

Bay Area Air Quality Management District
939 Ellis Street
San Francisco, California 94109

APPROVED MINUTES

Advisory Council Technical Committee
1:00 p.m., Wednesday, June 14, 2006

- 1. Call to Order – Roll Call.** Mr. Altshuler called the meeting to order at 1:17 a.m. Present: Sam Altshuler, P.E., Irvin Dawid, John Holtzclaw, Ph.D. Absent: Louise Bedsworth, Ph.D., Robert Bornstein, Ph.D., Chairperson, William Hanna, Stan Hayes.
- 2. Public Comment Period.** There were no public comments.
- 3. Approval of Minutes of April 12, 2006.** The approval of minutes was deferred to the next meeting due to the lack of a quorum.
- 4. Ambient Particulate Matter (PM) and the Evolution of Concern to Ultrafine PM.** Technical Committee member Sam L. Altshuler, P.E., Senior Program Manager, Clean Air Transportation Group, Pacific Gas & Electric, San Francisco, California, stated he would review key information presented at a recent conference on Ultrafine PM held at the South Coast Air Quality Management District.

Mr. Altshuler reviewed the history of PM measurements from the 1950's with the British Smoke measurements to the early category of "Total Suspended Particulates" (TSP) at the level of 50 microns. In the mid-1980's, PM₁₀ was the new fraction of measurement, followed in the 1990's by PM_{2.5}. At the present time, the nanoparticle (nPM) of 1-100 nanometers is getting attention.

The size fraction of measurement has evolved in parallel with the ability to measure smaller fractions of PM. Motivations to assess the impacts of fine PM are due to the greater visibility impairment in blockage of light, the soiling of materials and monuments, and health impacts related to diesel PM, both in terms of chronic effects (cancer, silicosis) and acute effects (asthma and pulmonary symptoms).

Measurement techniques have also evolved over time from 8"x10" filters, impactors with size separation, coefficient of haze, Tapered Element Oscillating Microbalance (TEOM) and beta gauges, particle number counters, Scanning Electron Microscopy(SEM)-(E-Ray Fluorescence)XRF for size and chemistry, and real time sulfate and nitrate monitors.

PM sizes from the primary sources include TSP—wind blown dust, combustion ash and soot; PM₁₀—chiefly sea salt, dust, combustion soot; PM_{2.5}—combustion soot, and atmospherically formed NO₃ and SO₄; and PM_{0.1} and nPM—combustion soot, aerosols (condensed oils and fuels), and atmospherically formed NO₃ and SO₄.

At the South Coast conference, David Kettleson presented a slide showing the interaction between particle count and size of a number of different types of PM from typical engine exhaust, in terms of distribution by mass, number and surface area showing varying health impacts.

Health issues associated with PM have also evolved over time. Many early air pollution studies were conducted as chamber exposure studies. In the 1990's, many epidemiological studies were published. These examined population', morbidity and mortality, and found correlations that linked to PM exposure. However, causality was never established. Other studies argued at that time that extremes of heat and cold could be correlated with similar health effects.

A slide presented at the conference by Dr. John R. Froines addressed the potential pulmonary effects of PM. It showed mitochondria at extreme magnification and revealed how PM is lodged within the interior of the lung cells. Dr. Froines hypothesized that PM causes cardio-respiratory effects because it induces oxidative stress.

Mr. Altshuler added that Dr. Robert Sawyer, Chairperson of the California Air Resources Board (CARB), also gave a noon time presentation at this conference summarizing many aspects being discussed at the conference. He observed that there are health-related findings that ultrafine particles cause greater inflammatory response and greater cellular damage than fine PM. Even though they have less mass than fine PM, ultrafine particles have large surface areas and occur in great numbers. They contain toxic components that can initiate harmful oxidant injury in the lung and have high deposition rates in the lung. They can also access the circulatory system and move from the lungs to other organs.

Dr. Sawyer spoke on the health effects as a function of particle size, with ultrafine PM being the most serious in comparison with coarse and fine PM. With respect to the source distribution of PM, Dr. Sawyer opined that ultrafine PM comes primarily from vehicle exhaust and fuel use. Concentrations of ultrafine PM along freeways with heavy gasoline or heavy diesel traffic are similar. Mr. Altshuler observed that diesel PM is primarily related to the chronic 70-year cancer potential, while the smaller particles are associated with causing more acute symptoms. This has generated some interesting discussion in strategies for mitigating vehicular emissions.

Mr. Altshuler showed a chart that set forth the source contributions to primary ultrafine particle emissions in the South Coast air basin in 1996. Ultrafine particles were found to originate almost exclusively from combustion sources. Another chart assessing the annual average PM₁₀ source contribution in the San Joaquin Valley for large particulates indicated that over one-half derived from fugitive dust, 27% directly from mobile sources, 11% from burning and cooking, 5% from ammonium sulfate, and 4% directly from mobile sources, 11% from wood burning and meat cooking, and 27% from secondary formation from ammonium nitrate.

Taking these data into account, Mr. Altshuler stated he had tabulated the health effects associated with fugitive dust, ammonium nitrate, ammonium sulfate, burning/cooking, and direct mobile sources. The preliminary calculations indicated that the highest risk factor was found in direct mobile sources for both chronic and acute symptoms. At the conference, however, there was no discussion of the possible health effects of ammonium nitrate, and to date no literature on this subject has been published. Wood burning and cooking also showed higher risk factors for acute and chronic pulmonary symptoms.

Mr. Altshuler stated that, at the conference, Charles Stanier presented a chart on how ultrafine PM is formed in the atmosphere throughout the day and found that it greatly resembles the ozone formation plot. A second slide by Stanier showed the formation of ultrafine PM on a cloudy and sunny day in Pittsburgh on November 10 and 11, 2001. The plot also paralleled the plot for ozone formation.

Mr. Altshuler concluded that adverse health effects of PM are determined by the concentration of PM, the potency/unit risk factor of the chemical constituents contained therein, and then the size and number of the particles. He added that controls are separately needed for nPM as well as ultrafine PM in order to complement the reductions in diesel PM. Such controls ought to consider lube oil regulations and its formulation for internal combustion engines.

While no health impacts have been reported to date for PM nitrate, the San Joaquin Valley plans to reduce PM nitrate to attain the PM_{2.5} standard. However, health impacts from nitrogen dioxide (NO₂) are being reported at increasingly lower levels. This should be closely followed along with the evolution of a lower NO₂ standard by CARB.

Mr. Altshuler added that the following anecdotal conclusions are fairly well-known:

- Diesel smoke is linked to chronic health effects (cancer).
- Ultrafine particulates are linked to acute and chronic cardiopulmonary health effects (heart attacks, asthma, etc.).
- Diesel soot seems to adsorb ultrafine PM aerosols.
- Reducing diesel smoke with a diesel PM increases exposure to ultrafine (a tradeoff between cancer and cardiopulmonary health effects) as well as increased NO₂.
- Other lube oil using IC engines can emit ultrafine PM similar to diesel.
- nPM falls off rapidly within 300 meters of a freeway but grows into larger particles as they move away from the freeway.
- Exposure to PM when your respiratory system is compromised exasperates the situation: extreme heat or old does the same.
- The question of second hand cigarette smoke may be related ultrafine PM.
- Meat should be salted after, and not before, it is grilled to reduce dioxin exposure.

Mr. Altshuler stated that ultrafine PM will become an increasingly important issue in the regulation of PM. Mr. Hess added that this will be addressed at the forthcoming Air & Waste Management Association conference.

- 5. Committee Member Comments/Other Business.** Mr. Dawid stated that in recent news articles, a trend toward an increase in diesel fuel vehicles in the fleet has been identified, and this raises serious air quality questions. Mr. Altshuler replied that this also raises issues of greenhouse gas emissions (GHGs), exhaust standards and other regulatory categories. The Council must assess whether or not it has a role to play in assessing the issue of increasing diesel fuel vehicles in the overall vehicle fleet. This could initially be discussed at the Committee level in the future.

6. Time and Place of Next Meeting. 1:00 p.m., Wednesday, August 9, 2006, 939 Ellis Street, San Francisco, California 94109.

7. Adjournment. 2:25 p.m.

James N. Corazza

James N. Corazza
Deputy Clerk of the Boards