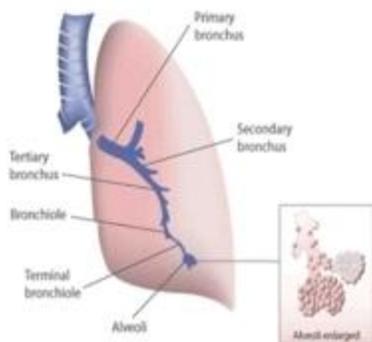


Diesel Particulate Matter



This article was researched and written by a student at Mount Holyoke College participating in the Encyclopedia of Earth's (EoE) Student Science Communication Project. The project encourages students in undergraduate and graduate programs to write about timely scientific issues under close faculty guidance. All articles have been reviewed by internal EoE editors, and by independent experts on each topic.

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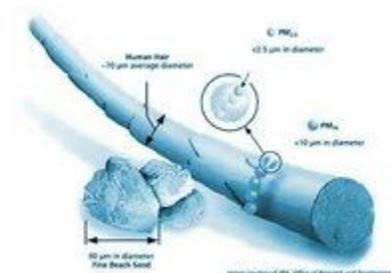
Diesel Exhaust and Diesel Particulate Matter (DPM)

Diesel particulate matter (DPM) is a complex mixture of elemental carbon (EC) particles, soluble organic carbon, including 5-ring or higher polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene, as well as other metallic compounds. Also, DPM usually contains some small amounts of nitrates, sulfates and sulfuric acid—that is created through reaction of sulfates with water molecules present in the air during ignition or after release into ambient air. Also, diesel exhaust contains some trace elements, water and unidentified components. DPM is made up almost entirely of tiny particles below 1-3 μ (microns) as well as ultrafine particles that are smaller than 1 μ .

Sources of DPM

DPM is a component of diesel exhaust that arises from combustion of diesel fuels. Diesel fuel is a less refined fuel than gasoline but is also derived from petroleum oil. Diesel exhaust is generated by machines including construction equipment, 18-wheel trucks, commuter trains, and buses, as well as ferries and fishing boats that use diesel engines.

Dangers of DPM



DPM next to human hair. (Source:[EPA](http://www.epa.gov))

DPM has a large surface area in relation to its mass. This enables DPM to absorb or attract other chemicals or organics found during diesel combustion as well as chemicals found in the ambient air after expulsion from the exhaust system. Their small size relative to their surface area enhances their potential to interact at the subcellular level with respiratory tissues after inhalation in both animals and humans. On the molecular level, carbon in DPM attracts other chemical molecules found in diesel exhaust as well as chemicals in the ambient air creating a potentially toxic mixture of materials in the particles and posing further danger when inhaled. The primary route of exposure to these chemicals is through inhalation with some through dermal absorption if ambient air concentrations are high enough.

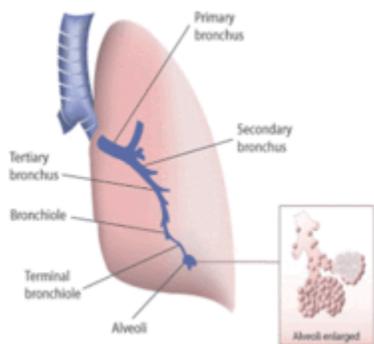
Human Health Effects

Non Carcinogenic

Toxicological data demonstrate that DPM is an etiologic agent in non-cancer health effects such as asthma and bronchitis (inflammation of bronchi) and other respiratory ailments. Also, DPM has been associated with an elevated risk of lung cancer in humans.

In humans such symptoms as asthma and other respiratory problems are found after long-term exposure to DPM in ambient air. Persons who live in cities are at a higher risk of developing asthma and other lung-related ailments, possibly because of their higher daily exposure to diesel vehicle traffic associated with cities.

Carcinogenic and mutagenic properties



Human lung. (Source: [EPA](#))

Additionally, Diesel Particulate Matter (DPM) has been associated with mutagenic properties. Most cancer is defined by such genetic alterations as translocation, deletion, and substitution. Since DPM components have had mutagenic effects on DNA it is suggested that DPM can cause cancer. In addition, because DPMs can pick up other chemical substances—as they remain airborne—they provide a direct route of exposure to other various carcinogenic chemicals that attach to them.

Alternatives

While alternative fuels are one solution, large nation-wide campaigns to change diesel regulation across the United States could substantially reduce DPM exposure. Diesel retrofit programs aim to decrease overall particulate matter through the addition of a second filtration system on the exhaust pipe. Such alternative fuels as biodiesel provide an alternative fuel for working diesel engines and decrease both DPM emissions and CO₂ emissions.

Diesel Retrofits

Diesel Retrofit programs that upgrade or retrofit vehicles can reduce particulate matter by up to 90%. There are many retrofit programs that have been instated throughout various school systems for the retrofitting of school bus retrofitting. Technology is available to reduce DPM emissions on already existing vehicles. Several States including California and Massachusetts have taken control at the state level and regulated the requirement of retrofits in school bus fleets that run within the state.

Regulation

The U.S. Environmental Protection Agency (EPA) monitors ambient air quality and regulates the amount of particulate matter that can be in the ambient air at any given time. In September of 2006 the EPA lowered the level of 24-hour DPM standard from 65 to 35 $\mu\text{g}/\text{m}^3$ and the retaining level particulate matter to a standard of 15 $\mu\text{g}/\text{m}^3$ at any given time. Retaining level means that areas may not exceed the standardized level and must retain a concentration of 15 $\mu\text{g}/\text{m}^3$ or less. This regulation aims to lower the allowable limits of DPM present in the ambient air at any given time. Areas that do not fit into these standards are designated "nonattainment areas" and are given a time frame for which to improve air quality. Those areas designated as "nonattainment areas" have three years to develop and begin implementing a plan that will reduce the amount of DPM in the ambient air.

In addition to air quality monitoring, the EPA has several Clean Diesel Programs funded by Congress that aim at decreasing diesel pollution at its source by requiring higher standards of emissions from vehicles.

References

- Peter Møller, Janne Kjærsgaard Folkmann, Lykke Forchhammer, Elvira Vaclavik Bräuner, Pernille Høgh Danielsen, Lotte Risom and Steffen Loft (2008). Air pollution, oxidative damage to DNA, and carcinogenesis *Cancer Letters*. xxx, xx-xx. [Article in Press; Retrieved from Science Direct database].
- U.S. Environmental Protection Agency (EPA). (2002) Health assessment document for diesel engine exhaust. Prepared by the National Center for Environmental Assessment, Washington, DC, for the Office of Transportation and Air Quality; EPA/600/8-90/057F. Available from: National Technical Information Service, Springfield, VA; PB2002-107661.
- U.S. Environmental Protection Agency (EPA). (2007) Particulate Matter (PM) In New England.
- U.S. Environmental Protection Agency (EPA). (2007) Which Areas in New England Do Not Attain PM Standards.
- U.S. Environmental Protection Agency (EPA). (2008) National Clean Diesel Campaign.
- U.S. Environmental Protection Agency (EPA). (2008) Verified Technologies list: Diesel Retrofit Technology Verification.

Source:<http://www.eoearth.org/view/article/51cbcd647896bb431f691f2f/?topic=51cbfc78f702fc2ba8129e7b>