

Particulate Matter in Ambient Air PM must be supplemented by Respirable Elemental Carbon REC and Solid Particle Number PN

Andreas C.R. Mayer
Dipl.Ing, SAE-fellow, Dr.med.hc

PM2.5 is not defined

- neither by substance
- nor by particle size distribution
- nor by solid/volatile ratio
- nor by solubility after inhaled

Can this metric be used as a marker for ambient air health impact ?

Milan

Zuerich

Hawaii (?)

Black Carbon
Organic mass
Nitrate
Sulfate
Ammonium
Chloride

<p>Occupational Health Protection is more precise and measures & limits Respirable Elemental Carbon REC at the working place → defines size and substance</p> <p>Actual limit in Switzerland is 100 µg REC/m³ and will be tightened soon to 50 µg REC/m³ all over Europe – which is by far not strict enough and should be lowered to 1 50 µg REC/m³ following the miners stude – see below</p>	<p>Diesel Engine Exhaust</p> <p>Health-based recommended occupational exposure limit</p> <p>Dutch Expert Committee on Occupational Safety (DECOS) a committee of the Health Council of the Netherlands</p>
<p>The Miners Study (Silverman et al., JNCI 2012) is a cohort study, performed 2011 in 8 US non-metal mining facilities (limestone, trona, potash, salt) of 12'315 workers with respect to long-time REC exposure and found 198 lung cancer deaths and a statistically overwhelming evidence that exposure to REC in diesel exhaust may cause lung cancer in humans.</p> <p>REC from diesel exhaust is < 300 nm, peak at 80 nm REC from petrol exhaust is < 250 nm, peak at 60 nm REC from must diff. technical combustions is very similar</p>	<p>A quantative Analysis of the Miners Study 2011 as Advice to the Minister of the Netherlands:</p> <p>The Committee estimates that a 8-hour time weighed average exposure concentration of respirable elemental carbon in the air REC, which serves as parameter for exposure to diesel exhaust powered by petroleum diesel fuels corresponds to</p> <ul style="list-style-type: none"> • 4 extra death cases of lung cancer per 100'000 (target risk level) for 40 years of occupational exposure, equals to 0.011 µg REC/m³ • 4 extra death of lung cancer per 1000 (prohibition risk level), for 40 years of occupational exposure, equals to 1.03 µg REC/m³

Based on the Miners Study the IARC (WHO) classified Diesel Exhaust in June 2012 as carcinogen to humans Group 1

Why “Diesel Engine Exhaust ” and not specify clearly “REC < 300 nm” as the miners study did? To politely protect PM2.5? And why not propose emission limits, clearly defined as REC < 300 nm as Gezondheidsraad did based on the Miners study?

Meanwhile the Engineering Community responsible for Generating Traffic Emissions took a different route

Engineers had provided excellent Diesel particle filters already in 1982 but clean air authorities could not implement them because of the prevailing PM-philosophy: PM gravimetry is far too insensitive and prefers large over ultrafine particles. As a consequence engines lost large particles and continued emitting the ultrafine alveoly penetration solid particles. **This only changed in 2009**, when the EU Parliament insisted “that the commission shall introduce particle number limit values which are likely to reflect the highest level of performance with particle filters using best available technology” to protect the citizens health (Art.12, Rec.15, EC-Regulation 595) and that’s why we have filters in all new cars

99.9 % filtration is state of the art with wall flow filters

Emission legislation is based on PM mass, so mass came down but PN remained high

This change of the paradigm from mass to number PN was rather metrology motivated but proves to be key for health

			<p>A detailed study by M.Kasper (Expert-Verlag 2005), based on EU-15 based PM2.5 analysis for 2000 and forecast 2020 (Rains Web) demonstrates that engine emissions are not well represented by mass in ambient air pollution samples, better by respirable elemental carbon and perfectly by nanoparticle numbers. Since ultrafine particles are suspected to be the main reason for “nanoImpact” on citizens health, they should a monitored in a dense network which mirrors the exposure of urban population.</p>
<p>Engine emission is not well represented in ambient PM10 or 2.5</p>	<p>Engine emission is better represented by ambient REC mass</p>	<p>Engine emission dominates ambient PN pollution</p>	<p>Remember Galileo Galilei 1610 to his students: you should measure whatever you can measure and what you cannot measure yet you should make measurable</p>

- We want a low carbon world – so why don't we monitor carbon in the ambient air?
- We know that soot is No. 2 global warming driver – so why don't we monitor soot in the global air?
- We know that mineral fuel based ICE emit soot and we must have a success control for mitigation measures
- We know “nanotoxicology” and “nanoImpact” – would it not be compelling to monitor the aerosol properties?
- **Why does it take so long**