



BENMARC

| SEE THE DIFFERENCE |

THE PERILS OF DUST

If we consider the air filtration system found in our motor vehicles, we have to express our appreciation for the function it has to perform in order to keep our vehicles operating at optimum efficiency.

It has to contend with a wide range of airborne substances that could adversely affect the operation of the engines installed in our vehicles if it failed its function of allowing only clean air into the engine intake.

In order to maintain functionality, we have to replace the filter elements on a regular basis – typically every 10,000km. Failing this would result in foreign objects being sucked into our engines that will not only affect the optimal performance, but also increase the rate of wear inside our engines.

Now consider the human equivalent of the above. During our entire lives we subject it to severe conditions such as cigarette smoke and industrial environmental conditions that could lead to the forced filtration or elimination of gasses, dust, and smoke.

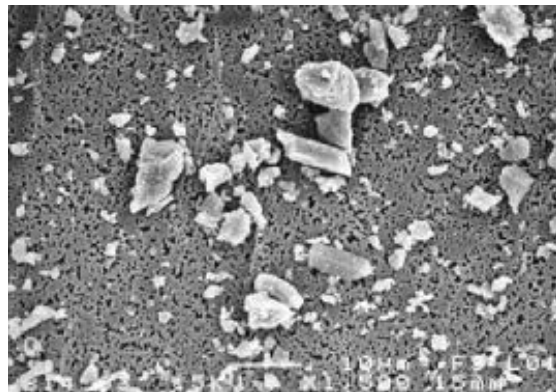
Every time we inhale, we subject our filtration system to a mammoth task of dealing with every particle that could negatively influence our health. Yet we live for an average of 75 years without ever changing or replacing any part of it.

Unfortunately dust is a reality of everyday life in most parts of the world and can therefore not be avoided or eliminated entirely without impeding the functionality of a society severely. But if we are aware of the dangers, we can apply our intellect to minimize the risk.

Some people will never experience health problems due to a failed filtration system, but still many will. It is therefore important that we understand our filtration system and defenses against harmful substances that are introduced into our bodies up to 23,000 times a day via our air ducts.

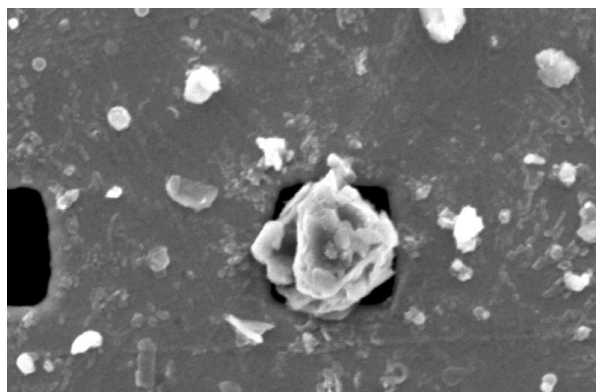
What is dust?

Dusts are tiny solid particles scattered or suspended in the air. The particles are "inorganic" or "organic," depending on the source of the dust. Inorganic dusts can come from grinding metals or minerals such as rock or soil. Examples of inorganic dusts are silica, asbestos, and coal.



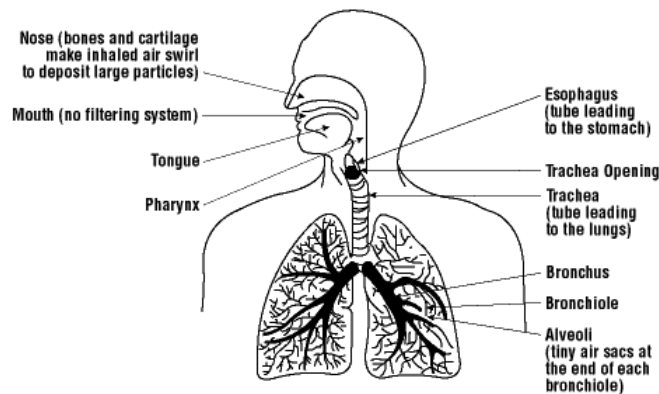
Organic dusts originate from plants or animals. An example of organic dust is dust that arises from handling grain. These dusts can contain a great number of substances. Aside from the vegetable or animal component, organic dusts may also contain fungi or microbes and the toxic substances given off by microbes. For example, histoplasmosis, parrot disease (psittacosis) and Q-fever are the diseases that people can get if they breathe in organic that are infected with a certain microorganisms.

Dusts can also come from organic chemicals (e.g., dyes, pesticides). However, we are only considering dust particles that cause fibrosis or allergic reactions in the lungs. We are not including chemical dusts that cause cancer or acute toxic effects, for example.



What happens when we breathe in dust?

The lungs are protected by a series of defense mechanisms in different regions of the respiratory tract.



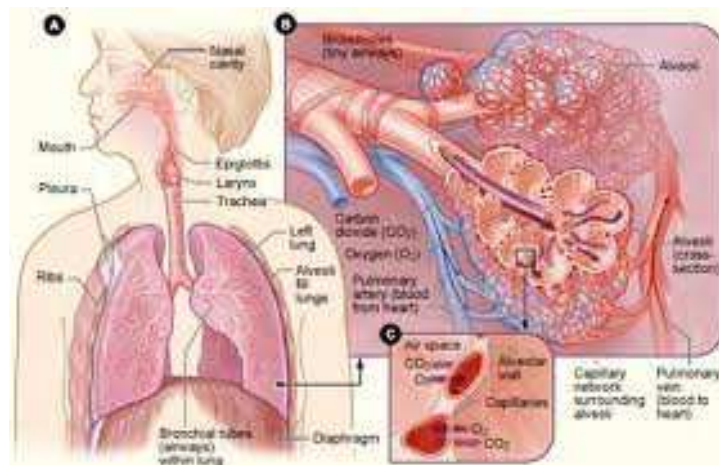
When a person breathes in, particles suspended in the air enter the nose, but not all of them reach the lungs. The nose is an efficient filter. Most large particles are stopped in it, until they are removed mechanically by blowing the nose or sneezing.

Some of the smaller particles succeed in passing through the nose to reach the windpipe and the dividing air tubes that lead to the lungs.

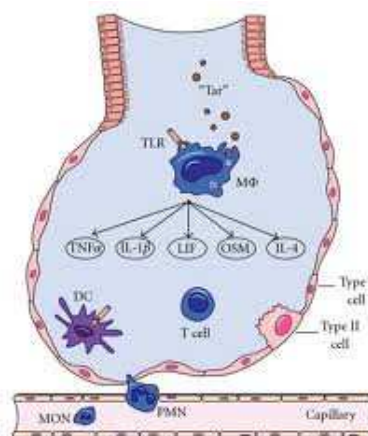
These tubes are called bronchi and bronchioles. All of these airways are lined by cells. The mucus they produce catches most of the dust particles. Tiny hairs called cilia, covering the walls of the air tubes, move the mucus upward and out into the throat, where it is either coughed up and spat out, or swallowed.

The air reaches the tiny air sacs (alveoli) in the inner part of the lungs with any dust particles that avoided the defenses in the nose and airways. The air sacs are very important because through them, the body receives oxygen and releases carbon dioxide.

Dust that reaches the sacs and the lower part of the airways where there are no cilia is attacked by special cells called macrophages. These are extremely important for the defense of the lungs. They keep the air sacs clean. Macrophages virtually swallow the particles. Then the macrophages, in a way which is not well understood, reach the part of the airways that is covered by cilia. The wavelike motions of the cilia move the macrophages which contain dust to the throat, where they are spat out or swallowed.



Besides macrophages, the lungs have another system for the removal of dust. The lungs can react to the presence of germ-bearing particles by producing certain proteins. These proteins attach to particles to neutralize them.



What are the reactions of the lungs to dust?

The way the respiratory system responds to inhaled particles depends, to a great extent, on where the particle settles. For example, irritant dust that settles in the nose may lead to rhinitis, an inflammation of the mucous membrane. If the particle attacks the larger air passages, inflammation of the trachea (tracheitis) or the bronchi (bronchitis) may be seen.

The most significant reactions of the lung occur in the deepest parts of this organ.

Particles that evade elimination in the nose or throat tend to settle in the sacs or close to the end of the airways. But if the amount of dust is large, the macrophage system may fail. Dust particles and dust-containing macrophages collect in the lung tissues, causing injury to the lungs.

The amount of dust and the kinds of particles involved influence how serious the lung injury will be. For example, after the macrophages swallow silica particles, they die and give off toxic substances. These substances cause fibrous or scar tissue to form. This tissue is the body's normal way of repairing itself. However, in the case of crystalline silica so much fibrous tissue and scarring form that lung function can be impair.

The general name for this condition for fibrous tissue formation and scarring is fibrosis. The particles which cause fibrosis or scarring are called fibrogenic. When fibrosis is caused by crystalline silica, the condition is called silicosis.

What are the factors influencing the effects of dust?



Several factors influence the effects of inhaled particles. Among these are some properties of the particles themselves. Size and heaviness are important because large and heavy particles settle more rapidly. Chemical composition is important because some substances, when in particle form, can destroy the cilia that the lungs use for the removal of particles. Cigarette smoking may alter the ability of the lungs to clear themselves.

Characteristics of the person inhaling particles can also influence the effects of dust. Breathing rates and smoking are among the most important. The settling of dust in the lungs increases with the length of time the breath is held and how deeply the breath is taken. Whether breathing is through the nose or mouth is also important.

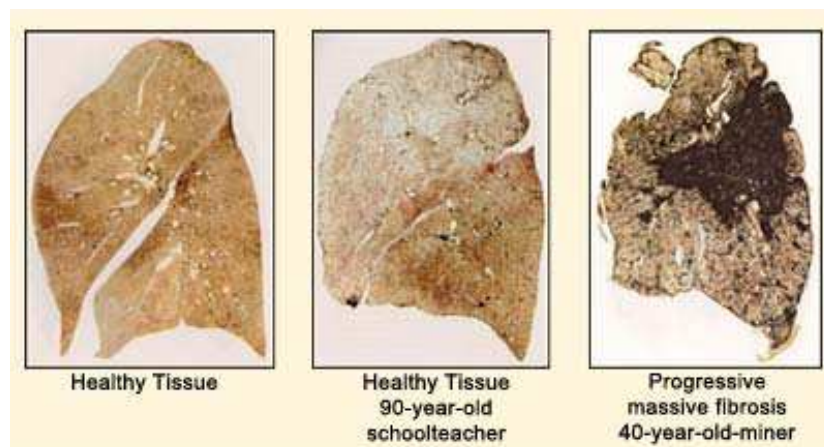


What are the diseases caused by dusty operations?

The classic diseases of "dusty" occupations may be on the decline, but they have not yet disappeared. Workers today still suffer from a variety of illnesses caused by dust they inhale in their work environments. For practical purposes, we limit this document to dust. We do not take into consideration combined effects arising from exposures to dusts, gases, fumes and vapours.

Some types of lung diseases caused by the inhalation of dust are called by the general term "pneumoconiosis." This simply means "dusty lung."

The changes which occur in the lungs vary with the different types of dust. For example, the injury caused by exposure to silica is marked by islands of scar tissue surrounded by normal lung tissue. Because the injured areas are separated from each other by normal tissue, the lungs do not completely lose their elasticity. In contrast, the scar tissue produced following exposure to asbestos, beryllium and cobalt completely covers the surfaces of the deep airways. The lungs become stiff and lose their elasticity.



Not all inhaled particles produce scar tissue. Dusts such as carbon and iron remain within macrophages until they die normally. The released particles are then taken in again by other macrophages. If the amount of dust overwhelms the macrophages, dust particles coat the inner walls of the airways without causing scarring, but only producing mild damage, or maybe none at all.

Some particles dissolve in the bloodstream. The blood then carries the substance around the body where it may affect the brain, kidneys and other organs.

The table below summarizes some of the most common lung diseases caused by dust.

Table Some types of pneumoconiosis according to dust and lung reaction		
Inorganic Dust	Type of Disease	Lung Reaction
Asbestos	Asbestosis	Fibrosis
Silica (Quartz)	Silicosis	Fibrosis
Coal	Coal Pneumoconiosis	Fibrosis
Beryllium	<u>Beryllium Disease</u>	Fibrosis
Tungsten Carbide	Hard Metal Disease	Fibrosis
Iron	Siderosis	No Fibrosis
Tin	Stannosis	No Fibrosis
Barium	Baritosis	No Fibrosis
Organic Dust		
Mouldy hay, straw and grain	<u>Farmer's lung</u>	Fibrosis
Droppings and feathers	Bird fancier's lung	Fibrosis
Mouldy sugar can	Bagassosis	Fibrosis
Compose dust	Mushroom worker's lung	No Fibrosis
Dust or mist	Humidifier fever	No Fibrosis
Dust of heat-treated sludge	Sewage sludge disease	No Fibrosis
Mould dust	Cheese washers' lung	No Fibrosis
Dust of dander, hair particles and dried urine of rats	Animal handlers' lung	No Fibrosis

How can we protect the lungs from dust?

To avoid respiratory or other problems caused by exposure to dust, hazardous substances should be substituted with non-hazardous substances. Where substitution is not possible, other engineering control methods should be introduced. Some examples are:

- use of wet processes
- enclosure of dust-producing processes under negative air pressure (slight vacuum compared to the air pressure outside the enclosure)
- exhausting air containing dust through a collection system before emission to the atmosphere
- use of vacuums instead of brooms
- good housekeeping
- efficient storage and transport
- controlled disposal of dangerous waste



Use of personal protective equipment may be vital, but it should nevertheless be the last resort of protection. Personal protective equipment should not be a substitute for proper dust control and should be used only where dust control methods are not yet effective or are inadequate. Workers themselves, through education, must understand the need to avoid the risks of dust.

Mine dust and you

People living near mine sites often ask about the effects of dust emissions in the air as a result of mining activities.

The sad fact is that the effect is a whole lot more serious than you think. Dust from mining operations typically drop out in a radius of under 2km, but can be carried for up to 20km on windy days. Suspended dust particles are generally bigger closer to the source of the dust, and drop out quicker because it is heavier. Finer particles will stay airborne for longer and would therefore drop out much further from the source. Unfortunately, due to the smaller size of the finer particles, they are able to evade most of our natural defences and tend to settle deeper in our lungs where tissue damage is more serious.



What is particulate matter?

We simply refer to it as “dust”. But scientists and regulators refer to the term “particulate matter” (or PM) to describe the range of particles that exists in the air we breathe.

PM exists naturally in the atmosphere, eg sea-salt spray and pollens. PM can be increased due to human activities such as vehicle exhaust, industrial processes, power stations, mining, farming and wood heaters, or smoke from bushfires.

Exposure to PM can be associated with health and amenity impacts. The likely risk of these impacts depends on a range of factors including the size, structure and composition of the PM and the general health of the person.



Sizes of particulate matter

Just as the size of balls we can see ranges from marbles to basketballs, PM can be thought of as microscopic balls of varying sizes. Instead of measuring PM in centimetres as we do with balls, scientists use micrometres (sometimes called "microns") to measure the diameter of particles. A micrometre is one-millionth of a metre and its symbol is μm .

For environmental health purposes, particles are usually described by their size:

Particle size	Description
TSP	Total Suspended Particulate Matter (TSP) refers to the total of all particles suspended in the air. Even the largest of these particles is barely half the width of a human hair.
"larger than" PM10	A subset of TSP, and refers to all particles of size $10\ \mu\text{m}$ in diameter and greater.
PM10	Also a subset of TSP, and includes all particles smaller than $10\ \mu\text{m}$ in diameter (smaller than 1/7th of a hair width). Particles in the size range $2.5\ \mu\text{m}$ to $10\ \mu\text{m}$ in diameter are referred to as coarse particles (PM 2.5-10).
PM2.5	A subset of both PM10 and TSP categories and refers to all particles less than $2.5\ \mu\text{m}$ in diameter. PM2.5 is referred to as <i>fine particles</i> and is mainly produced from combustion processes such as vehicle exhaust.

Particles levels in air are measured by the weight (micrograms) of particles per cubic metre of air ($\mu\text{g}/\text{m}^3$). One ($\mu\text{g}/\text{m}^3$) equals one millionth of a gram in a cubic metre of air. TSP can also be measured as the weight of dust falling on a given area over time ("dust deposition").

Particulate matter from mining

The vast majority of dust from mining activities consists of coarse particles (around 40 per cent) and particles larger than PM10, generated from natural activities such mechanical disturbance of rock and soil materials by dragline or shovel, bulldozing,

blasting, and vehicles on dirt roads. Particles are also generated when wind blows over bare ground and different types of stockpiles. These larger particles can have amenity impacts as well as health impacts.

Fine particles from vehicle exhausts and mobile equipment are also produced at mine sites, though they only account for about 5 per cent of the particles emitted during the mining process. Fine particles produced at mine sites are mainly from vehicle and mobile equipment exhausts.

Potential health impacts from PM

The human body's respiratory system has a number of defence mechanisms to protect against the harmful effects of PM. PM is often trapped in sticky mucus on the walls of the airways and can be removed by cilia, small hair-like objects which line the surface of the airways. This mucus can then be swallowed or coughed up.

PM exposure can lead to a variety of health effects. For example, numerous studies link particle levels to increased hospital admissions and emergency room visits and even to death from heart or lung diseases. Both long (over years) and short term (hours or days) particle exposure have been linked to health problems.

Generally, it is thought that fine particles below 2.5 μm in diameter may be of a greater health concern than larger particles as they can reach the air sacs deep in the lungs. However, coarse particles (PM 2.5-10) could also be associated with adverse health effects.

People who may be more susceptible to the health effects of fine and coarse particles are:

- infants, children and adolescents
- elderly
- people with respiratory conditions such as asthma, bronchitis and emphysema
- people with heart disease
- People with diabetes.

If health effects arise from exposure to coarse particles, such as from mining activities, the symptoms are likely to be:

- cough
- wheeze, or worsening of asthma
- increased need for medications (eg: inhalers, puffers, antibiotics)
- Increased breathlessness.

Some recent research suggests that heart problems, such as angina and heart attacks may also be associated with coarse particle pollution.

Potential amenity impacts

Amenity impacts from dust are usually associated with coarse particles and particles larger than PM10. The impact of dust from a nearby mine on local amenity depends on the distance from the mine site and climatic conditions such as wind.



Concerns about amenity from mine site dust often relate to "visibility" of dust plumes and dust sources. Visible dust is usually due to short-term episodes of high emissions, such as from blasting and ore-tipping.

Other amenity impacts include dust depositing on fabrics (such as washing) or on house roofs, and the transport of dust from roofs to water tanks, during rain.

How can you avoid mine dust?

Provided that mines are operated with proper dust controls it is unlikely that healthy adults would suffer any serious health effects from the expected exposure to particulate matter.

If you notice that dust levels are high, try to keep your windows and doors closed. People who have asthma or lung conditions should avoid outdoor activities at these times. An air-conditioner can reduce PM levels inside, but it is important to regularly clean the intake filter.



Your family, your health – take care of it ...