



Diesel Soot in workplace air: State of regulations and prevention in Germany

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■ Contents



- State of Regulations until 2004
- State of Regulations since 2005

■ Until 2004: Diesel Particulate Matter - Definition



- Diesel “soot” is a complex mixture of particulate matter.
- As the carcinogenicity is supposed to be connected to the particle phase and as up to this date no single compound has been identified to be solely or predominantly responsible for this, **elemental carbon** has been defined to be the analyte of choice.

■ Coulometric Determination

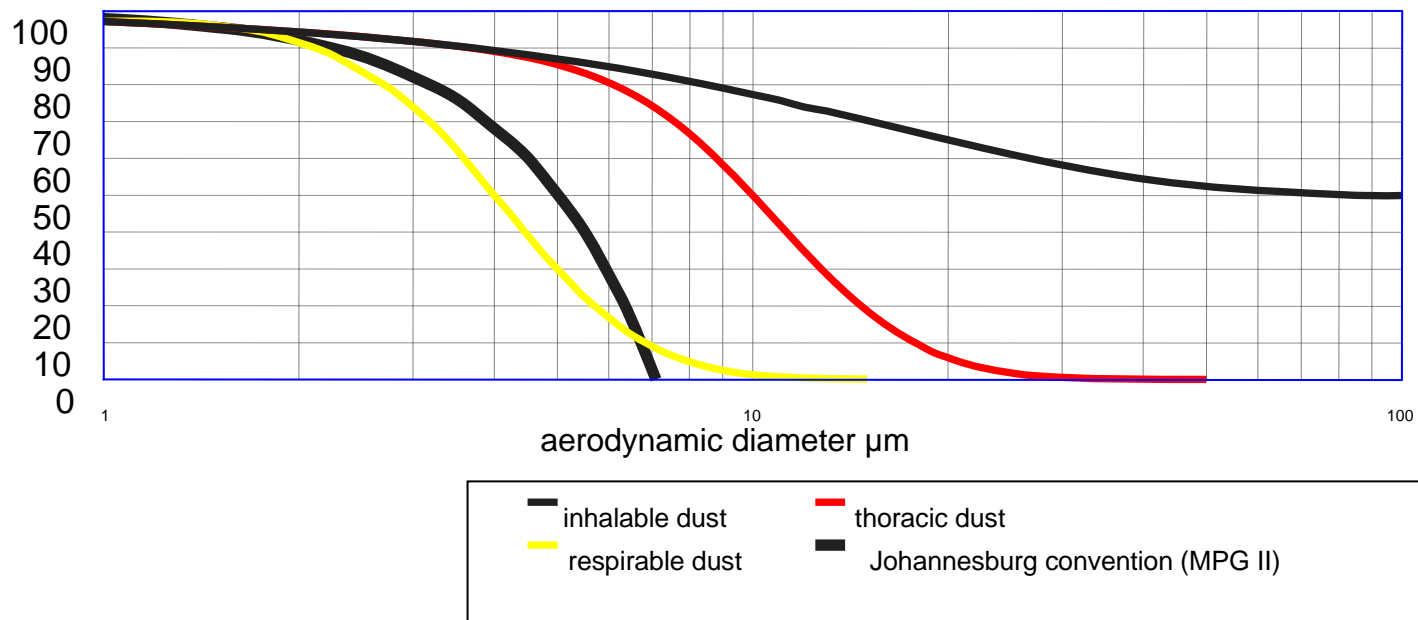


- Sampling on quartz fiber filters (**respirable dust**)
- Thermal desorption/decomposition of „**organic carbon**“ (volatile compounds) in inert carrier gas and subsequent oxidation and determination of the resulting CO₂
- Oxidation of the residual „**elemental carbon (ec)**“ and determination of the resulting CO₂
- Threshold limit (purely technical base): 100 µg/m³ ec (Exceptions for underground mining, no tlv in coal-mining)

■ Respirable Dust (EN 481):



percentage of the total of all airborne particles



■ Some Stationary Samplers:





Oven (800°C) filled with CuO to ascertain complete oxidation of the desorption/combustion products
oven (400°C) filled with silver wool to remove acidic gases, sulfides and acid halides

N₂-inlet for the desorption of OC
O₂-inlet for the combustion of EC
or O₂-inlet for the combustion of TC

IR-oven for the desorption/combustion process

Spoon for placing the filter sample

Cooling device for condensing water

Thermometer

CO₂-Outlet for the coulometric determination

Trap filled with quartzwool - coated with diluted phosphoric acid to remove aerosols

Combustion unit of the coulometric device



■ ... and the method's lower detection limit:

- In the region of 0.005 mg/filter or
- about **0.003 mg/m³** for an eight-hour-sampling period (for the stationary samplers mentioned above)
 - person carried samplers: about 0.06 mg/m³

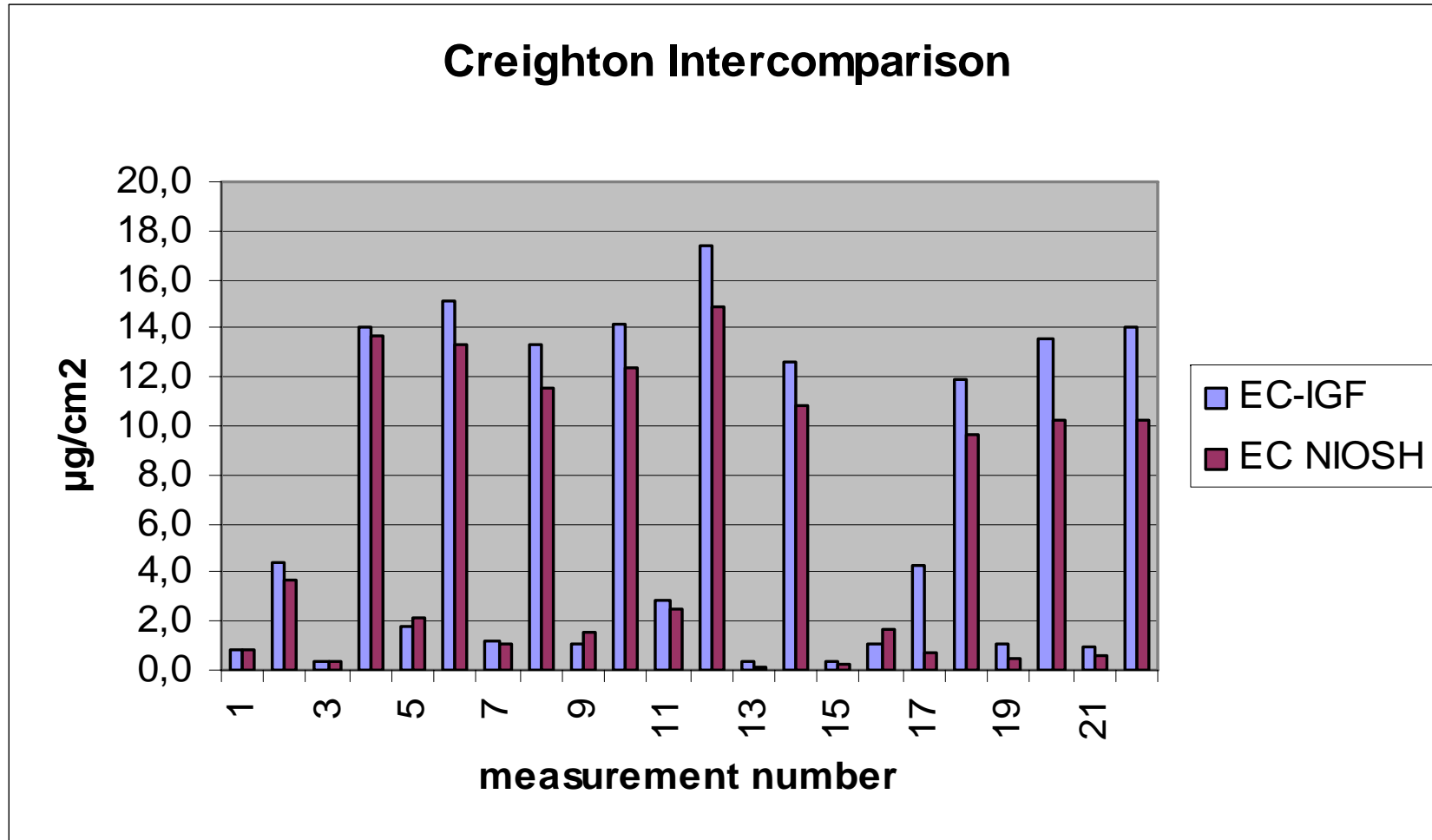
- ... of „elemental carbon“!

■ NIOSH 5040: another method for „elemental carbon“



- Also called the „thermo-optical“ method:
 - different „cut“ between „EC“ and „OC“ (higher temperature)
 - detailed investigation of the filter during the desorption process with optical (laser) methods to see changes within the sample and correct for them
 - consequently a little different analytical conditions between each sample
 - more expensive(?)

Results from a Canadian Mine:



■ Problems?



- Not in mining environments (as these are characterized by „mainly pure diesel EC“) as far as we can see
- however, in environmental settings (tobacco smoke, humic acid, and generally lower concentrations), problems with comparabilities may not be excluded (decomposition of oxygen containing compounds by higher desorption temperatures)

■ European Development



- A CEN group has finished work on a coulometric standard method, which has been successfully tested in a round robin test in our (IGF) test facility in Dortmund
 - results: All participants (Switzerland, France, Belgium, UK, Germany) reported results within 30% of the common average concentration

■ Problems:



- Currently **diesel particulate matter** („EC“) in workplaces is measured with **mass based procedures** though there is a lot of evidence that particle mass may **not** be the **relevant** property with respect to **health problems**
- The **particle number** (so-called „ultrafine particles“) based procedures are currently **not as well developed** with respect to standardization as the mass based ones.

■ Which methods are available?



- SMPS (DMA + CNC)
 - „scanning mobility particle sizers“
- ELPI
 - „electrical low-pressure impactors“
- PAS
 - „see before“
- DC
 - similar to PAS, but particles are „diffusion charged“

■ The SMPS Device:



■ Regulations since 2005



- Diesel soot is still considered carcinogenic
- The threshold limit was skipped
- Exposure has to be „minimized“ according to the state of the art.
- ...nevertheless the old ‘tlvs’ can be used to check whether the „state of the art“ of exposure control was matched.

■ Exposure Controll



- A variety of measures is given in the Technical Rule for Hazardous Substances (TRGS) 554 “Diesel Particulates (Dieselmotoremissionen)”
 - Primarily filter traps (NOT state of the art underground because of NO₂ problem)
 - Clean engines
 - Special fuel
 - Maintenance
 - Organizational matters
- This TRGS is currently revised because of the new Decree



Thank you for your attention and glückauf!