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BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

CLEAN **AIR** RESEARCH PROGRAM

RESEARCHERS STUDY CHEMICAL REACTIONS THAT LEAD TO PARTICLE POLLUTION

Issue:

Particulate matter (PM) is an air pollutant that is made up of many different chemical compounds. The specific chemicals in the PM are determined by the pollutant source and even geographic location. While ozone, for example, has the same chemical composition or formula no matter where you find it, PM does not.

PM can be composed of many compounds, including:

- Inorganic compounds such as sulfate, nitrate, and ammonium, and different elements;
- Organic compounds from the incomplete burning of fuels such as wood, gasoline, and diesel fuel; and
- Secondary organic aerosols, or SOAs.

SOAs are created when chemicals from different air pollutants mix and react with one another to form new organic compounds. These new compounds eventually attach themselves to preexisting air particles.

Scientists at the U.S. Environmental Protection Agency are studying the chemistry of PM, particularly the formation of secondary organic aerosols to protect public health. The knowledge can be incorporated into models that are used to estimate air quality and, in turn, the amount of PM that people are exposed to. Researchers are working to learn more about the formation of SOAs, describe or characterize their physical properties, and determine their exact chemical composition when possible.

There are substantial scientific and technical obstacles to studying the formation of organic matter by chemical processes in the atmosphere. Some of the chemical reactions themselves are poorly understood. Because such a large number of organic products form, many have not yet been identified.

In addition, there are hundreds of chemicals present from hydrocarbons emitted into the atmosphere. When they react with one another, they produce thousands of different secondary organic aerosols, making it a challenge to determine even a small fraction of these products. Even measuring the total organic mass without regard to chemical identity represents a significant challenge.

Scientific Objective:

The Clean Air Research Program in EPA's Office of Research and Development is conducting atmospheric chemistry research on the small particles known as $PM_{2.5}$, which are regulated by EPA. The research objective is to

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CLEAN **AIR** RESEARCH PROGRAM

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understand the major processes that produce SOAs and other important components of $PM_{2.5}$.

Atmospheric chemistry also provides critical information to support health studies and research to understand the sources of particle pollution.

Key scientific questions being addressed include:

- What are the main emitted compounds which lead to SOA formation?
- What fraction of the organic matter in PM comes from natural versus human-made sources?
- What atmospheric factors such as temperature and season influence SOA formation and to what extent?

Application and Impact:

For more than a decade, the Clean Air Research Program has provided innovative science in the field of atmospheric chemistry to understand the properties and chemical components of many SOAs.

EPA funded research is changing the way scientists understand and model organic particles and the formation of SOA in the atmosphere. By identifying the largest sources contributing to $PM_{2.5}$ and its precursors, the work enables regulators and air quality managers to create more effective control strategies.

Researchers have also developed instruments and techniques to measure particles and their composition. This leads to an improved understanding of particle sources and formation processes. Health scientists value the new information about particle composition as it guides their own studies.

Atmospheric chemistry research has been used to improve air quality models such as EPA's CMAQ model. One of the model features allows regulators and air quality managers to predict secondary organic aerosol concentrations.

The discoveries are also helping states to develop and implement plans to control particle emissions.

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CONTACT

Contact: Tad Kleindienst, National Exposure Research Laboratory, EPA's Office of Research and Development, 919- 541-2308, kleindienst.tad@epa.gov

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