Real-time exposure measurements of carbon nano-tubes using an aethalometer

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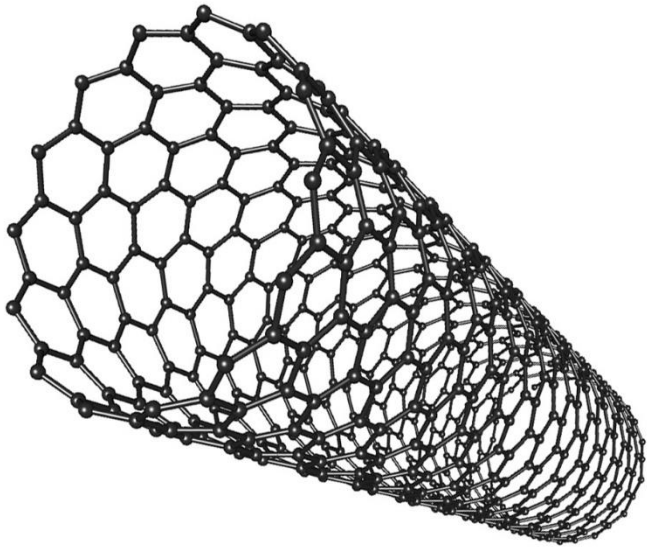

Presentation outline

- Study background & study design
- Results from particle counters & Aethalometers
- Conclusions about using Aethlometers for workplace measurements

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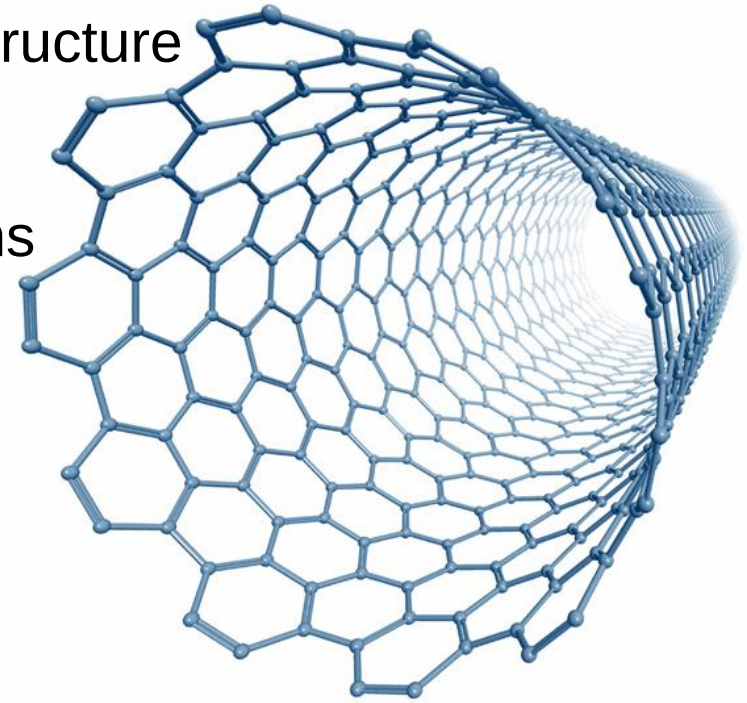
Carbon nanotubes (CNTs) - what & why

- Cylindrical, fiber-shaped nanostructure
- Material & electronic applications
  - Stronger & lighter materials
- Biopersistent
  - **High-toxicity materials**



Important with workplace exposure measurements

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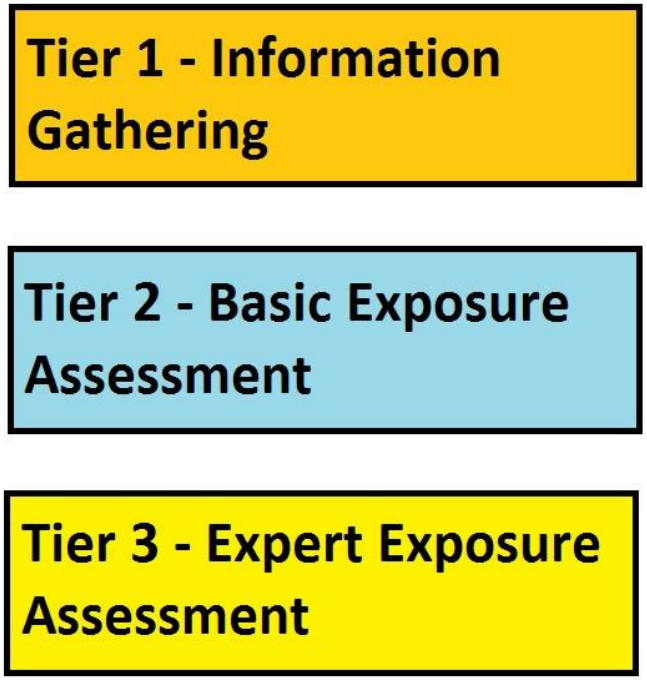
Performing workplace aerosol exposure measurements

- OECD suggests a harmonized tiered approach
- Tier 3: Expert exposure assessment with e.g. SMPS, CPC, APS, chemical analysis



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Workplace CNT exposure measurements

- Secondary manufacturer of CNT composite (CNT down-stream user)
- CNT exposure & emission monitoring
- 7 work tasks (WT)
- 3 measurement positions:
  - Background zone (BG)
  - Emission zone (EZ)
  - Personal breathing zone (PBZ)

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Instruments

- **SMPS** – Scanning mobility particle sizer
  - Particle concentration & size distribution
  - 0.01 to 0.7 µm
- **CPC** – Condensation particle counter
  - Particle concentration
  - 0.01 to 1 µm
- **APS** – Aerodynamic particle sizer
  - Particle concentration & size distribution
  - 0.5 to 20 µm
- **Aethalometers**
  - Black Carbon concentration
- **Filters**

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µ-Aethalometer (AE51)

- Used in the personal breathing zone (PBZ)

- Real-time analysis
- Measures absorbance at 880 nm
  - Sensitive to soot, elemental carbon (EC), CNT
  - Interpreted as concentration of **Black Carbon (BC)**
- Not specific for CNTs

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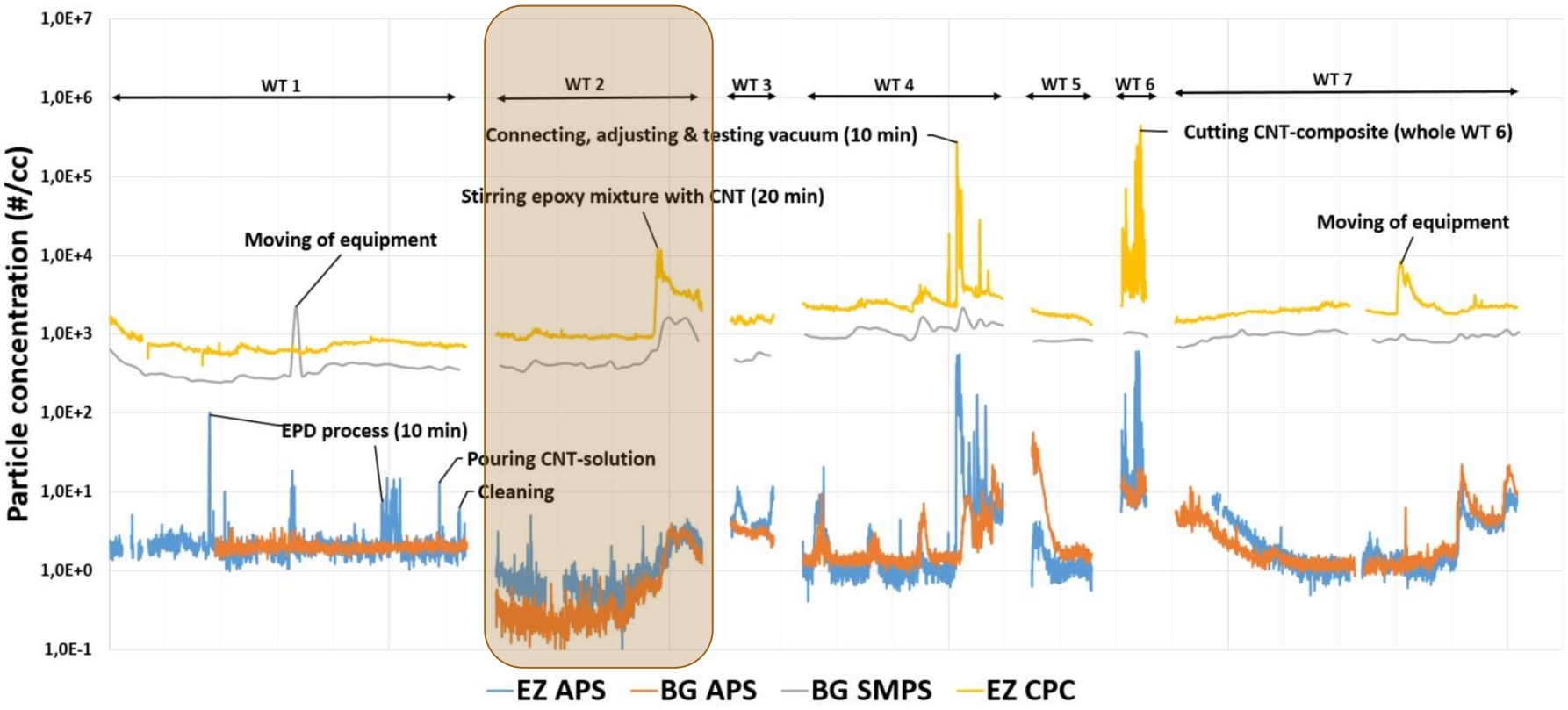
Results – SMPS, CPC, APS



EZ = Emission zone
BG = Background zone

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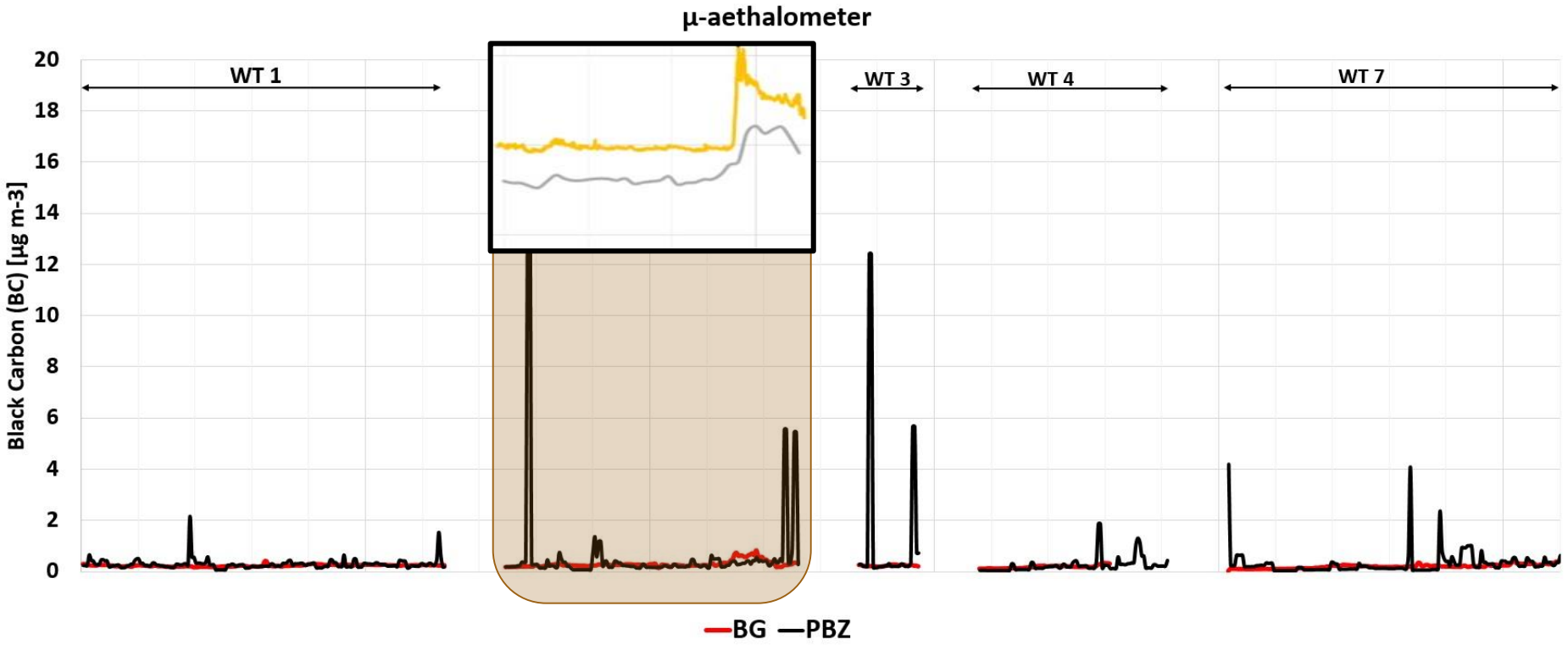
Results – Aethalometers



PBZ = Personal breathing zone
BG = Background zone

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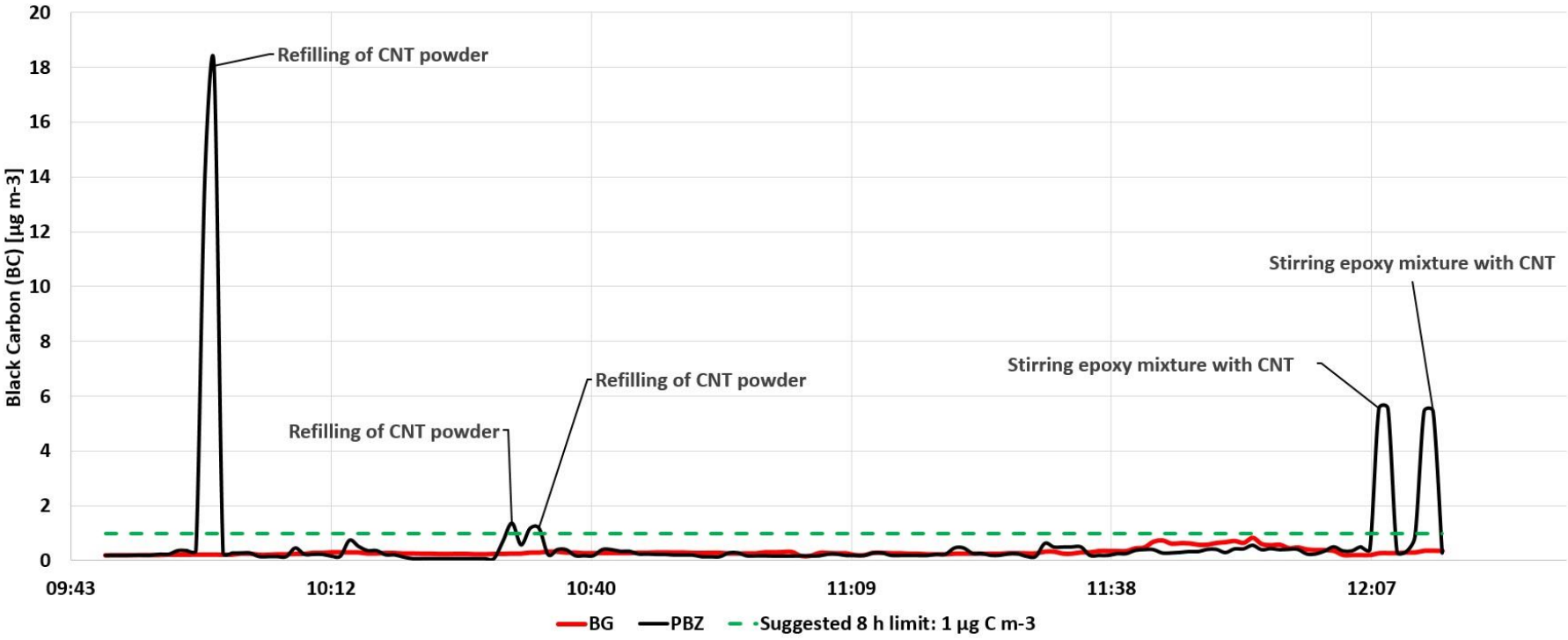
Results – zoom in of WT 2



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Results

	WT 1		WT 2		WT 3		WT 4		WT 5		WT 6		WT 7	
	av ± std	max, min	av ± std	max, min	av ± std	max, min	av ± std	max, min	av ± std	max, min	av ± std	max, min	av ± std	max, min
BC PBZ [ng/m3]	291 ± 198	2157, 71	649 ± 2008	*18050*, 73	**1394*** ± 3187	12419, 155	258 ± 315	1865, 42	(-)	(-)	(-)	(-)	312 ± 494	4194, 37
BC BG [ng/m3]	241 ± 34	401, 179	308 ± 127	825, 162	240 ± 26	280, 194	193 ± 58	343, 121	(-)	(-)	(-)	(-)	212 ± 77	446, 30

Bold* = (average PBZ– average BG) > 3*std BG
Italic = max value
(-) = instrument failure

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Conclusions

- Aethalometers
  - Valuable instrument for CNT exposure assessments
  - Easy to use & relatively cheap
  - Real-time exposure information
    - » Can link exposures to specific work-tasks (in comparison with time-integrated filters)

- µ-Aethalometer could be a good *Tier 2* instrument
  - Promising for personal exposure assessment of CNTs!

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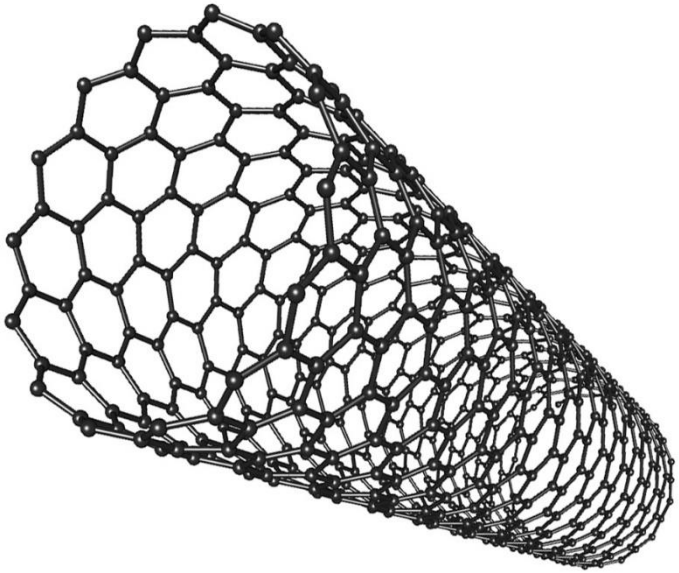
Thank you for your attention!



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