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The role of occupational exposure monitoring in the construction workplace with reference to diesel engine exhaust emissions LLECP Meeting 03/02/17

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Outline of talk



- Background overview of workplace respiratory hazards and the role of occupational exposure monitoring
- Approaches to personal exposure monitoring and required attributes
- Overview of developments at HSL in monitoring diesel engine exhaust emissions (DEEE)

• Summary

Exposure to construction dusts not new





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Workplace Respiratory Hazards – various airborne agents?



- Asbestos
- Silica
- Diesel engine exhaust emissions
- Wood dust
- Cement dust
- Lead and other metals
- Organics and solvents

COSHH



Regulation 10

 'Using valid and suitable occupational hygiene techniques to estimate the amount of employees' exposure to substances hazardous to health'





Role of exposure monitoring (HSG 173)





Managing Construction Health Risks

http://www.hse.gov.uk/construction/index.htm

http://www.hse.gov.uk/coshh/essentials/directadvice/index.htm

http://www.breathefreely.org.uk/

http://www.notimetolose.org.uk/

http://www.nepsi.eu/





Exposure monitoring options





- selectivity
- sensitivity (measurement range)(response time)
- acceptability (technical and cost considerations)
- robustness
- Output usually as published validated methods
 HSE MDHS, green handbook
 - -EN, ISO, ASTM consensus standards
 - -meeting EN 482 performance requirements

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Composition of DEEE



0.010

0.100

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1.000

Personal air sampling for DEP fraction of DEEE







Laboratory-based combustion analysis

- Measurement of elemental carbon (soot core) via combustion analysis
- Methodology codified in reference methods EN 14530 and NIOSH 5040
- Not quite equivalent but share the same two basic steps
 - Heat the quartz fibre filter to temperature A, quantify the evolved gas = OC
 - Increase to temperature B, quantify the evolved gas = EC
 - OC + EC = TC



Laboratory-based combustion analysis





"Bosch-meter " in-field measurement approach

- Low cost methodology for field-based measurements based upon an optical property i.e. "blackness" of the sampled soot
- Historically used in the UK mining industry
- Cross calibrated by HSL against reference EN combustion approach (site specific calibrations)





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"Bosch-meter" replacement project





Ongoing evaluation at HSL of the suitability of wearable sensors







Biological monitoring approach



- Two biological monitoring analytes have been proposed, namely 3aminobenzanthrone and 1-aminopyrene.
- It is thought that these two urinary amino-PAHs could serve as biomarkers of DEEE because amino-PAHs are metabolites of nitro-PAHs that are considered to be specifically emitted by diesel engines.
- Studies to date have observed a large inter-person variability, for example, in both the concentration of urinary 1-aminopyrene and the time course of appearance in the urine following controlled volunteer DEEE exposure studies.
- This suggests the need to explore further subject variables, for example, that may affect conversion of inhaled 1-nitropyrene to urinary excretion of 1-aminopyrene.

Take home messages



- Exposure monitoring has a part to play in workplace risk management strategies.
- With regard to inhalation hazards, we have the following monitoring approaches: personal air monitoring, real-time monitoring and biological monitoring.
- With respect to DEEE occupational air monitoring, we have reference combustion-based methods and we are seeing developments in wearable sensors (both based upon measuring the soot 'carbon' core).
- Occupational air DEEE monitoring and environmental/urban air monitoring approaches are aligned – sharing of data?
- Further work is required in developing urinary biomarkers for occupational monitoring.





- James Forder, Kate Jones, Chris Keen and Jim Knoll.
- David Green and Daniel Marsh.

Health and Safety Laboratory





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