OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Particulate Matter

General

Particulate matter (PM) is a complex mixture of extremely small particles and liquid droplets 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 of chemical compounds 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 and industrial boilers; dust from 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, and metal processing and grinding. The condensation or transformation of emitted gases such as sulfur dioxide (SO2) and volatile organic compounds (VOCs) can also form PM.

PM can range in size from less than 0.1 micrometer (µm) to 50 µm. To put this into perspective, human hair ranges from 50 to 70 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 (PM10) presents a health risk because those particles pass through the nose and throat and can enter the lungs.

Particulate matter 2.5 µm in diameter and smaller is called PM2.5 present a greater health risk because they travel farther and embed deeper into the lungs than large particles. PM2.5 can also cause visibility problems. The particles scatter light, which produces haze, thus decreasing the amount of sunlight reaching the ground.

The distance PM travels from its source depends on its physical characteristics and the weather conditions. It can travel hundreds of miles 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 quickly. Their impact is felt primarily near their source. PM2.5, because of its small size, can remain suspended in the atmosphere for long periods of time - days or even weeks, such as dust from the Saharan Desert.

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Effects

PM may lead to major human health effects. 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 the concentration and composition of any pollutant gases reacting in combination with the PM. Particles less than 6 µm in diameter can penetrate the bronchial passages. Particles smaller than 1 µm can 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.
3. The particle may act as a carrier of an absorbed toxic substance.

Exposure to PM in combination with other pollutants such as SO2 produces more severe effects than does exposure to pollutants separately.

PM also affects materials, vegetation, and animals. Besides affecting visibility, PM damages painted surfaces and textiles and can be corrosive to metals.

Standards

There are multiple long- and short-term National Ambient Air Quality Standards (NAAQS) for PM2.5, which are all based on three year averages:

1. a primary standard of an annual arithmetic mean of 9.0 micrograms per cubic meter (µg/m3),
2. a secondary standard of 15 µg/m3 (annual arithmetic mean) and
3. identical primary and secondary standards of 35 µg/m3 (24-hour average).

For PM10, the primary and secondary standard is a 24-hour average of 150 µg/m3, which cannot be exceeded more than once per year over an average of three years.

The highest Oklahoma PM2.5 values can be found online at **https://tinyurl.com/ms5c55ya**. PM2.5 and PM10 values are also listed in our annual Air Data Report at **https://tinyurl.com/4n42temh**. If you have any questions, please contact our Air Quality Division at **(405) 702-4100**.