

AIR

Particulate Matter

General

Particulate matter (PM) is the broad classification of material that consists of either tiny solid particles or fine liquid droplets found in the atmosphere. The particles or droplets have many different chemical compositions, depending on the source of the emissions.

Chemical reactions can occur in the atmosphere to form new chemical compounds or change the form from gases and liquids into solid particles. Globally, natural sources account for the majority of PM. Natural forms of PM include pollen and spores, sea salt, windblown dust from arid areas, volcanic dust, and products of combustion from wildfires. Man-made sources of PM include motor vehicles; utility boilers; industrial boilers; dust from paved and unpaved roads; agricultural, construction, and mining activities; prescribed fires and other forms of open burning; as well as fugitive emissions from industry. PM is directly emitted into the air by processes such as combustion, incineration, construction, mining, metal smelting, metal processing, and grinding. Particles formed in the atmosphere by condensation or the transformation of emitted gases such as SO₂ and VOCs are also considered PM.

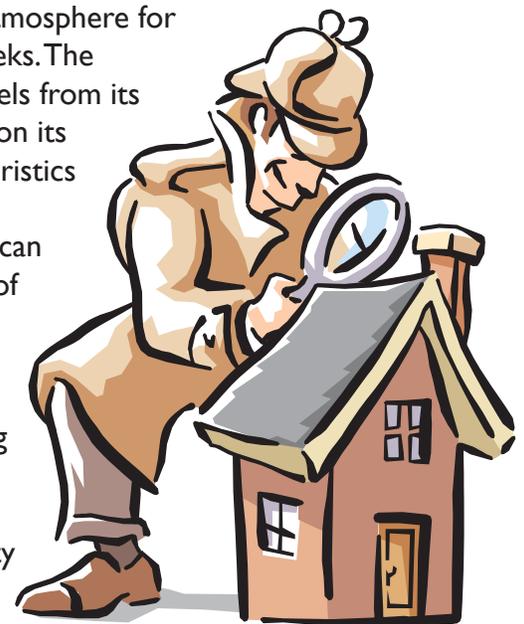
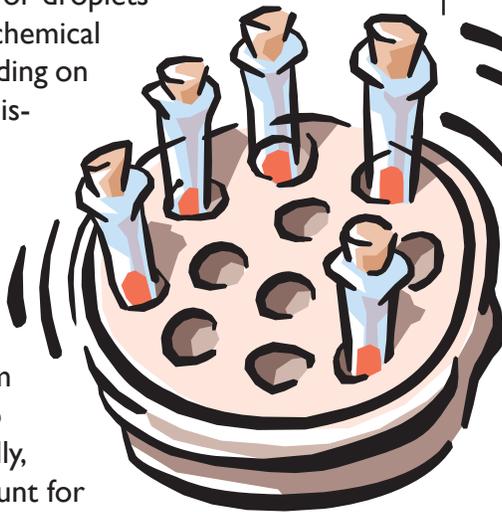
Particulates range in size from less than 0.1 μm to 50 μm. Particles larger than 50 μm tend to settle out of the air. Particles larger than 10 μm are usually fugitive dust blown by winds from roadways, fields, and construction sites. Particulate matter 10 μm in diameter and smaller is called PM-10 and is consid-

ered inhalable. Particles less than 10 μm present a health risk because they are fine enough to enter the respiratory system and may become lodged in the tiny sacs of the lungs. Particulate matter 2.5 μm in diameter and smaller is called PM-2.5.

PM-2.5 are major contributors to visibility-related problems in both urban and rural areas. The haze, which obscures the clarity, color, texture, and form of what we see, is caused by the presence of particles in the air. In essence, visibility impairment is a complex problem caused by tiny particles of several different pollutants.

Additional problems are associated with PM-2.5 because their small size allows them to remain suspended in the atmosphere for long periods of time. Smaller particles can stay in the atmosphere for days or even weeks. The distance PM travels from its source depends on its physical characteristics and the weather conditions. They can travel hundreds of kilometers before being removed from the air by settling or precipitation.

The size, shape, and density of the particles influence the rate PM settles to the surface. Particles larger than about 10 μm in diameter settle fairly rapidly. Their impact is felt primarily near their source.



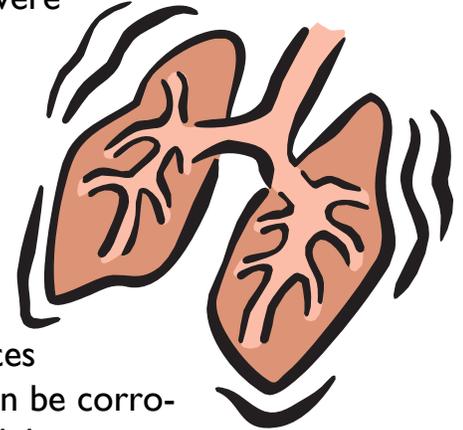
Effects

There are major human health effects of concern. These include effects on breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular diseases, alterations in the body's defense systems against foreign materials, damage to lung tissue, carcinogenesis, and premature death. Individuals with chronic obstructive pulmonary or cardiovascular disease, influenza, asthmatics, the elderly, and children are highly susceptible to the effects of PM.

The extent of the effects depends on the concentration, size, and chemical composition of the PM as well as concentration and composition of any pollutant gases occurring in combination with the PM. Particles less than 6 μm in diameter can usually penetrate the bronchial passages. Particles smaller than 1 μm can penetrate and be deposited in the lungs. Lung tissue becomes damaged and changes may occur in the immune system.

An inhaled particle may exert a toxic effect in three ways: (1) the particle may be

intrinsically toxic due to its inherent chemical or physical characteristics, (2) the particle may interfere with one or more of the mechanisms which normally clear the respiratory tract, or (3) the particle may act as a carrier of an absorbed toxic substance. It has been observed that exposure to PM in combination with other pollutants such as SO_2 produces more severe effects than does exposure to each pollutant separately. PM also affects materials, vegetation, and animals. PM damages painted surfaces and textiles and can be corrosive to metals. Visibility is reduced by PM in the 0.1 μm to 1 μm range. The particles scatter light, which produces a haze. In turn, the haze decreases the amount of sunlight reaching the ground.



Standards

The NAAQS for PM-2.5 is an annual arithmetic mean not to exceed 15 $\mu\text{g}/\text{m}^3$ and a 24-hour average not to exceed 35 $\mu\text{g}/\text{m}^3$. The standard for PM-10 is a 24-hour average not to exceed 150 $\mu\text{g}/\text{m}^3$.

Attainment of the standards is based on an average of three calendar years of data. Thus, the 24-hour PM 2.5 standards are attained when the three-year expected number of exceedances per year at each monitoring site is less than or equal to one. The annual standard is attained when the three-year expected annual arithmetic mean is less than or equal to the standard.