

Three Reasons Why Greater Emphasis Should be Placed on Particulate Matter (PM) in Clean Air Initiatives (in addition to SO_x, NO_x, and Mercury).

1. FINE PARTICULATE MATTER (SOOT & FLYASH) CAUSES HUMAN HEALTH PROBLEMS.

Evidence from academic and industry-funded studies indicates that fine PM from coal-fired boilers is causing serious health problems for many Americans:

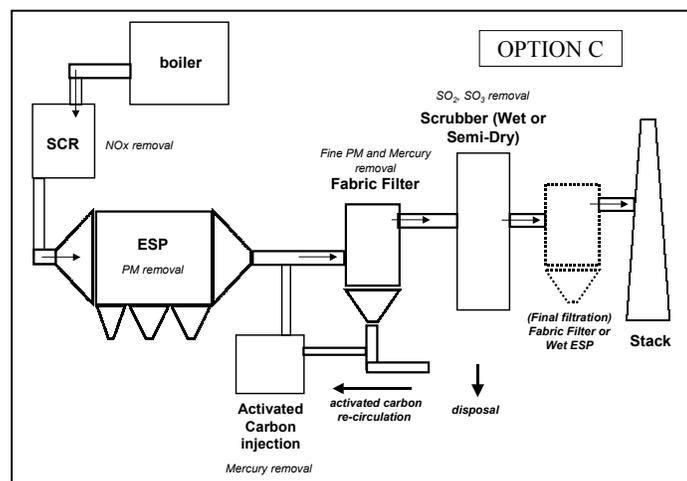
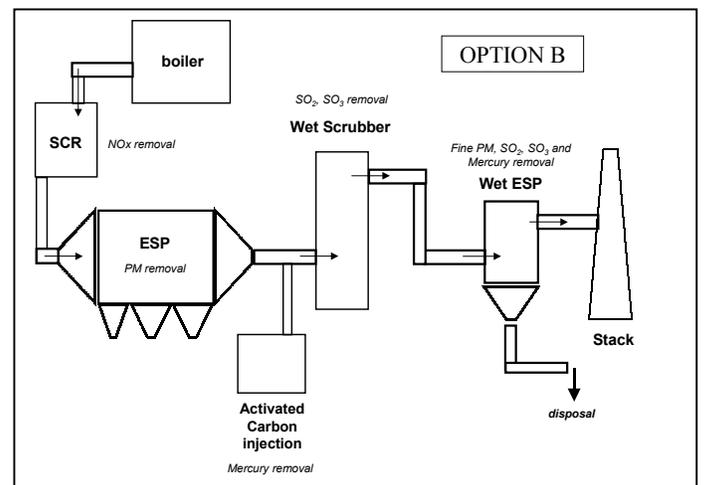
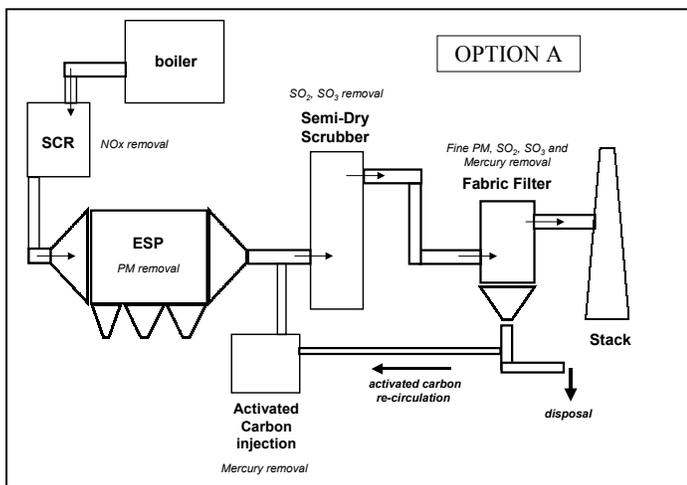
- A 2002 released study by Dr. George Thurston et al.ⁱ of 500,000 people over 16 years showed a strong correlation between PM and nonmalignant cardiopulmonary disease. There is good evidence that PM causes heart attacks and respiratory problems. There is also evidence that links PM with lung cancer. The American Lung Association strongly agrees with this study and has demanded publicly that EPA act more strongly toward PM emission control.
- A 2002 released study by Abt Associationsⁱⁱ projects: 6000 premature deaths, 140,000 asthma attacks, and 14,000 cases of acute bronchitis by 2007 as a direct result from air pollution (including PM) primarily from power plants and vehicles.
- A 2001 released study by Dr. Doug Dockery of Harvard et al.ⁱⁱⁱ linked the onset of heart attacks with times of the day when small PM concentration was the highest in the city of Boston.
- A 2000 released study by Dr. Jonathan Samet^{iv} of Johns Hopkins found a 1% rise in death rate for each small increase of fine PM and a 2-4% increase in hospitalization for the elderly. The correlation was strongest in the Northeast, especially NYC. In response, the Ford Motor Company (a sponsor of the research) said, “We are not arguing with their findings.”
- Another 2000 released study by Dr. Samet et al.^v published in the *New England Journal of Medicine* examined air pollution and mortality in 20 U.S. cities from 1987-94. This study provided evidence that PM less than 10 micron is associated with mortality rates especially due to cardiovascular and respiratory illness. Important quotes from the study:
 - “There is consistent evidence that the levels of fine particulate matter in the air are associated with the risk of death from all causes and from cardiovascular and respiratory illnesses. These findings strengthen the rationale for controlling the levels of respirable particles in outdoor air.”
 - “Levels of other pollutants [i.e. SO_x and NO_x] were not significantly related to the mortality rate.”
- A 2000 released study by Jonathan Levy of Harvard et al.^{vi} studied the public health impact of two cities which each had a coal-fired power plant vs. cities without a power plant. In the cities with a power plant, there were more premature deaths, more emergency room visits, more asthma attacks, and more upper respiratory symptoms. The health risks were the highest among people living closest to the power plants.
- A 1999 press release^{vii} announcing that the U.S. Dept of Justice, on behalf of the EPA, was suing 7 power utilities states that, “Breathing high concentrations of PM can damage lung tissue and contribute to cancer and respiratory disease.”
- A 1995 released study by Dr. Arden Pope^{viii} found links between small PM (<2.5micron) and mortality rates. This study was instrumental in the 1997 promulgation of PM_{2.5} rulings
- Summaries of numerous other PM related studies can be found courtesy of the American Lung Association website.^{ix}
- Several studies (cited above) have shown that particles less than 2.5 micron but larger than 1 micron are the most problematic for human health. These 1-2 micron particles can penetrate deeply into the alveoli and are not coughed up. Larger particles do not make it past normal defense mechanisms and extremely tiny particles simply exhaled. Some researchers believe 1-2 micron black soot and flyash particles can stay in the body for up to 4 years.

2. FOR EVERY DOLLAR SPENT ON PM CONTROL, EXPECT UP TO \$10 BENEFIT IN HEALTH CARE COSTS

The EPA has estimated that compliance with the 1997 PM_{2.5} standards will cost industry about \$10 billion/yr. This will result in health benefits estimated at \$20 - \$100 billion/yr. Therefore, the benefit-to-cost ratio of tighter PM controls is 2 – 10 times. Also, the EPA has estimated the health benefits of controlling particulate from diesel engines to be around 17x the costs. Since the human health impact of particulate from diesel engines and power plants is similar, we should expect similar (17x) benefit-to-cost ratios.

3. PROVEN CONTROL TECHNOLOGY IS AVAILABLE AND COST-EFFECTIVE TO REMOVE FINE PM.

- A recent study by Cambridge Energy Research Associates discovered that to meet proposed emissions legislation for PM_{2.5}, it would cost utilities less than \$45 per kW. This is less than half the cost to control SO_x emissions (\$100 per kW) and 65% of the cost for NO_x emissions control (\$70 per kW). Numerous control options exist (see “Technologies” at www.icac.com).
- Most coal-fired power plants use an electrostatic precipitator (ESP) to collect flyash. ESPs are very efficient at collecting larger (>2.5 micron) and extremely small (<1 micron) dust particles. ESP upgrades/rebuilds (i.e. new voltage controls, mechanical parts) can have a positive impact on fine particulate collection efficiency.
- Another solution is to install a fabric filter collector downstream of the existing ESP. The fabric filter collector, using ePTFE (a.k.a Teflon[®]) membrane filter technology, provides 99.99% collection efficiency and compliments the existing equipment by capturing the hard-to-collect 1-2 micron particles.
- An economical and efficient way to collect SO₂ and SO₃ is by using a semi-dry scrubber in conjunction with a membrane fabric filter collector. The Sulfur Oxides combine with injected lime to form small particles that are collected in the fabric filter. (see Option A)
- A “wet” system, consisting of a wet scrubber to remove SO_x and a wet ESP to collect PM is another solution. (see Option B)
- A membrane fabric filter collector can aid in the removal of Mercury by collecting and re-circulating activated carbon that is injected into the gas stream (Mercury adsorbs onto the carbon particles). DOE commissioned testing shows that the most effective commercially available method of capturing Mercury is to use activated carbon injection in conjunction with a fabric filter collector.
 - Option A shows how a fabric filter collector, when placed after the activated carbon injection and a semi-dry scrubber can help remove SO_x and Mercury and also re-circulates the activated carbons (lowering reagent costs).
 - Mercury can also be removed in a wet system, however the reagent cannot be re-circulated. (Option B)
 - Option C shows how a fabric filter collector, when placed after the carbon injection but before a scrubber can provide an effective and economical way to collect mercury and re-circulate the reagent. An important consideration of this scenario is the collection of fine particulate that may be created in the scrubber. To account for this, another fine PM collection device (fabric filter or Wet ESP) may be necessary after the scrubber and before the stack.



Works Cited

ⁱ Pope CA III, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, and Thurston, GD. “Lung Cancer, Cardiopulmonary Mortality and Long-Term Exposure to Fine Particulate Air Pollution.” Accepted for publication in the Journal of the American Medical Association. March 6, 2002.

ⁱⁱ Abt Associates, Inc. (April 2002). “Particulate-Related Health Impacts of Eight Electric Utility Systems.”

ⁱⁱⁱ Mittleman, M., Dockery, D. et al. “Tiny air pollutants linked to heart attack.” Circulation: Journal of the American Heart Association. June 12, 2001.

^{iv} “Research Links Deaths with Pollutants.” New York Times. June 22, 2000. Page A-18.

^v Samet, J. et al. “Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987-1994.” The New England Journal of Medicine. December 14, 2000. Vol. 343, No. 24.

^{vi} Levy, J, Spengler J. et al. “Estimated Public Health Impacts of Criteria Pollutant Air Emissions from the Salem Harbor and Brayton Point Power Plants.” Commissioned by the Clean Air Task Force. May 2000.

^{vii} “U.S. Sues Electric Utilities in Unprecedented Action to Enforce the Clean Air Act.” www.usdoj.gov. November 3, 1999.

^{viii} Pope, C.A., Thun, M.J., Namboodiri, M.M., Dockery, D.W., Evans, J.S., Speizer, F.E., and Heath, C.W. “Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults.” American Journal of Respiratory Critical Care Medicine, 1995.

^{ix} <http://www.lungusa.org/air/wordfiles/pmstudies.doc>