

Particular matter (PM)

Particulate matter: It is any material of solid particles and liquid droplets remain suspended or floating in the air for long period. Some of particular matter are large and dark as soot and smoke, others are small that they can detect only with electron microscope. Particular matter is a key indicators of air pollution caused by variety of human and natural activity, it can be suspended for long time and travel in atmosphere over long distances.

Sources of particles:

Particles matter originate from different sources, it can be directly emitted or can formed in the atmosphere when two particles react to form new particles. The main sources are:

- 1- **Natural sources:** About 62% of particles matter in outdoor come from natural sources such as volcanic activities release particular matter to atmosphere may remain and suspended in air or precipitate, sea salt, dust storm, forest fire and pollen grain.
- 2- **Anthropogenic sources:** about 38% (22% is transport, 32% is industrial, 46% is fuel combustion) remaining as a man-made source from human activities which includes:
 - a-Agriculture** activities such as use of natural fertilizer release greenhouse gases. Pesticides release persistent organic pollutants and methane. Toxic chemicals found in pesticide reduces the quality of air inhaled.
 - b-construction** project (building & roads) and repair works are main factors to create particular matter. Drilling, blasting, transportation, loading activities in construction area often causes dust generation. In addition, there are several non-point anthropogenic sources related to dust generation such as painting.
 - c-industrial** activity (cement factory & iron factory). Most of the industries are directly or indirectly depend on fossil fuel, as they produce CO and CO₂ and particle matters. Mainly cement industry releases large amount of particle matters in the environment.
 - d-motor** vehicles: it is the most dangerous form of pollution because it is a continuous source of emission particles by exhaust vehicles.
 - e-tobacco** smoke: It is very fine suspended carbon particles, it produced by incomplete combustion of coal and wood.
 - f-coal** burning: This is more severe threat to the environment as it contaminates the atmosphere with persistent organic pollutants such as dioxins.

Effect of the particles matter on human:

The distribution of particular matter in the air is considered as one of the critical public health problems in both developed and developing countries that have received more attention in recent decades due to the environmental factors in advanced economies and resulting from emission produced by industries. The main effect of PM are:

- 1- Irritation of eyes, nose and throat.
- 2- Asthma
- 3- Coughing and shortness of breathing.
- 4- Heart attacks.
- 5- Damage lung and reduce lung function.
- 6- Irregular heartbeat.
- 7- Premature death in people with heart and lung diseases.
- 8- Chemical particles are toxic such as Lead, cadmium can cause mutation, reproduction problems and forming cancer.
- 9- Particles reduce visibility.
- 10- Decay metals, discolor cloth and paint.
- 11- Damage soil and forest or crop, sometime this effect transfer based on food chain.

According by new research that conduct over 7 million deaths were attributed to the impact of indoor and outdoor particular matter inhalation, about 28% of diseases and death caused by indoor air pollution. Annually 0.8 million premature death were recorded in worldwide caused by air pollution results from PM_{2.5}. particulates pollution is classified by size such as particulates with diameters of 2.5 micrometers or less are considered to fine particular matter and refer to PM 2.5. The life of PM_{2.5} in atmosphere is usually several days without precipitation, fine particles poor sedimentation rate and are not rapidly removed by dry deposition processes. These particles travel for long distances.

particulates with diameters of 10 micrometers or less are considered to inhalable particular matter or coarse particle matter and are refer to PM 10(sometimes called Respirable suspended particles RSP). These particles can settle quickly from the atmosphere and they travel short distances. The total suspended particle (TSP) refer to all suspended particles that include the largest ones.

According to the EPA, particles are classified to:

1-Ultra fine particles: size 0.001, 0.01-2.5 micrometer. Example: gaseous contaminant, soot, tobacco smoke, smog and virus.

2- fine particles: size these particles 2.5-10 micrometer, example: bacteria and fly ash.

3- coarse particles: size these particles 10, 30, 100 and 1000 micrometer, larger size particles, example: dust, pollen and heavy metals.

Aerosol: It is dispersed particles matter, may be solid and liquid in the gaseous media based on the state of matter that exist in atmosphere in suspended form.

Smoke: It is very fine suspended carbon particles, it produced by incomplete combustion of coal and wood. It is suspended in air. Size ranged from 0.5-1 micrometer.

Fume: These particles formed by condensation gaseous pollutants or by chemical reaction. The size is very small which smaller than 1 micrometer, example tobacco smoke.

Mist: It is a small droplet of water suspended in air (liquid droplets of water suspended in air formed by condensation of vapor). The difference between mist and fog in visibility (In fog, visibility for one kilometer or less, while visibility is known as mist).

Smog: It is suspended particles in air, (smoke +fog = smog, smoke and condensed liquid droplets) it is formed by photochemical reaction between particles matter and water molecules (PM+ water).

Dust: it is mixture of irregular shape particles, which generated as a result various manual and natural operation, this solid particle larger than colloidal size, suspended in air for some days or a few months (range size 1-200 micrometer).

Sources of Dust:

Dust come from natural sources, usually large areas of land or desert with a few or no vegetation especially during presence of heavily wind. Amount of dust increase when volcanic eruption occurs.

construction project (building & roads) and repair works are main factor to create particular matter. Drilling, blasting, transportation, loading activities in construction area often causes dust generation. Other manmade factors that increase the dust include industrial activities, agriculture.

Effect of dust

- 1- Dust particles can reflect sunlight back into space, thus cooling the weather. This phenomenon happens directly and indirectly. Dust particles can reflect the sun's rays through cloud formation indirectly.
- 2- When the dust particles fall dawn and accumulated on the surface of plant leaves, they reduce photosynthesis by blocking or damage stomata pores
- 3- effects of dust can be associated with its role in the biogeochemical cycles and soil formation.
- 4- It is reduced visibility, it shut down airport and disrupt traffic.
- 5- Effect on human as following:

Types of Dust pollutants	Effect
Pollen and coarse dust	Headache
Mold spore	Dizziness
Fine dust	Irritation of eyes, nose and throat
Dust mites	Nausea
Invisible dust and gases	Constricted airways
Tobacco smoke	Allergic and asthma
Toxic chemical	Lung diseases
Bacteria and viruses	Influenza and common cold

Silicosis is a fibrotic lung disease that is caused by overexposure to dusts composed of or containing free crystalline silica. The silicosis risk depends on the amount of free crystalline silica inhaled and actually deposited in the alveolar region.

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Effect of different sized particular matter on respiratory system

PM10 is defined as all particles with diameter of 10 μm or smaller. These particles are small enough to pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects.

Some common examples of **PM10** are:

- Mold spores
- Bacteria
- Dust
- Smoke
- Airborne viral particles

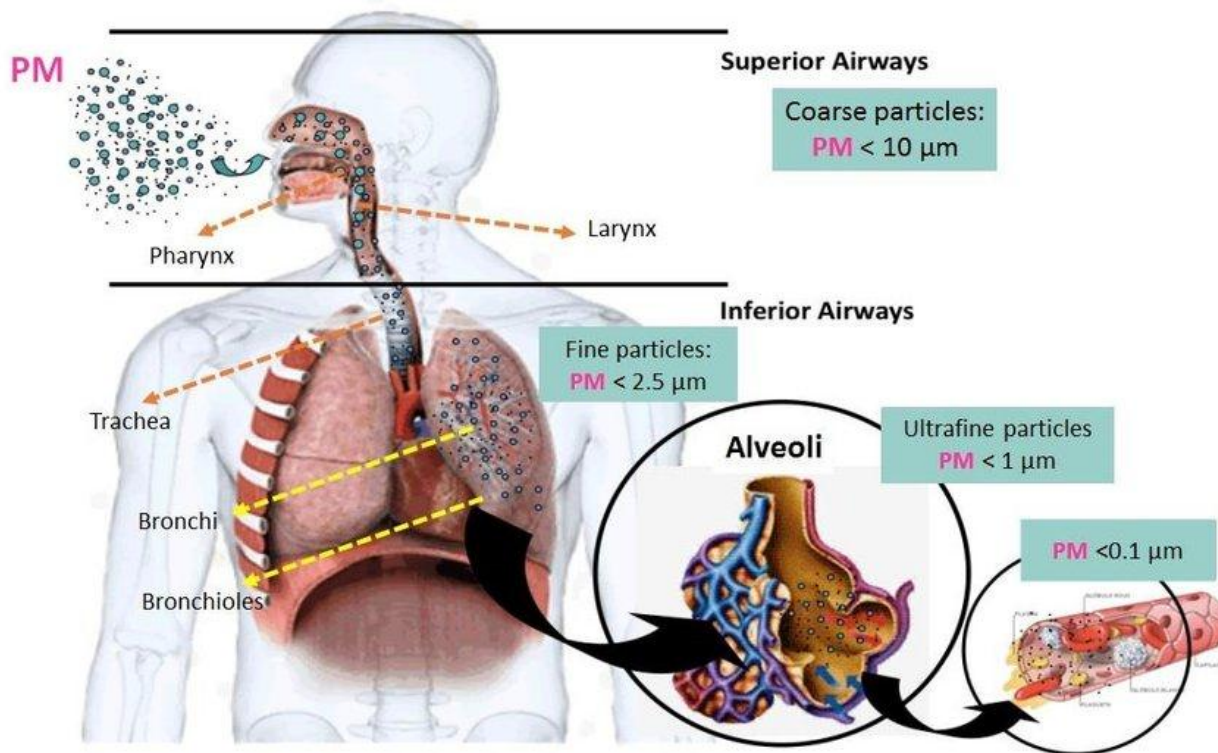
PM 2.5 is a grouping of particles with an aerodynamic diameter of 2.5 μm or less, capable of penetrating deep into our lungs and even entering our bloodstream.

Fine particles can come from natural or human-made sources, like:

- Vehicle exhaust
- Wildfires
- Power plant emissions
- Other combustion activities

Ultrafine Particles (PM 0.1)

The final type of particulate matter we will address is ultrafine dust. PM 0.1 is even smaller than fine dust, with an aerodynamic diameter of 0.1 μm or smaller, and originates from similar sources as PM_{2.5}. Exposure to PM_{0.1} induces cough and worsens asthma. Metal fume fever is a systemic disease of lung inflammation most likely caused by PM 0.1.



Effect of different sized particular matter on respiratory system

Dust is made of fine particles of solid matter. It generally consists of atmospheric particulates (particles in the atmosphere) that come from various sources such as soil lifted by wind, volcanic eruptions, and pollution...

Advantages and Disadvantages of dust:

+ Advantages:

- it reduces the air temperature.
- reduces the risk of toxic gases in the atmosphere.

- Dust particles help in the process of cloud condensation and rain.
- it helping in the process of pollination of plants.
- Exposure of children to dust and wind in a moderate manner that is not exaggerated helps improve and enhance children's immunity, through gardens and dust in the child's natural surroundings.

Disadvantages:

- **Effect on human health**

- premature death in people with heart or lung disease.
- nonfatal heart attacks.
- irregular heartbeat.
- aggravated asthma.
- decreased lung function.
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

- **Environmental damage**

Dusts can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include:

- making lakes and streams acidic.
- changing the nutrient balance in coastal waters and large river basins.
- depleting the nutrients in soil.
- damaging sensitive forests and farm crops.
- affecting the diversity of ecosystems.
- contributing to acid rain effects.

- **Materials damage**

Dust can stain and damage stone and other materials, including culturally important objects such as statues and monuments. Some of these effects are related to acid rain effects on materials.

