghouse with advanced instrumentation and controls, sophisticated filter media (PTFE membrane bags with sealed seams), and very challenging maintenance practices. Compliance with this limit is made more difficult by the fact that certain control systems that are being contemplated to meet the limits for HCl, mercury, and THC will add particulate loading to the exhaust of the unit.

While a number of cement plants already have baghouses, very few facilities can comply with the 0.04 lbs/ton clinker limit without major investments in new and upgraded PM controls[3]. A

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[1] This PM limit applies to the kiln exhaust, the clinker cooler exhaust and any by-pass stacks. Compliance is based on a 30 day rolling average determined using a PM Continuous Emissions Monitoring System (CEMS).

[2] It is should noted that a limit of 0.085 lb/ton of clinker, based on stack testing rather than CEMS, is what was in the proposed rule (May 6, 2009, 74 Fed. Reg, 21136).

[3] EPA's assessment of the technical and cost impact of the rule is consistent with this perspective. See Attachment A for a summary of EPA's earlier conclusions.

corrected NESHAP PM limit (on the order of 0.06 to 0.08 lbs/ton clinker) will result in a number of changes to the control strategy adopted for PM.

The PM sources addressed under this regulation are currently controlled with either an Electrostatic Precipitator (ESP) or a Baghouse.[4] Sources controlled with ESPs cannot achieve the 0.04 lbs/ton clinker limit. To meet the limit, an existing ESP would need to be: (1) replaced with a baghouse, (2) converted to a baghouse, (3) modified to a hybrid design (where the back end of the ESP is converted to a baghouse configuration), or (4) supplemented with a polishing baghouse.

Alkali control is an important consideration for many cement plants. In plants with ESPs, this is accomplished by segregating the dust in the different fields of the ESP and removing the high alkali fraction. Changing the PM standard, which may change the control technology chosen, may also require a re-engineering of the alkali control strategy.

The optimal strategy to meet the corrected limit (of 0.06 to 0.08 lbs/ton clinker) for units currently controlled with ESPs will change or at a minimum will require in-depth engineering studies to evaluate available options. It is anticipated that:

- Many ESPs can be retained with modifications (retrofitting with a hybrid system or a polishing baghouse),rather than being removed and replaced with a baghouse, and
- Even if the ESP is being replaced with a baghouse, the specifications for the baghouse will change.

Baghouses are generally considered to be the most effective PM control devices for many types of sources, including cement plants. The 0.04 lb/ton of clinker PM limit is so strict that a large number of sources with relatively new baghouses cannot meet the limit. A baghouse designed to meet the corrected limit of 0.06 -0.08 lb/ton clinker, versus 0.04 lb/ton clinker, will not be the same. A baghouse designed to meet the corrected limit will have a higher air to cloth ratio, and lower energy consumption. This also translates to a smaller size and smaller footprint. It can also mean the use of more conventional filter materials.

For those sources currently controlled with baghouses that cannot meet 0.04 lb/ton clinker, the options to meet the limit will be to replace the baghouse, increase the size of the baghouse, add a second polishing baghouse, upgrade the filter materials and advanced instrumentation and controls. If the applicable limit is corrected, a number of changes in the compliance strategy are available, including:

- Some baghouses that were going to be replaced can be instead upgraded.
- Others that were to be replaced can be replaced with a smaller baghouses

Cement plants run on induced draft. Changing the PM control device strategy (ESP to baghouse, ESP to hybrid, baghouse to bigger baghouse) will change the pressure drop over the system. A higher pressure drop with the same fan results in decreased flow. The required new fan design must be carefully matched to the final PM control device in order to maintain the correct flow.

With a change in PM limit, another option that will now be considered, instead of replacing or modifying the existing PM control device, is adding cyclones upstream of the existing ESP or

[4] One member company has indicated that they have at least one affected source that is currently controlled with a gravel-bed filter.

baghouse. This requires engineering of the ductwork, layout, and any associated local permitting.

It is clear that a move from a limit of 0.04 to one in the range of 0.06-0.08 will have a significant impact on the selection of PM controls. When the approach for addressing HCl, mercury and THC compliance is considered, the implications are even greater.

Anticipated Changes to Control Strategies for HCl, Mercury and THC

The NESHAP for cement plants includes new limits for HCl, mercury and THC emissions that are scheduled to go into effect at the same time as the PM limit. As indicated in Attachment A, all of the control systems for these three pollutants (with the possible exception of a thermal oxidizer to control THC) increase the particulate loading in the exhaust. Therefore, the control strategy for these three components of the exhaust must be accounted for when determining the optimal strategy for simultaneous compliance with the NESHAP PM limit.

The following control measures for all three pollutants require either the collection of additional particulate that is injected into the exhaust of the unit or consideration of the indirect impact on the nature and level of PM needing control:

- When dry lime injection is used to reduce HCl emissions, the lime dust increases PM emissions unless the PM controls downstream of the injection point are designed to accommodate the increased dust load.
- Wet scrubbers, to control either HCl or mercury or both, can remove some particulate but they also create entrained droplets of scrubbing solution that form dry particulate as they dry in the exhaust. Although a wet scrubber would come after the main PM control, the evaluation of the wet scrubber contribution to the final PM emissions must be accounted for in the evaluation of the PM compliance strategy.
- Activated carbon injection is the leading add-on control measure for mercury and under consideration for THC emissions. The carbon must be removed from the exhaust downstream of the injection point. A polishing baghouse downstream of the primary PM control device is likely to be used, so as to isolate the carbon from the rest of the dust.

Because these control strategies for HCl, mercury and THC rely on the injection and removal of added particulates, a change in the PM limit can cause a change in the strategy for one or more of these pollutants. Further, compliance with all four standards (for PM, HCl, mercury and THC) must be coordinated for several reasons:

- One cannot design these injection systems without knowing the ultimate PM limit.
- The use of these injection strategies requires an upgrade in PM control both to avoid a PM increase and properly manage the additional particulate materials.
- The retrofitting of controls in plants with limited space means that the fans, ductwork and controls will need to located and sized carefully in a coordinated manner.
- These controls require changes to current air permits and state agencies will want to permit the integrated NESHAP compliance strategy rather than doing so piecemeal.

If EPA corrects the PM limit but only extends the compliance deadline for the PM limit, companies will still need to upgrade or replace PM controls in conjunction with integrated HCl, mercury and THC control systems. Optimal design and installation of these systems cannot be separated.

A change in the PM limit can also change the basic approach to HCl, Mercury and THC:

- A wet scrubber to remove HCl and/or mercury may be more or less attractive than lime and/or carbon injection, if the current PM control systems can be retained relative to the final PM limit.
- ESPs convert some of the elemental mercury in the exhaust to an oxidized form that can be removed as particulate. If an ESP can be retained with a downstream polishing baghouse, some additional mercury removal may occur.
- If an ESP can be converted to a hybrid design and meet the PM limit, it will be possible to inject and collect carbon in the hybrid portion of the ESP rather than adding a standalone polishing baghouse.

Compliance Timing

Assuming that the PM limit is changed, the time it will take to come into compliance will also change. For most cement plants, the installation of new emission controls will have to coincide with an extended outage during the low production season (i.e., Jan-Feb). Fabrication and electrical/mechanical/civil work will be started ahead of this, but the final installation can easily require 3 to 6 weeks of outage. To meet the current September 2013 deadline, final installation of all control systems must occur in the winter of 2012-13, with commissioning, CEMS implementation, and demonstration of compliance taking until September, 2013.

Assuming that a new PM standard is finalized in December of 2012, it will be necessary to conduct and/or commission new engineering studies to determine what options are available and their cost-effectiveness, which will take a minimum of 2-3 months.

If the result is that the facility will not change their control strategy (e.g., still intend to install a new bag filter) but adjustments to the baghouse design specification are needed, the facility will go through a new procurement process to assure competitive pricing of the new design. This would add a minimum of 6 months, which means that final installation could not take place until Jan./Feb. 2014, with commissioning, CEMS implementation, and demonstration of compliance taking until at least September of 2014.

If the new standard justifies a different technology (for example, a hybrid ESP/bag filter instead of a new baghouse filter), it will be necessary to:

- Conduct a new engineering study, including evaluation of the technical impacts to other pollution control devices and on the process.
- Go through a new selection process for qualified suppliers.
- Go through new bidding/procurement process to select the most cost effective vendor/contractor.
- Develop detailed engineering drawings.

All of the above takes 12-18 months, which means that final installation could not take place until Jan./Feb. of 2015, with commissioning, CEMS implementation, and demonstration of compliance taking until September of 2015.

The new and modified control systems will also be subject to air permitting, which could take up to 12 months or more and, with some agencies, cannot be completed until final designs are available.

Air permitting may be complicated if the pollution control devices or related process changes create a new emission point or changes (e.g., flow or temperature) to an existing emission point that must be accounted for in previously conducted air quality impact modeling.

If a wet scrubber is required, a new water discharge permit or permit amendment would be required. Building permits could also take several months after designs are completed.

When accounting for all of the above factors and the limited availability of /competition for vendors, consultants, suppliers and contractors, it will be very challenging to be ready for installation in early 2015 and ready for compliance at the end of 2015.

Survey of PCA Members

PCA recently completed a survey of its member regarding the potential impact of this magnitude of change in the PM limit under NESHAP on the optimal strategy for bringing their kilns, clinker coolers and by-pass stacks into compliance with all of the NESHAP limits. The results are summarized in Attachment B.

PCA received survey responses from 18 companies, representing 92 kilns. Of those kilns, 21 presently have ESPs, 70 have baghouses and one has both. The survey also addressed compliance for 75 by-pass and clinker cooler stacks.

Of the kilns, clinker coolers and alkali by-pass stacks, the operators of **62%** of those with ESPs report that they will need to reconsider and revamp their PM strategy if the limit is corrected. The most common reason given is that they believe that they can keep an existing ESP with an upgrade rather than removing it and replacing it with a new baghouse.[5]

For the affected sources currently controlled with baghouses, the operators of **43%** of those baghouses report that they will revamp their PM strategy. The most common reason given is that they feel that they can keep the current baghouse and upgrade it rather than replace it, or they were planning for an upgrade of the existing baghouse and the scope of the upgrade will change.

Respondent were also asked if the interaction of the PM limit with their compliance strategy for the other three pollutants would cause them to consider changing the compliance method for the other pollutants. The respondents indicated that a change in the PM standard would cause them to review and revise their control methods for HCl at 25% of the kilns, for mercury at 14% of the kilns and for THC at 5% of the kilns.

Lastly, respondents were asked if a deferral of the PM limit would interfere with meeting the other three limits in advance of the PM limit. Respondents identified 40 instances where there will be a problem with trying to comply with the limits for HCl, THC and mercury in advance of having the time needed to meet the PM limit. The problems included the need to upgrade PM controls to handle the increased dust loading associated with measures for HCl, mercury or THC, and the inability to install ductwork and fans without including the PM control changes associated with the final PM limit.

[5] It should be noted that a number of the respondents who indicated a change strategy would not be warranted by a change in the PM limit stated it was only because they had already made irreversible commitments to controls, some of which are in the context of consent orders with EPA.

Attachment A EPA Information on the Technical Implications of the NESHAP PM Limit

This PCA paper outlines the ways in which a different PM limit will affect the selection of controls for PM, HCl, mercury and THC. EPA's own analyses in support of the NESHAP rule are consistent with this assessment. EPA's "Summary of Environmental and Cost Impacts of Final Amendments to Portland Cement NESHAP" states:

- Because of emissions variability, a unit needing to comply with 0.04 lbs/ton clinker via CEMS must be designed to meet 0.02 lbs/ton clinker in a stack test. (New data shows that the variability is even greater and suggests a still larger margin is needed.)
- EPA notes that a number of existing baghouses cannot meet the 0.04 lbs/ton clinker standard. EPA identifies the use of membrane bags as a possible solution. EPA estimates the cost of retrofitting membrane bags at over $1 million per baghouse.
- Further, EPA notes that the compliance strategy for all four pollutants involves changes to the PM controls. Here is an excerpt from a table in that report where the expected controls are listed:

Regulated HAP and Appropriate Add-On Control Devices HAP	Control Device
Mercury	Wet scrubber ACI w/polishing baghouse
THC /Organic HAP	ACI w/polishing baghouse RTO (preceded by wet scrubber)
HCl	Wet scrubber Lime Injection
PM	Baghouse

(Note that lime injection is also dependent on dust removal downstream of the lime injection.)

Attachment B: Survey Results Summary

NESHAP PM Control Strategy Implications of a Relaxation in the PM Limit	Kilns with ESPs	Clinker Cooler and By-pass Stacks with ESPs	Kilns with Baghouses[6]	Clinker Coolers and By-pass Stacks with Baghouses
• No Change in PM Compliance Strategy Contemplated	7	4	38	41
• Keeping Current PM Control System, With Modification, Instead of Replacement Now Contemplated	9	3	9	5
• Changing Design of Anticipated Upgrade or Avoiding Upgrade Now Contemplated	2	0	21	18
• Changing Design of Replacement Now Contemplated	3	1	3	3
Total[7]	21	8	71	67

NESHAP Control Strategy Implications of a Relaxation of the PM Limit	Number of Kilns	Number of Clinker Cooler and By-pass Stacks
Changes for HCl:		
• Choice of Sorbent/ Scrubber System	2	1
• Change to Type, Rate or Configuration of Sorbent Injection	11	1
• Change to Downstream Systems	10	0
Total	23	2
Changes For Mercury:		
• Change to Design of Sorbent Injection and Collection System	10	1
• Retained ESP Impacts Oxidized Mercury Control	3	0
Total	13	1
Changes For THC:		
• Change to Design of Sorbent Injection and Collection System	2	0
• Change to the Selection of a Control Method	3	3
Total	5	3

Impediments to Early Compliance with HCl, THC and Mercury Limits if PM Limit Compliance Deadline is Deferred	
• PM Upgraded Needed To Handle Sorbent Loading	17
• Changes Cannot be Permitted without PM Upgrade at the Same Time	5
• Layout of Controls, Fans and Ductwork Affected by Necessary PM Control System Design	18

[6] Includes one kiln equipped with both an ESP and a baghouse.

[7] Total reflects the 92 kilns that were surveyed, including 21 with equipped with ESPs and 71 equipped with baghouses.