



**Finnish Institute of  
Occupational Health**

# **LOCAL EXHAUST VENTILATION AIR RECYCLING AND EXPOSURE TO METAL WORKING FLUIDS**

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# Background

- Metal working fluids (MWF) are complex chemical mixtures
- Concentrations of the single components of the mixtures in workplace air are usually well below their OELs
- Workers are still experiencing respiratory symptoms due to the combined exposure to chemicals and endotoxins
- Airborne chemical agent in 2004-2005 Finnish metalworker project:
  - Oil mist 0.14 (0.01 – 0.6) mg/m<sup>3</sup>
  - Inhalable dust 0.78 (<0.14 – 2.0) mg/m<sup>3</sup>
  - Total-VOC 1.9 (0.35 – 4.5) mg/m<sup>3</sup>
  - Total aldehydes 0.095 (0.026 – 0.38) mg/m<sup>3</sup>
  - Formaldehyde 0.040 (0.011 – 0.15) mg/m<sup>3</sup>
  - Alkanolamines 0.15 (0.0082 – 0.82) mg/m<sup>3</sup>



# OELs and target levels

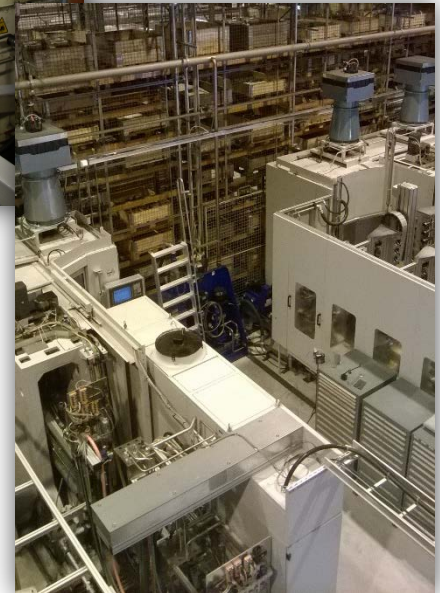
- Finnish OELs (8h) for some of the components:
  - 2-aminoethanol (2.5 mg/m<sup>3</sup>), diethanolamine (2 mg/m<sup>3</sup>), triethanolamine (5 mg/m<sup>3</sup>), morpholine (36 mg/m<sup>3</sup>), formaldehyde (0.37 mg/m<sup>3</sup>) and oil mist (5 mg/m<sup>3</sup>)
- Target levels
  - voluntarily applied guideline values for the improvement of work environments beyond the legally binding or OEL-defined levels of workplace air quality
  - especially useful for complex mixtures where occupational exposure limit values of individual substances are not applicable
  - FIOH's target level for alkanolamines 0.1 mg/m<sup>3</sup>
  - FIOH's target level for Total-VOC 300 µg/m<sup>3</sup>
  - FIOH's action level for Total-VOC in industrial premises 3000 µg/m<sup>3</sup>

**Target level =**  
Exposure level  
achievable by  
advanced control  
technology with  
minimal health  
and comfort effects

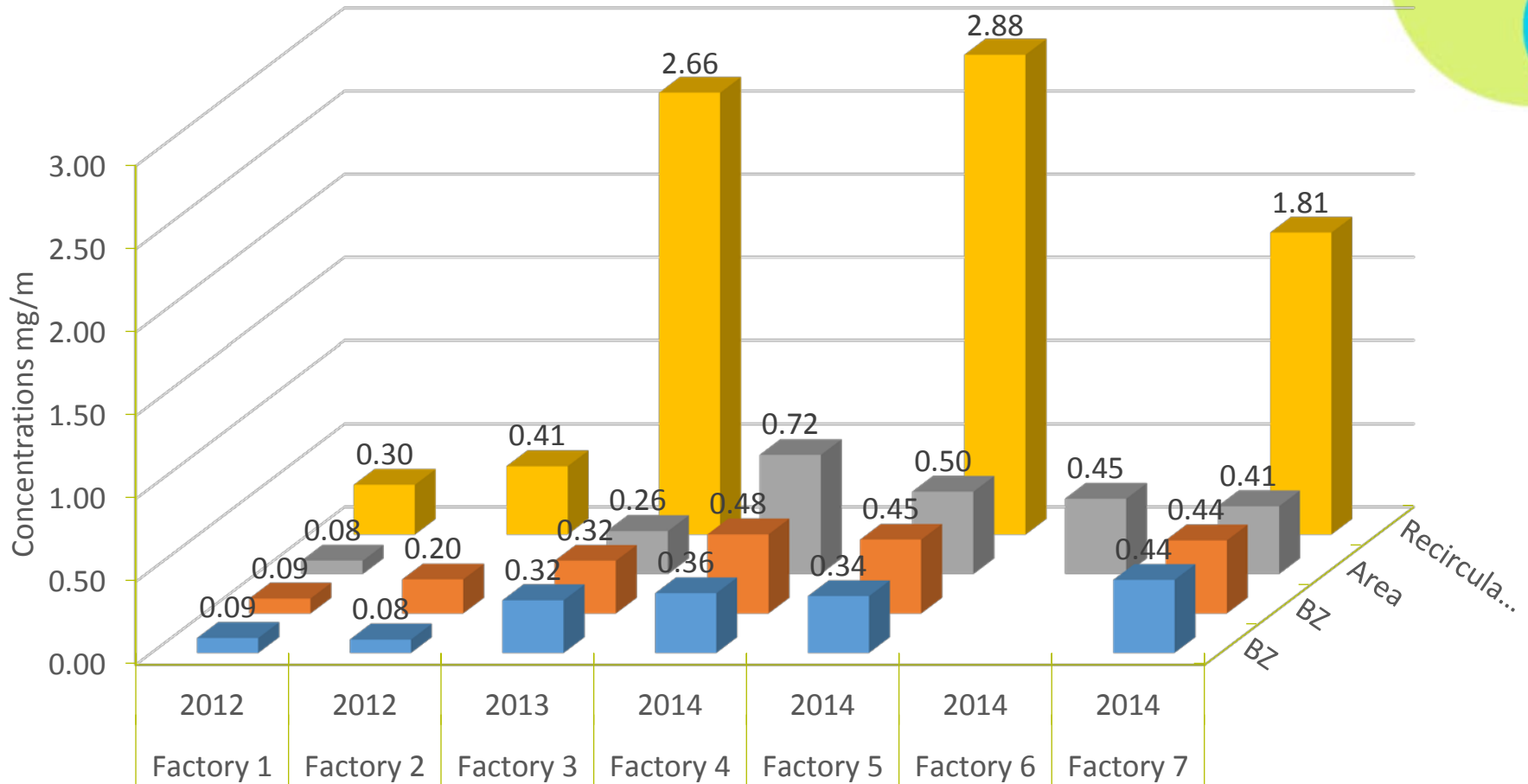


# Local exhaust ventilation air filtration in machining centres

- Modern machining centres have full enclosures and are normally equipped with local exhaust ventilation (LEV).
- The air from the LEV unit can be directed outside the factory or returned back to the hall after filtration.
- Mist collectors used in machining centres usually consist of multi-stage particulate filters and they can remove particles efficiently especially if HEPA filters are used.
- Chemical agents occurring in the vapour phase penetrates the filtration unit and may increase the airborne contaminant levels



# Some FIOH's latest consultancy measurements



■ BZ ■ BZ ■ Area ■ Recirculation

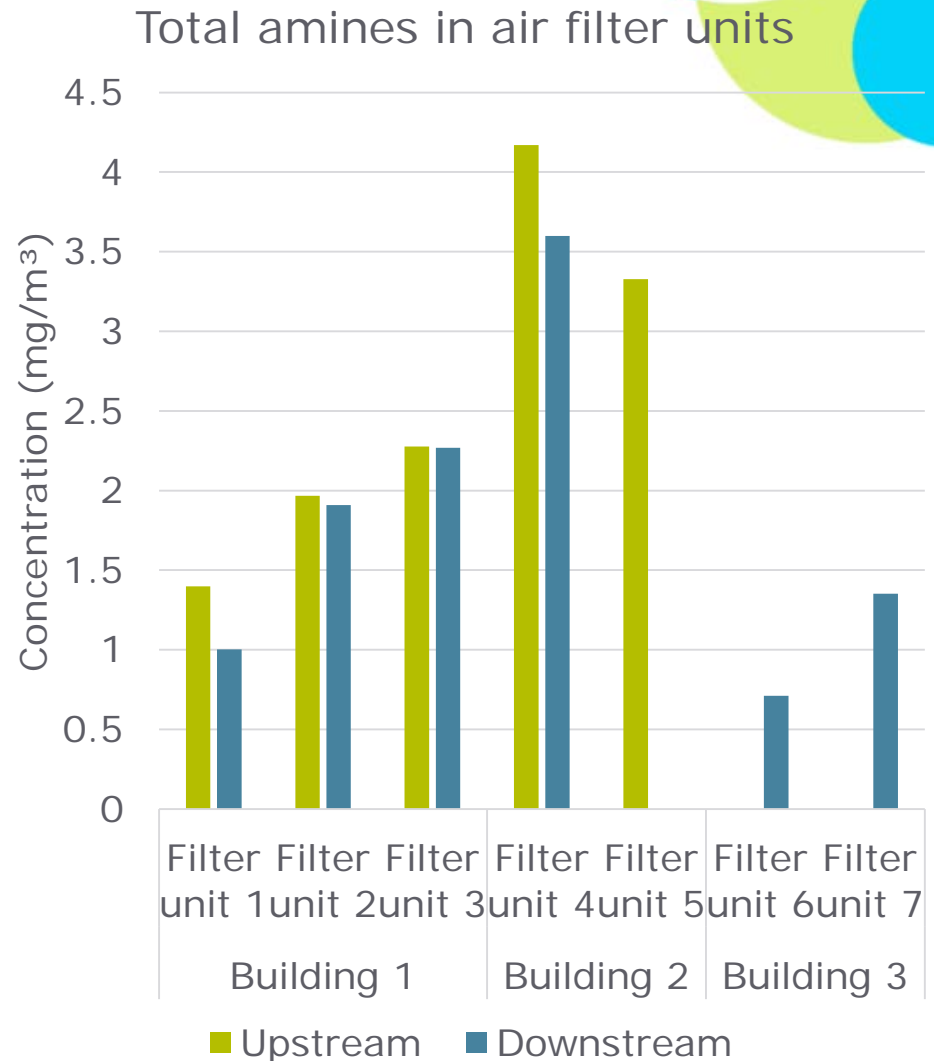
# Studied air filtering units

- All filtering units had at least HEPA 13 filters as final stage

Factory	ID	Type	Exhaust air
<b>Building 1</b>	Filtering unit 1	Centralized filtering unit	Outside
	Filtering unit 2	Centralized filtering unit	Recirculation
	Filtering unit 3	Single machine filtering unit	Recirculation
<b>Building 2</b>	Filtering unit 4	Centralized filtering unit	Outside
	Filtering unit 5	Centralized filtering unit	Outside
<b>Building 3</b>	Filtering unit 6	Single machine filtering unit	Recirculation
	Filtering unit 7	Single machine filtering unit	Recirculation
	Filtering unit 6	Single machine filtering unit	Outside
	Filtering unit 7	Single machine filtering unit	Outside

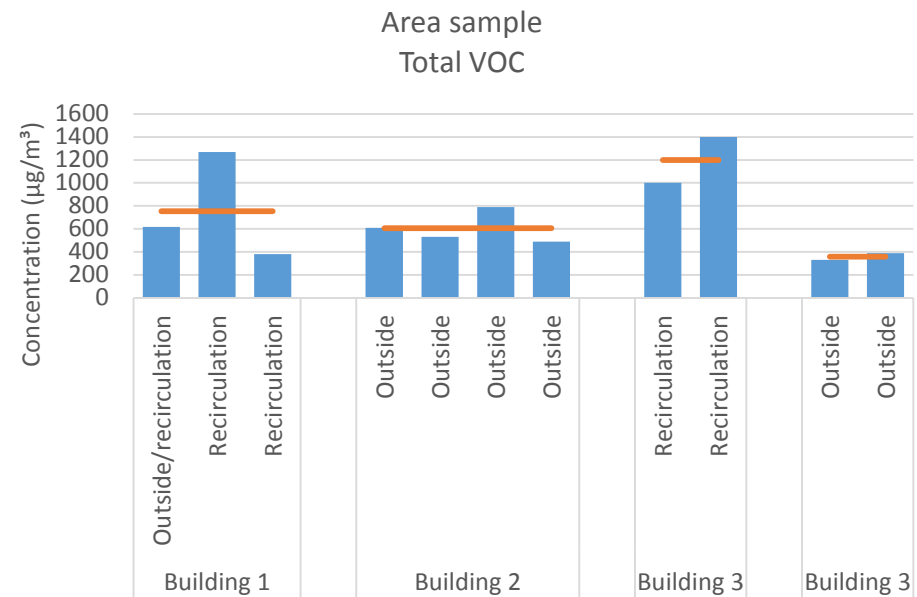
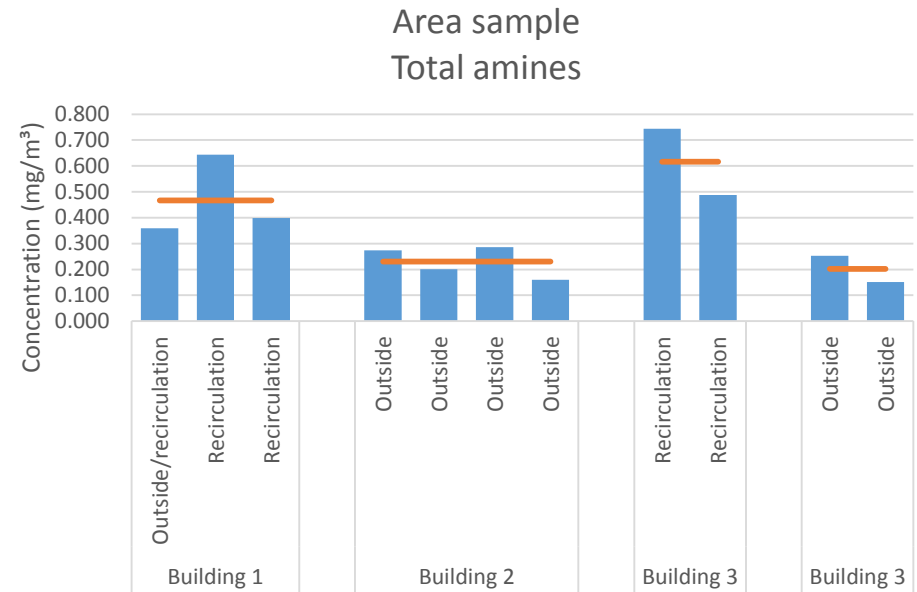
# Volatile compounds in recirculating air

- Total amine concentration 0.67 – 4.17 mg/m<sup>3</sup>
  - Dicyclohexylamine
  - 2-Dimethylaminoethanol
  - N-Cyclohexylaniline
- Total VOC concentration 1700 – 4400 µg/m<sup>3</sup>
  - Nitrogen compounds
  - Alcohol and phenol ethers
- Concentrations much higher than in general room air



# Area samples = Air quality in general room air

- Total amine concentrations were lower when LEV air was exhaust outside
- Also in the case of total VOC but not so clear
- Building 3: Change recirculation → exhaust outside
  - Reduction  $\approx 70\%$



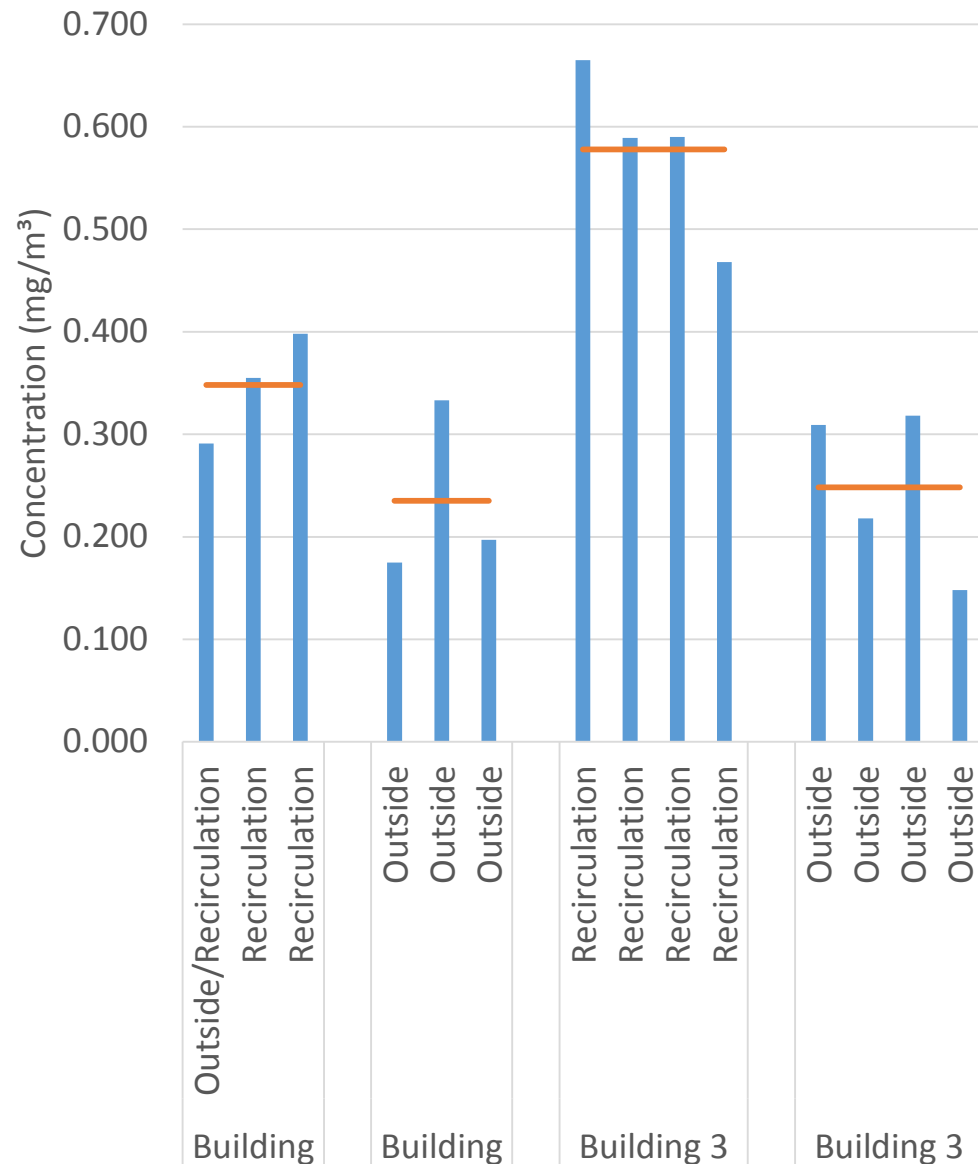


# Breathing zone samples

- Concentrations about the same level as in the area samples
- Concentrations exceeding the FIOH's target level of  $0.1 \text{ mg/m}^3$
- Contribution of other sources?



Breathing zone samples  
Total amines



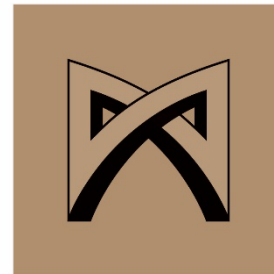
# Conclusions

- Most of the recirculating LEV air filtering devices are not retaining volatile contaminants
- Concentrations of volatile compounds in recirculating air much higher than in general room air
- Exhausting LEV air outside the building may reduce volatile contaminants inside the building significantly
- Next step: Filtering of volatile compounds
  - Several air cleaning methods are under development and testing



# Acknowledgements

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at work is productive**

**Thank you!**

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