

# WHY DIESEL EXHAUST IS SO DAMAGING TO HEALTH

Mark Curran March 2006

It is not long ago that diesel engines were regarded as being safer alternatives to the petrol engine and the 'smoke' was thought of as a minor irritant, important because it was unsightly, smelly and reduced visibility in tunnels.

Modern medical science has clearly shown that this is not the case and that diesel exhaust is one of the most dangerous and widespread of modern pollutants.

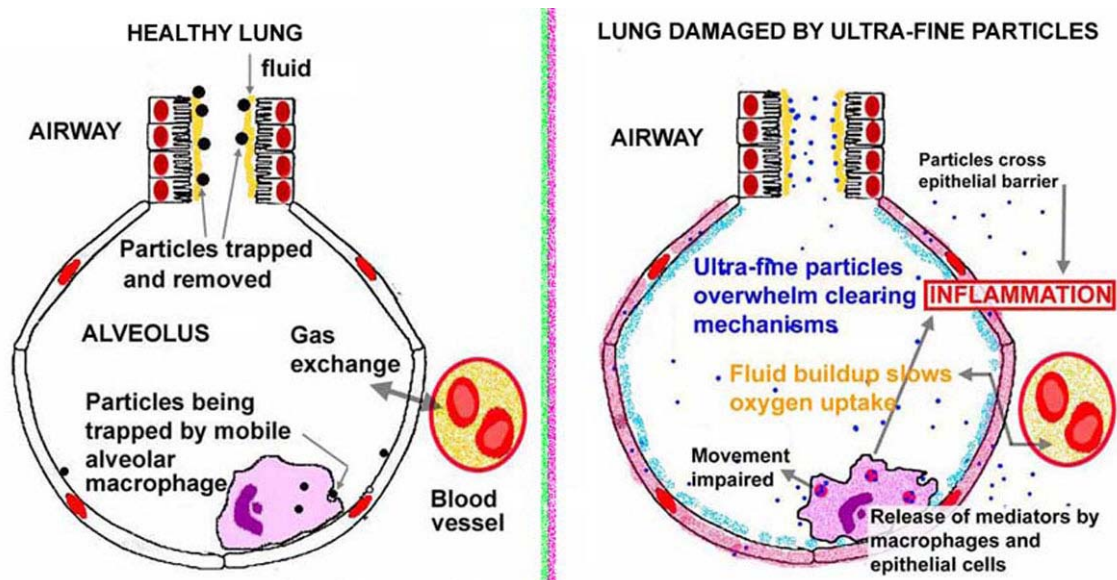
All of the exact mechanisms by which diesel exhaust causes harm are not yet known but it is clear that the harmful effects are related both to the size and composition of the particles in the exhaust.

Diesel exhaust is now known to be a carcinogen<sup>1 2</sup> and particulate pollution has been fairly labelled as the 'new asbestos' for its ability to cause serious illness and death.

Recently, the respected New England Journal of Medicine listed the following health impacts from particulate air pollution

- Rhinitis and laryngitis Large particles are deposited in the nose, pharynx, and larynx.
- Tracheitis, bronchitis and bronchiolitis Particles larger than 10 $\mu$  cleared by cilia. Smaller particles and fibers deposited in bronchioles and alveola ducts.
- Asthma and chronic obstructive pulmonary disease. Allergens and irritants are deposited in large airways causing chronic inflammatory changes
- Cancer Carcinogens (asbestos and polycyclic aromatic hydrocarbons) come into contact with bronchial epithelial cells, causing mutations on proto-oncogenes and tumor-suppressor genes and leading to malignant transformation.
- Interstitial disease Small particles and fibers are deposited in terminal bronchioles and alveoli. Penetration of interstitium results in fibrosis and formation of granulomas.

All particles are dangerous and there is no safe level of exposure, but weight for weight, toxicity appears to double with each halving in the diameter of the particles inhaled. "Nano" particles less than about 100 nanometers in diameter severely irritate the lung, irrespective of their composition and can carry adsorbed toxins directly into lung tissues, easily penetrating cellular membranes.



In December 2005, MedicineNet confirmed that diesel exhaust contains up to 100 times more ultra-fine and 'nano' particles than does exhaust from petrol engines.<sup>3 4</sup>

## Growth of medical knowledge

Over 200 papers on the health effects of fine particles have been published in the last 10 years.

In 1996 Dockery and Pope<sup>5</sup> published the findings of their '6 cities' study which clearly associated increases in particulate matter with increases in mortality and hospital admissions.

In 2001, Friedman and Powell<sup>6</sup> showed that the reduction in vehicle emissions during the Atlanta Olympic Games significantly reduced childhood asthma attacks.

In 2004 Ann Peters (*et al*)<sup>7</sup> published highly significant research which showed that short term exposure to vehicle pollutants could trigger the onset of myocardial infarctions (heart attacks).

These are just landmarks in the steady progress of medical knowledge showing the adverse impacts of vehicle pollution and especially particulate pollution on all stages of the human life cycle, from before birth<sup>8</sup>, through childhood<sup>9</sup> and early adulthood<sup>10</sup> to the causation of early mortality.<sup>11</sup>

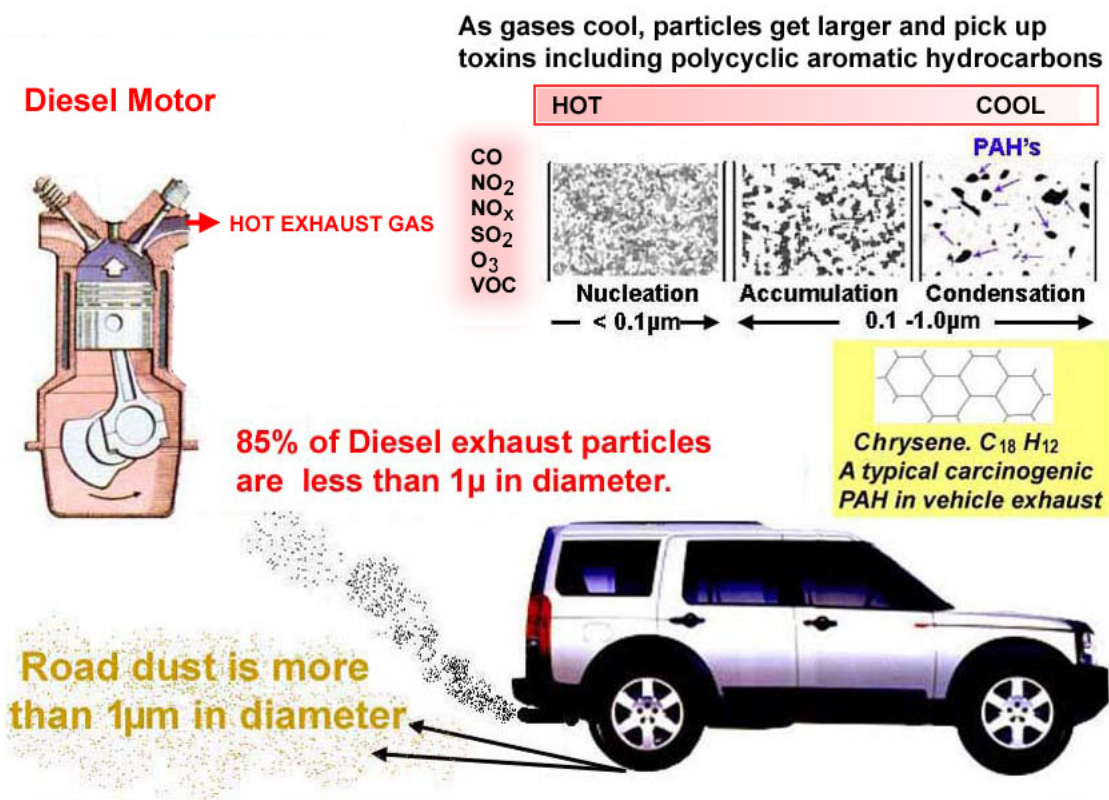
In addition recent research carried out for the World Road Association (PIARC)<sup>12</sup> shows that particles interact with another significant pollutant, nitrogen dioxide in an additive way especially inside tunnels.

Particles in vehicle emissions consist mainly of carbon but also include fibers, metal fragments and soluble salts. The carbonaceous particles carry carcinogenic polycyclic aromatic hydrocarbons (PAH) and other volatile, and also carcinogenic, organic compounds (VOC) on their surface.

Diesel particles, which are mainly less than 1 μ (micron) in diameter and have an median diameter of about 0.2 μ (200 nanometers), are by far the most dangerous of the commonly found particles.

We are exposed to these pollutants at high concentrations in our cars or beside busy roads. In addition, every time we travel through an unfiltered urban tunnel our exposure jumps 10-20 fold.

*Tunnels might be good for traffic but unfiltered tunnels are bad for health!*



<sup>1</sup> Lipslett M, Campleman S. Occupational exposure to diesel exhaust and lung cancer: a meta-analysis. Am J Public Health 1999;89:1009-17.

<sup>2</sup> Harrison RM, Smith DJT, Kibble AJ. What is responsible for the carcinogenicity of PM2.5? Occup Environ Med 2004;61:799-805

<sup>3</sup> Diesel Exhaust Chokes Human Arteries. Ed Edelson. <http://www.medicinenet.com/script/main/art.asp?articlekey=57072>

<sup>4</sup> Kittelson, D B. (1998) Review of Diesel Particulate Matter Sampling Methods. Supplemental Report # 2 EPA Grant Review Of Diesel Particulate Matter. <http://www.me.umn.edu/centers/cdr/reports/EPAreport2.pdf>

<sup>5</sup> Dockery, D.W., Pope, C.A., Xu, S. and Spengler, J.D., et al: An Association Between Air Pollution and Mortality in Six U.S. Cities. 329 NEJM 1753-59 (1993).

<sup>6</sup> Friedman, M S, *et al*. Impact of Changes in Transportation and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma. JAMA, Vol 285, (2001) pp897-905

<sup>7</sup> Peters, A., Von Klot, S., Heier, A., Trentinaglia, I., Hormann, A., Wichmann, E., Lowel, H., Exposure to Traffic and the Onset of Myocardial Infarction. NEJM, Vol. 351, No 17, (October 15, 2004):

<sup>8</sup> Dejmek J, Solansky I, Benes I, Lenicek J, Srám RJ. 2000. The impact of polycyclic aromatic hydrocarbons and fine particles on pregnancy outcome. Environ Health Perspect 108:1159-1164.

<sup>9</sup> Brauer, M., Hoek, G., Van Vliet, P., et al., Air Pollution from Traffic and the Development of Respiratory Infections and Asthmatic and Allergic Symptoms in Children, Am Journal of Respiratory and Critical Care Medicine, Vol.166, (2002), pp. 1092-1098;

<sup>10</sup> Riediker, M., Cascio, *et al*, Particulate Matter Exposure in Cars Is Associated with Cardiovascular Effects in Healthy Young Men, Am. Journal of Respiratory and Critical Care Medicine, Vol. 169, (2004), pp. 934-940;

<sup>11</sup> Finkelstein, M., Jerrett, M., and Sears, M., Traffic, Air Pollution and Mortality Rate Advancement Periods, Am J Epidemiology, Vol. 160, (2004), pp. 173-177.;

<sup>12</sup> Bjornback, M., Bylin, G, *et al*. Impact of NO2 on Health: exposure in Road Tunnels. (2000) PIARC Committee on Road Tunnels WG No2 "Pollution, environment and ventilation".