Sulfuric Acid Mist: Regulating Uncertainties

By Matthew Thurlow*

Sulfuric acid mist, also known as H$_2$SO$_4$ or SO$_3$, is one of the least publicized air pollutants associated with emissions from coal-fired power plants. Long overshadowed by nitrogen oxides, sulfur dioxide, and carbon dioxide, sulfuric acid mist is typically not emitted in the boundary-crossing and globe-altering quantities of the more frequently discussed air pollutants. In the whirlwind of the United States Environmental Protection Agency’s (EPA) recent air regulations of coal-fired power plants including the Mercury and Air Toxics Standards for power plants (MATS), the New Source Performance Standards and the Tailoring Rule for greenhouse gases, and the recently vacated Cross-State Air Pollution Rule, sulfuric acid mist has remained relatively untouched. But EPA’s regulations, which have imposed dramatic

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new emission limits on sulfur dioxide, nitrogen oxides, greenhouse gases, mercury, and hydrochloric acid, are likely to have a significant impact on sulfuric acid mist emission control strategies at coal-fired power plants.  

Although sulfuric acid mist has been recognized as an air pollutant for decades, it only emerged as a significant problem for the utility industry in the early 2000s. In 2001, after the General James M. Gavin Power Plant installed a type of nitrogen oxide controls called selective catalytic reduction devices (SCRs), sulfuric acid mist emissions unexpectedly spiked from 9000 to 11,000 pounds per day to allegedly more than 64,000 pounds per day. In Cheshire, Ohio, a small village of 200 people in the shadow of the Gavin plant, residents reported asthma-like symptoms and noted corrosion and discoloration of paint on cars and houses, as blue plumes of sulfuric acid periodically drifted through the village. The owner of the plant, American Electric Power (AEP),...
eventually paid $20 million to buy out most of Cheshire. A decade later, the village remains mostly empty.  

The utility industry responded to the Gavin incident by investing significant time and money to study the sulfuric acid mist problem. EPA has also responded by paying closer attention to sulfuric acid mist from power plants and bringing a handful of sulfuric acid mist enforcement actions. Current and future enforcement cases involving sulfuric acid mist pose a number of challenges. In cases brought under the Clean Air Act’s (CAA) Prevention of Significant Deterioration of Air Quality (PSD) Program, utility companies, regulators, and courts may struggle to determine what emissions limits and controls are required for sulfuric acid mist. This struggle is based on uncertainties about the precise conditions under which sulfuric acid mist forms, how it can be controlled, how emissions can be monitored, and most importantly, at what emissions levels it poses a threat to human health and the environment.

The Gavin incident and subsequent studies have dramatically improved the utility industry’s understanding of sulfuric acid mist. Sulfuric acid mist emissions strongly correlate with the sulfur content of coal: the higher the sulfur content, the higher the sulfuric acid mist emissions. But the precise circumstances that result in the formation of sulfuric acid mist have been much more difficult to unravel. Experts believe that vanadium and other constituents in coal may increase sulfuric acid mist formation. In addition, boiler design and oxygen levels in the flue gas appear to influence sulfuric acid mist formation. High temperatures in boilers increase the formation of sulfuric acid
mist with the mist forming at the highest levels in a temperature band above approximately 800 degrees. Finally, ambient conditions, including wind and water content in the air, also influence sulfuric acid mist formation and its impacts. This means that even if all other factors remain constant, weather conditions may result in higher or lower ambient concentrations and can increase the risk of human exposure to sulfuric acid mist.

The uncertainties and complexities associated with sulfuric acid mist are further compounded by its relationship to other pollutants. Most troubling, as discovered at the Gavin plant, there is a clear relationship between the use of SCRs to reduce nitrogen oxide emissions and increases of sulfuric acid mist. A study of power plants equipped with SCRs found that 98 percent of the plants were expected to emit sulfuric acid mist at levels above 5 ppm, a level that might result in environmental impacts. But enforcement actions brought against plants that have installed SCRs raise the troubling specter of potentially penalizing utilities for their efforts to reduce their environmental impact. In exercising enforcement discretion, regulators may be forced to balance the need to reduce nitrogen oxides and their regional impacts with the need to protect communities from the more localized impacts of sulfuric acid mist. And as with any pollutant from power plants, industry, government, and the public must weigh the environmental and health benefits of sulfuric acid mist control on one side, versus energy supply and demand and the potential increased cost of electricity on the other. This Article briefly outlines the scientific and legal complexities facing the utility industry and environmental regulators in developing sulfuric acid mist control strategies. Next, it compares the economic and environmental tradeoffs of different control strategies. Finally, it recommends control strategies that provide the utility industry operational flexibility while ensuring that human health and the environment are protected from sulfuric acid mist and recognizes that there may not be a one-size-fits-all solution to reduce sulfuric acid mist emissions at power plants.

12. See EPRI, SO Mitigation Guide Update, supra note 6, at 1-4, 1-5.
15. See Murphy, SO Control, supra note 11.
16. Facilities that installed SCRs prior to 2005 and otherwise complied with the applicable provisions can argue that the pollution control project exemption to New Source Review applies. See 40 C.F.R. § 52.21. Although the pollution control project exemption has been vacated by the D.C. Circuit, the decision does not apply retroactively. See New York v. EPA, 413 F.3d 3 (D.C. Cir. 2005).
I. REGULATING SULFURIC ACID MIST UNDER THE CLEAN AIR ACT

A. Prevention of Significant Deterioration Provisions

One of the most important avenues for regulating sulfuric acid mist under the CAA is through the New Source Review (NSR) program. Under NSR, major new and modified stationary sources in areas that are unclassifiable or that meet the National Ambient Air Quality Standards (NAAQS) are subject to PSD permitting. Notwithstanding certain exceptions, NSR and PSD are triggered either by new construction, or a physical change or change in the method of operation of an existing facility that results in a significant net increase of emissions of a pollutant. The threshold for “significant increase” varies by pollutant. For sulfuric acid mist, the threshold is an increase of 7 tons per year. Facilities subject to the PSD program must submit a PSD permit to the permitting authority and implement Best Available Control Technology (BACT) for each regulated pollutant. Thus, unless an exception applies, any power plant that makes a physical or operational change to its plant resulting in

17. Unlike the criteria air pollutants, there are no NAAQS for sulfuric acid mist. Because sulfuric acid mist always falls within an unclassifiable area, the prevention of significant deterioration (PSD) permitting program applies to new and modified major sources that emit sulfuric acid mist. See Coalition for Responsible Regulation, Inc. v. EPA, 684 F.3d 102; 2012 U.S. App. LEXIS 12980 (D.C. Cir. 2012). In Coalition, the D.C. Circuit rejected Petitioners’ arguments that greenhouse gases were not subject to PSD because they are not air pollutants emitted from major emitting facilities. Id. at *64, 72–85 (“EPA’s interpretation of the CAA requires PSD and Title V permits for stationary sources whose potential emissions exceed statutory thresholds for any regulated pollutant—including greenhouse gases. . . .[G]iven both the statute’s plain language and the Supreme Court’s decision in Massachusetts v. EPA, we have little trouble concluding that the phrase “any air pollutant” includes all regulated air pollutants, including greenhouse gases.”).

18. In the Gavin matter, the non-profit Citizens Against Pollution (CAP) brought a case against the Ohio Power Company (a subsidiary of AEP) under the Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and Emergency Planning and Community Right to Know Act (EPCRA). It appears that the non-profit brought these claims because U.S. EPA and the Ohio EPA entered into a memorandum of agreement with the power plant to reduce sulfuric acid mist emissions and CAA claims were barred. See Opinion and Order, Citizens Against Pollution v. Ohio Power Co., No. C2-04-CV-371 (S.D. Ohio 2007) (“OPC took measures to correct the situation, including, inter alia, implementing air testing and entering into an Memorandum of Agreement with the United States Environmental Protection Agency and the Ohio Environmental Protection Agency.”).


20. While there is little doubt that a significant project like the installation of nitrogen oxide pollution controls can be construed as a physical modification of a power plant, it is less clear if minor tweaks to operations trigger PSD. Power plant owners would likely contend that these tweaks were routine maintenance and that the statute’s exception for “routine maintenance, repair, and replacement” applies. 40 C.F.R. § 51:166(b)(2)(iii)(a). A more interesting scenario is a situation in which the power plant has merely switched fuel sources from a low sulfur coal source to a high sulfur coal source. Making this type of switch, for instance, from 1-2 lb/MMBtu coal source to a coal source three to four times higher in sulfur content, would likely dramatically increase emissions of sulfuric acid mist (as well as sulfur dioxide). This scenario might seem an obvious trigger of EPA’s PSD program because it would appear to be a change in the method of the plant’s operation, but there is a specific carve-out in the PSD program for fuel switches. A fuel switch exception applies to the use of an alternative fuel that a source “was capable of accommodating before January 6, 1975.” 40 C.F.R. § 51:166(b)(2)(iii)(e)(1); see also Hawaiian Elec. Co., Inc. v. U.S. EPA., 723 F.2d 1440, 1448 (9th Cir. 1984) (citing 1979 EPA determination that “an increase in sulfur content does not constitute use of an ‘alternative’ fuel”).
an increase of sulfuric acid mist emissions of more than 7 tons a year must obtain a PSD permit and apply BACT to limit sulfuric acid mist emissions.

**B. Best Available Control Technology**

BACT is an emissions limit “based on the maximum degree of reduction of each pollutant subject to regulation under” the CAA “on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs,” that the permitting authority “determines is achievable.”21 EPA recommends, and most permitting agencies apply, a top-down BACT analysis that ranks all available control technologies for a regulated pollutant in descending order of effectiveness.22 Following this approach, the most stringent control alternative is selected unless technical considerations, energy, environmental, or economic impacts lead the permitting authority to conclude that it is not “achievable.”23 Because BACT is assessed on a case-by-case basis, it may differ significantly from one power plant to another power plant.

**C. Control Technology Available for Sulfuric Acid Mist**

One of the most effective control options for sulfuric acid mist is a wet electrostatic precipitator (WESP), a particulate control device that removes particles, including sulfuric acid mist, from flue gas by using an electrostatic charge.26 WESPs are extremely efficient at removing sulfuric acid mist, but

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they can cost $50 million to $200 million and require a significant amount of energy, up to 0.5 percent of the plant’s gross output, to operate.\textsuperscript{27} Because BACT analyses require economic assessment of control options, including a calculation of removal costs on a per ton basis, utilities may effectively argue that a WESP is not required under BACT if the amount of sulfuric acid mist removed is less than several thousand tons per year. There is no bright-line rule for per ton removal costs under BACT, but costs above five or six thousand dollars per ton for controls have been referenced as approaching the upper limit of the threshold of economically feasible technology required under BACT.\textsuperscript{28}

The current preference of the utility industry for sulfuric acid mist control appears to be sorbent injection, an option that is much more economical than WESPs in the short term. Dry sorbent injection uses nozzles to spray a dry powder, typically magnesium, lime, or trona (a sodium-based mixture), into the flue gas.\textsuperscript{29} The sorbent binds with the sulfuric acid mist and removes it from the flue gas stream. But there are limits on the use of sorbent control. Excessive use of sorbents can clog equipment, so power plant engineers may need to experiment with different levels of sorbent injection. They may also need to balance sorbent injection with other control methods, including configuration changes that increase the amount of time sulfuric acid mist remains in the

\textsuperscript{27} The costs of a WESP are highly plant-specific and depend on plant size and configuration. The cost of capital projects for power plants is typically expressed as a function of cost per kilowatt of energy. The estimated capital costs for WESP’s range from $20 to $45 per kilowatt, which, for a 2500 megawatt power plant, would translate to a cost of $50 million to $112 million. See John Caine & Hardik Shah, Membrane WESP – A Lower Cost Technology to Reduce PM 2.5, SO\textsubscript{3} & HG\textsuperscript{+2} Emissions (2006), http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/AQIV-Caine.pdf (last visited Aug. 17, 2012); see also Gary M. Blythe, et al., Economic Comparison of SO\textsubscript{3} Control Options for Coal-Fired Power Plants, NETL.DOE.GOV. (Nov. 25, 2003), http://www.netl.doe.gov/technologies/coalpower/ewr/pm_emissions_control/pubs/SO3%20Control%20Options%20for%20AQ%20IV.pdf (last visited Sept. 1, 2012). Blythe estimates that the capital costs to retrofit a plant and install a WESP would be $40 to $90, for a total cost of $100 to over $200 million for a 2500 megawatt power plant.

\textsuperscript{28} Because BACT determinations are made on a case-by-case basis, there is no bright line rule regarding the economic feasibility of per ton pollutant removal costs. See Brandon A. Mogon, The BACT Analysis Guide: Cost Analysis Considerations, THE BACT ANALYSIS GUIDE, (Oct. 23, 2009), http://bactanalysis.com/bact-analysis/the-bact-analysis-guide-cost-analysis-considerations (“Each regulatory agency has a different opinion about the maximum economically feasible cost effectiveness value, and many (e.g., CTDEP) will not tell you what that value is.”). But some states have provided guidance that the general rule of thumb for the upper bound of economic feasibility for per ton reduction of pollutants approaches $4,000 to $6,000. See, e.g., MASS. DEP’T OF ENVTL. PROT., Best Available Control Technology Guidance 6 (June 2011), available at http://www.mass.gov/dep/air/approvals/bacguid.pdf; NEB. DEP’T OF ENVTL QUALITY, Best Available Control Technology, http://www.deq.state.ne.us/Publica.nsf/e4afce1e3f6ee077e11862568770059b/3f60944822f884b8e1862573bd007da9e9OpenDocument; UTAH DEP’T OF ENVTL QUALITY, Best Available Control Technology, http://www.airquality.utah.gov/Permits/FORMS/Form01b.pdf. Maximum removal costs should, in theory, relate to pollutants’ proportional threat to the environment and human health with more harmful pollutants having a higher cost per ton threshold of feasibility under BACT than more innocuous air pollutants.

\textsuperscript{29} See EPRI, Estimating Total Sulfuric Acid Emissions from Stationary Power Plants, supra note 14, at 3-6.
The longer the residence time for sulfuric acid mist in the stack, the more opportunity the sulfuric acid mist has to bind with sorbent. Facilities can also maximize sulfuric acid mist control if they mill sorbent into smaller particles that increase the surface area of sorbent and improve its potential to capture sulfuric acid mist. However, even with these measures, there remains a saturation point beyond which increasing the amount of sorbent injected will not further reduce the amount of sulfuric acid emissions. Other plant improvements, including installation of low catalyst SCRs, which reduce, but do not eliminate the impacts of SCRs on sulfuric acid mist formation, or switching or blending fuel with low or medium sulfur content coal, may be used to supplement sorbent injection.

Baghouses, which are large filters designed to capture soot and other particulates, can also reduce sulfuric acid mist emissions. One study indicates that baghouses can remove up to 90 percent of sulfuric acid mist. As with WESPs, however, installing baghouses can be a significant capital expenditure. Utilities may balk at the expense and argue that the technology is not economically feasible under a BACT analysis.

Improvements in sorbent control may be increasing regulators’ and industry’s confidence that sorbent injection, while not achieving the same reductions in sulfuric acid mist as WESPs, can reduce sulfuric mist emissions to levels that are sufficient to protect human health and the environment at a fraction of the cost. The effectiveness of sorbent injection, however, may

30. See EPRI, SO$_3$ Mitigation Guide Update, supra note 6, at 1-7, 2-13, 4-2; see also EPRI, SO$_3$ Mitigation: Current Utility Operating Experience A19 (2006).

31. Residence time is the amount of time that sorbent is present in the gas stream and has an opportunity to bind with sulfuric acid mist and form a precipitate. Injecting the sorbent before the electrostatic precipitator also increases residence time. See Douglas Ritzenhauer, SO$_3$ Control: AEP Pioneers and Refines Trona Injection for SO$_3$ Mitigation, COAL POWER MAGAZINE (Mar. 1, 2007), http://www.coalpowermag.com/plant_design/SO3-Control-AEP-Pioneers-and-Refines-Trona-Injection-Process-for-SO3-Mitigation_29.html; EPRI, Estimating Total Sulfuric Acid Emissions from Stationary Power Plants, supra note 14, at 3-6, 4-19.

32. See EPRI, SO$_3$ Mitigation: Current Utility Operating Experience, supra note 30, at 3-19 (“Performance testing completed by the manufacturer of the catalyst actually showed less than 0.1 percent SO$_3$ conversion to SO$_2$ from three different reactor tests.”).

33. See EPRI, SO$_3$ Mitigation Guide Update, supra note 6, at 2-19 (noting that the effectiveness of fuel blending can be difficult to predict, but one facility reduced its sulfuric acid mist emissions to zero by switching to low sulfur, Powder River Basin coal). The economics and cost effectiveness of switching coal can be very site-specific because switching or blending fuels depends on long-term coal contracts, coal availability, and other plant-specific factors. Id.; see also Gary M. Blythe et al., SO$_3$ Control Options for Coal-Fired Power Plants, supra note 27, at 2.


36. See EPA Air Pollution Control Cost Manual supra note 34, at 1-1.

37. Despite their high operation and maintenance costs, WESPs may compare more favorably with sorbent injection over the long-term, especially if used year-round. See EPRI, SO$_3$ Mitigation Guide Update, supra note 6, at 3-37.
depend on proper calibration and maintenance of sorbent injection rates over time and a consistent fuel source. If these inputs are not constant, sulfuric acid mist emissions could spike. To mitigate the possibility of fluctuations in sulfuric acid mist emissions, operators need to build in some compliance headroom by ensuring that day-to-day emissions of sulfuric acid mist are marginally lower than levels that could result in opacity problems or violate permit limits. Once a control strategy has been adopted, power plants and enforcement authorities need to monitor the effectiveness of the controls over time and in different operating scenarios. Some power plants may need to continue to experiment with a variety of controls to find a solution that provides the best balance of sulfuric acid mist reduction, control of other pollutants, and power plant performance.

D. Opacity Violations

The appearance of the tell-tale blue plume of sulfuric acid mist from the stack of a power plant often indicates a different violation of the CAA. In addition to, or in lieu of, claims brought under the CAA’s PSD provisions, EPA may bring claims against power plant owners and operators for opacity violations under the Act’s New Source Performance Standards (NSPS) (Section 111 of the Act) or the applicable State Implementation Plan. Opacity means the degree to which emissions reduce the light and obscure the view of an object in the background.” 40 CFR § 63.2. At 100 percent opacity, no light is visible through a plume. At zero percent opacity, a plume is completely transparent. While opacity is not itself a pollutant, it serves as a surrogate for particulate matter pollution, including sulfuric acid mist pollution, from power plants.

The NSPS for fossil-fuel-fired steam generators provide that, for power plants constructed after August 17, 1971, gases emitted from the facility cannot “exhibit greater than 20 percent opacity except for one six-minute period per hour of not more than 27 percent opacity.”40 For facilities not subject to the NSPS (built prior to August 1971), opacity limits can vary depending on the applicable State Implementation Plan. In Kentucky, for example, facilities are not to exceed 40 percent opacity except for one six-minute period per hour of not more than 60 percent opacity.41 In Texas, older facilities cannot exceed 30 percent opacity averaged over a six-minute period.42

Opacity problems associated with sulfuric acid mist can occur with emissions as low as 3-4 ppm.43 The utility industry reports that sulfuric acid mist...
mist concentrations of only 10 ppm can result in opacities greater than 40 percent, the upper opacity limit for many older power plant units.44 Other industry guidance indicates that opacity problems can occur at sulfuric acid mist concentrations above 5-15 ppm.45 The impacts of sulfuric acid mist emissions on stack opacity can fluctuate depending on operating conditions. Opacity monitors can provide accurate opacity data and send an immediate warning to plant operators if limits are exceeded. But many power plants have had to install wet scrubbers to address sulfur dioxide emissions, which makes it difficult or impossible to monitor opacity within their stacks. As a result, many plants have either removed their opacity monitors or replaced them with particulate monitors. Continuous sulfuric acid mist monitors, which would best address the current monitoring problem, are still under development.46

As a result of the unavailability of effective monitoring devices for sulfuric acid mist, in many instances the only method to determine opacity at a power plant is through visual observation of the plume. Method 9 readings, which rely on the judgment of a trained inspector, are the most common method of visual opacity assessments.47 Although inspectors are typically experienced and well trained, Method 9 is subject to judgment, memory, and the human eye.48 Inspectors record 24 consecutive observations (typically in six-minute increments) and average the results. An accurate opacity test requires ideal weather conditions because the plume cannot be clearly observed on cloudy days. The difficulty and uncertainty associated with visual opacity readings are a cause for concern for both regulators and the industry.49 On the one hand, regulators have to undertake opacity readings onsite and in clear

44. See EPRI, SO3 Mitigation Guide Update, supra note 6, at 1-3.
45. See EPRI, SO3 Mitigation: Current Utility Operating Experience, supra note 30; EPRI, Estimating Total Sulfuric Acid Emissions, supra note 14, at 3-7 (“The alkali injection system usually is operated to reduce SO3 emissions to between 5 and 15 ppm, an optimal range to prevent formation of a visible plume”); SO3 Mitigation Guide Update, supra note 6, at 1-8 (providing that flue gas concentrations of sulfuric acid mist of 10 ppm can result in plume opacities above 40 percent).
46. See Pastore, Continuous SO3 Monitoring Can Reduce Sorbent Consumption, supra note 3.
48. Method 9 inspectors are trained and recertified every six months at “smoke school,” in which they observe white and black smoke plumes from a stack with opacity monitoring equipment. As part of their training, inspectors are tested on their ability to recognize different opacity levels of smoke plumes. See, e.g., SMOKE SCHOOL, INC., http://smokeschoolinc.com (last visited Aug. 13, 2012); EASTERN TECHNICAL ASSOCIATES, VISIBLE EMISSIONS OBSERVER TRAINING MANUAL (Aug. 2004), http://www.eta-is-opacity.com/E.T.A._VE_manual.pdf.
49. See National Parks Conservation Assoc., Inc. v. TVA, 175 F. Supp. 2d 1071, 1079 (E.D. Tenn. 2001) (“Obviously, monitoring the smokestack emissions continuously with equipment capable of reliably measuring the opacity will identify many more exceedances than will be identified by an operator ‘eyeballing’ the smokestack emissions once a day, or less.’’); Sierra Club v. Public Service Co of Colorado, 894 F. Supp. 1455, 1459-60 (D. Colo. 1995) (citing the “relative reliability of CEM data over Method 9 data”).
weather to document opacity violations. On the other hand, an opacity reading made by a regulator visually assessing real time emissions from memory is difficult for a defendant to refute.

If a pattern of opacity violations at a power plant can be established, EPA or state environmental authorities may argue that significant controls are required to eliminate the visible sulfuric acid mist plume. Enforcement authorities may obtain civil penalties for each day a plant exceeds opacity limits, or obtain significant injunctive relief that, in some cases, approaches a BACT-like remedy.

II. HUMAN HEALTH AND THE ENVIRONMENT AND EMISSIONS LIMITS

Perhaps the thorniest issue with regard to regulating sulfuric acid mist is determining at what levels emissions of sulfuric acid mist threaten human health and the environment. Studies indicate that sulfuric acid mist can impact the health of children with asthma at 70 micrograms per cubic meter, and can impact normal adult lung function at 100 micrograms per cubic meter. The impact on health, however, is a function of exposure duration, individual sensitivity, and exposure to other air contaminants.

In the early 2000s, toxicologists from the Agency for Toxic Substances and Disease Registry evaluated the impacts of sulfur dioxide and sulfuric acid mist on the village of Cheshire, Ohio, near the Gavin power plant, and concluded that emissions posed a public health hazard to some residents. The highest officially recorded levels of sulfuric acid mist in Cheshire were approximately 120 micrograms per cubic meter of air, but there were unofficial reports of levels as high as 200 micrograms per cubic meter of air. It was difficult for investigators to determine the duration of individual exposure to sulfuric acid mist, but exposures ranged from several minutes to several hours. Residents in Cheshire were also exposed to high levels of sulfur dioxide and metal oxide particulates and investigators indicated that the presence of these and other co-contaminants might also have had health impacts.

Following the lawsuit brought by Citizens Against Pollution, AEP agreed to emissions limits of 14 ppm of sulfuric acid mist at the Gavin plant. By comparison, in the only settled case to date in which EPA has directly addressed sulfuric acid mist, involving the Hoosier Energy Company, the parties agreed to limits of approximately 2.5 ppm (.007 lb/mmBTU). But this

50. See AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY, HEALTH CONSULTATION, GAVIN POWER PLANT 12 (Apr. 2007).
51. Id. at 16.
52. Id. at 5–6.
53. Id. at 5.
54. Id. at 13.
55. The Hoosier settlement included a limit of .007 lb/mmBTU, but provided Hoosier with the option to petition for a lower limit. However, the limit could not be lower than .009 lb/mmBTU. See U.S. ENVTL. PROT. AGENCY, Consent Decree, U.S. v. Hoosier Energy Rural Elec. Coop., Inc. (S.D. Ind.
limit was only one part of a larger settlement that required a number of significant improvements to the facility at a total cost of $250 million to $300 million. Additionally, Hoosier had a lengthy compliance period, almost two years, to meet the sulfuric acid mist emissions limit, and an additional year before it was subject to stipulated penalties to meet these limits.

Although there appears to be some consensus in the utility industry that emissions of sulfuric acid mist above 5 ppm may result in opacity problems, many power plants may be disinclined to agree to similarly low limits. This hesitation is in part a function of the difficulty of measuring sulfuric acid mist. Although there is an accepted EPA methodology for stack testing for sulfuric acid mist, the industry has expressed concern that this method does not provide accurate results. Sulfuric acid mist emissions also may fluctuate between stack tests. While sorbent controls may ensure compliance with a 5 ppm limit most of the time, ambient conditions or variations in fuel could result in higher emissions. Both EPA and the industry are concerned that no continuous emissions monitoring device is commercially available for sulfuric acid that has the requisite sensitivity to detect changes of less than 1 ppm in the stack.

In the absence of recurrent, visible opacity problems, power plants may remain unaware of the potential significance of sulfuric acid mist emissions until stack testing can be performed, at a relatively high cost, on a quarterly or biannual basis. Infrequent stack tests threaten both utility operators and regulators. Utility operators may worry that one high stack test could be used as evidence of continuous non-compliance with emissions limits, while regulators may be concerned that stack tests do not provide adequate monitoring of sulfuric acid mist emissions and could fail to identify non-compliant facilities.

III. UNCERTAINTY AND BALANCING

As EPA seeks more stringent regulation of other air pollutants, the utility industry and regulators will need to keep close tabs on sulfuric acid mist emissions. Perhaps the most vexing problem for regulators and industry alike is the uneasy relationship between sulfuric acid mist control and control of nitrogen oxides. A significant sulfuric acid mist problem first emerged, at Gavin and elsewhere, with the adoption of SCRs used to reduce nitrogen oxide emissions.


58. Id. EPA uses EPA Method 8 to test for sulfuric acid mist. The utility industry prefers the controlled condensate system method because it claims EPA Method 8 results in a positive bias for detection of sulfuric acid mist. See id. at 2-1; 3-7.

59. See Murphy, SO3 Control, supra note 11.
emissions. When SCRs are combined with high-sulfur coal, as they were at the Gavin plant, sulfuric acid mist emissions can increase dramatically.

In response to the now decade-old problem with SCRs, the utility industry developed low-acid conversion catalysts that reduce the sulfuric acid conversion rate. But SCRs still involve a trade off with generally higher emissions of sulfuric acid mist. Power plants have sought to compensate for the higher sulfuric acid mist emissions with many of the control technologies described above, but several of these strategies, including WESPs and baghouses, may not be economical if used solely to control sulfuric acid mist. Sorbent injection, while typically the most economically feasible control method for sulfuric acid mist in the short term, may be insufficient to control very high levels of sulfuric acid mist emissions.

Following the recent regulations for hazardous air pollutants, including mercury and acid gases, power plants may increasingly turn to sorbent injection. The need to control mercury and acid gas may have a positive impact on sulfuric acid mist control because power plants may not only invest in superior sorbent injection systems, but may also install baghouses that increase the effectiveness of sorbent controls. Additional controls that target sulfur dioxide, including scrubbers, should also serve to reduce sulfuric acid mist emissions.

In the current regulatory landscape, optimizing the performance of coal-fired power plants and ensuring that they run efficiently within permit limits is increasingly difficult. Finding the operational “sweet spot” at power plants may require a significant investment of time and money. In order to reduce sulfuric acid mist emissions and balance other regulatory requirements, enforcement authorities and the utility industry must develop control strategies tailored to individual power plants. Regulators must allow time for calibration of sulfuric acid mist and other air pollutant control strategies and stack testing. For their part, plant operators must think ahead and consider the impacts of implementing control schemes for multiple pollutants. In an environment of regulatory uncertainty, it may be worthwhile for the utility industry to consider adopting conservative control strategies with multi-pollutant control benefits that increase operational flexibility, reduce the risk of future non-compliance, and anticipate the possibility of stricter, long-term emissions limits. The high costs of control equipment, complex maintenance and operation schedules of

60. See Sarunac, *Power 101*, supra note 13 (indicating that high oxidation catalysts in an SCR can double the concentration of sulfuric acid mist in flue gas; low conversion catalyst significantly reduce sulfuric acid mist conversion).
62. The MATS for power plants sets numerical limits for mercury emissions, other hazardous metal emissions, and hydrochloric acid emissions.
63. 77 Fed. Reg. at 9411 (“[T]he EPA agrees that DSI [dry sorbent injection] technology is proven and ready for commercial uses in controlling acid gases from coal combustion.”). As described above, baghouses permit the injection of additional sorbent into the flue gas stream and increase the amount of residence time in which sorbent can bind with air pollutants. WESPs also can be used to control mercury. See John Caine & Hardik Shah, *Membrane WESP*, supra note 27, at 9.
power plants, and threat of future enforcement actions leave little room for trial and error.