



# A Comparison of Samplers for Inhalable Welding Fumes and Laboratory Analysis for Manganese

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Belgian Center for  
Occupational Hygiene



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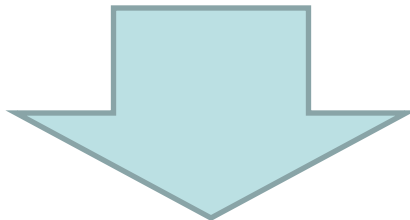
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# Introduction

- Welding fumes and manganese exposure is a major domain of interest for Occupational Hygienists
- Important to decide which material should be used for sampling
- International methodology is not consistent according to the use of:
  - Samplers
  - Sampling filters
  - Sampling time
  - Laboratory analysis
- Dose-response recalculations out of historical data
  - ! Conditions have to be comparable

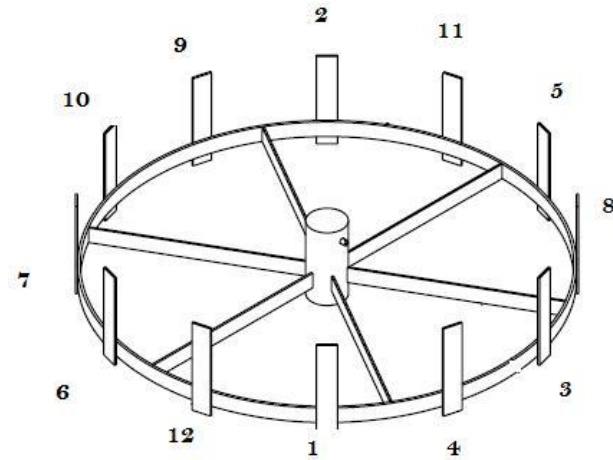
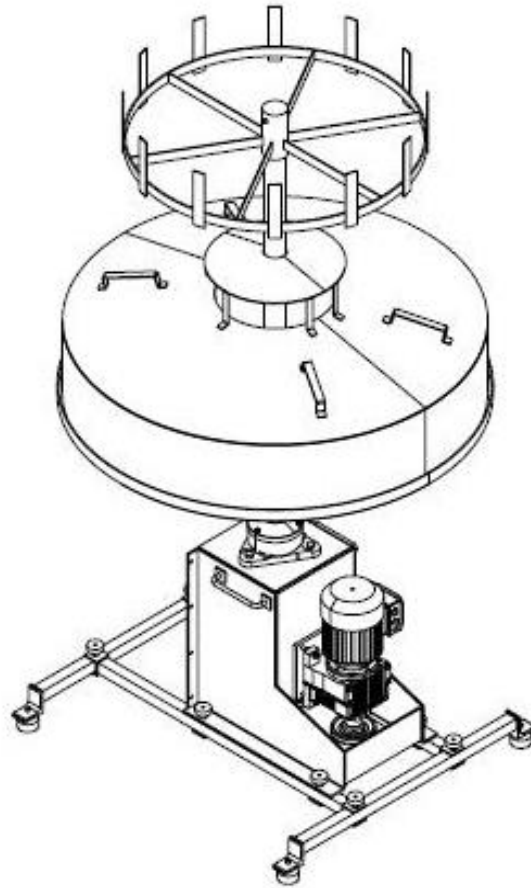
# Laboratory vs WP

- Laboratory
  - Controllable atmosphere
  - Controllable homogeneous aerosol
  - Equal exposure for each sampler
- Workplace
  - Stationary ⇔ personally
  - Work routine not controllable
  - No equal exposure



Hard job to execute  
comparisons in WP

# Workplace Atmosphere Multisampler: WAM

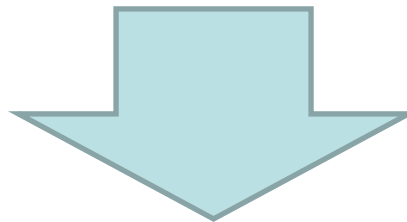


# Workplace Atmosphere Multisampler: WAM



# WAM

- WAM makes it possible to
  - Provide a homogeneous aerosol for all 12 samplers → 2,8 rpm
  - No interferences from pump flows → shielded with decks
  - Mobile & light → comparisons possible at different places
  - Adjustable for explosive atmospheres (mines, ATEX,...)
  - Good height → respiration zone
  - Stable
  - Can it be used to compare inhalable samplers according to Witschger, O., Willeke, K., Grinshpun, S.A., Aizenberg, V., Smith, J. and Baron, P. "Simplified Method for Testing Personal Inhalable Aerosol Samplers", J. of Aerosol Science, 29:855-874 (1998)?



Needs validation

# WAM: Validation part 1 – is the use of a torso required?

- According to Witschger et al. “Simplified Method for Testing Personal Inhalable Aerosol Samplers”, J. of Aerosol Science, 29:855-874 (1998) a torso is needed when inhalable samplers are compared
- A torso was used next to the WAM runs



# WAM: Validation part 2 – equal sampling

- Gravimetric analysis
- 3 runs with 6 identical combinations of plastic IOM samplers filled with MCE filters
- Average concentration and range
- SD
- RSD (%)

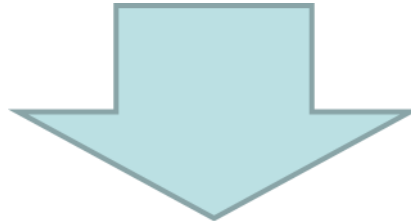


# WAM: Validation

- Goal: Average RSD < 10% for each type of sampler
  - Pump fault
  - Gravimetric analysis
  - Samples with pump errors are not included in these figures
- EN 482 – Expanded uncertainty requirements for measurements for comparison with limit values and periodic measurements
  - Long term sampling (> 2 hours)
    - Exposure index (Concentration measured/Limit value) 0,1 - < 0,5 → 50%
    - Exposure index (Concentration measured/Limit value) 0,5 - 2 → 30%
- EN 689 – Assessment of exposure by inhalation to chemical agents for comparison with limit value and measurement strategy
  - Exposure index < 0,1 → exposure negligible
  - Exposure index 0,1 - < 0,25 → exposure under control
  - Exposure index 0,25 - < 0,5 → exposure not under control – follow up needed identify exposure
  - Exposure index > 1 → over exposure– immediate measures needed to reduce exposure

# WAM: Validation - results

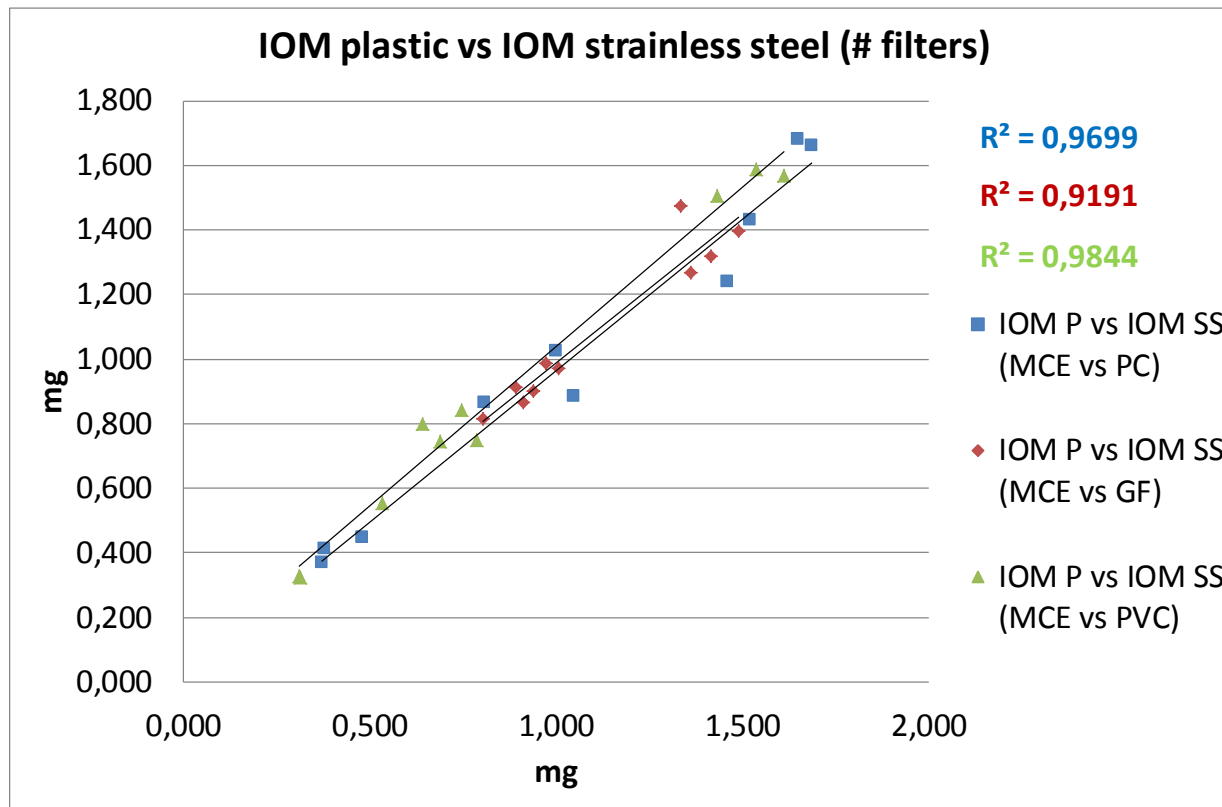
- Is a torso required in a workplace – calm air conditions?
  - The variation between the WAM and the Simplified Torso was not more than 4,9% → OK
- Does the WAM equally sample?
  - The average variation of the 3 runs was 5,5% → OK



WAM can be used for a  
comparison study of inhalable  
samplers

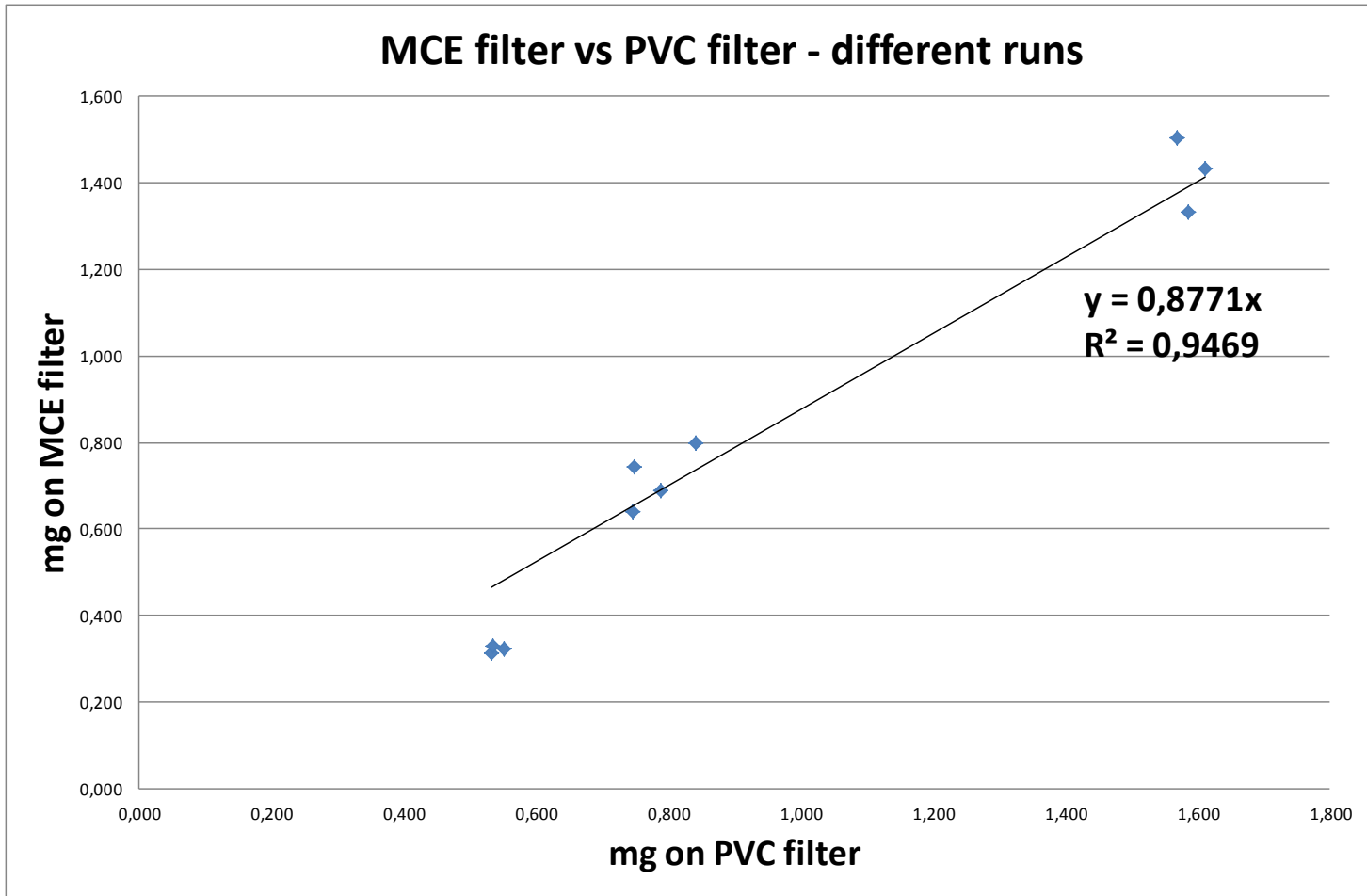
# Results - Comparison inhalable samplers

- 2 types of samplers where compared with different filters
  - MCE filter was used as a reference filter
  - Plastic IOM and cassette vs Stainless steel IOM and cassette

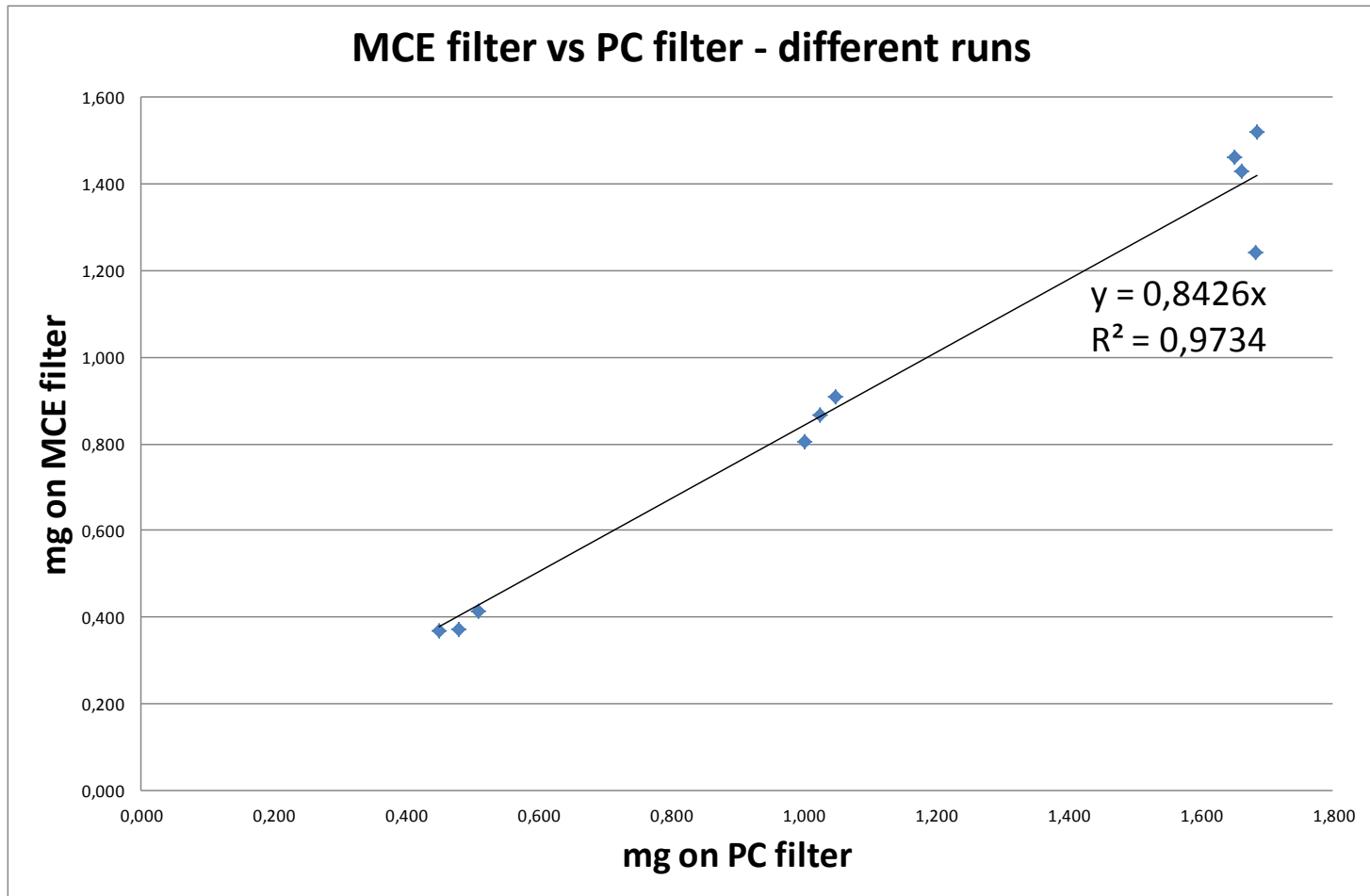


No significant difference  
between the two samplers

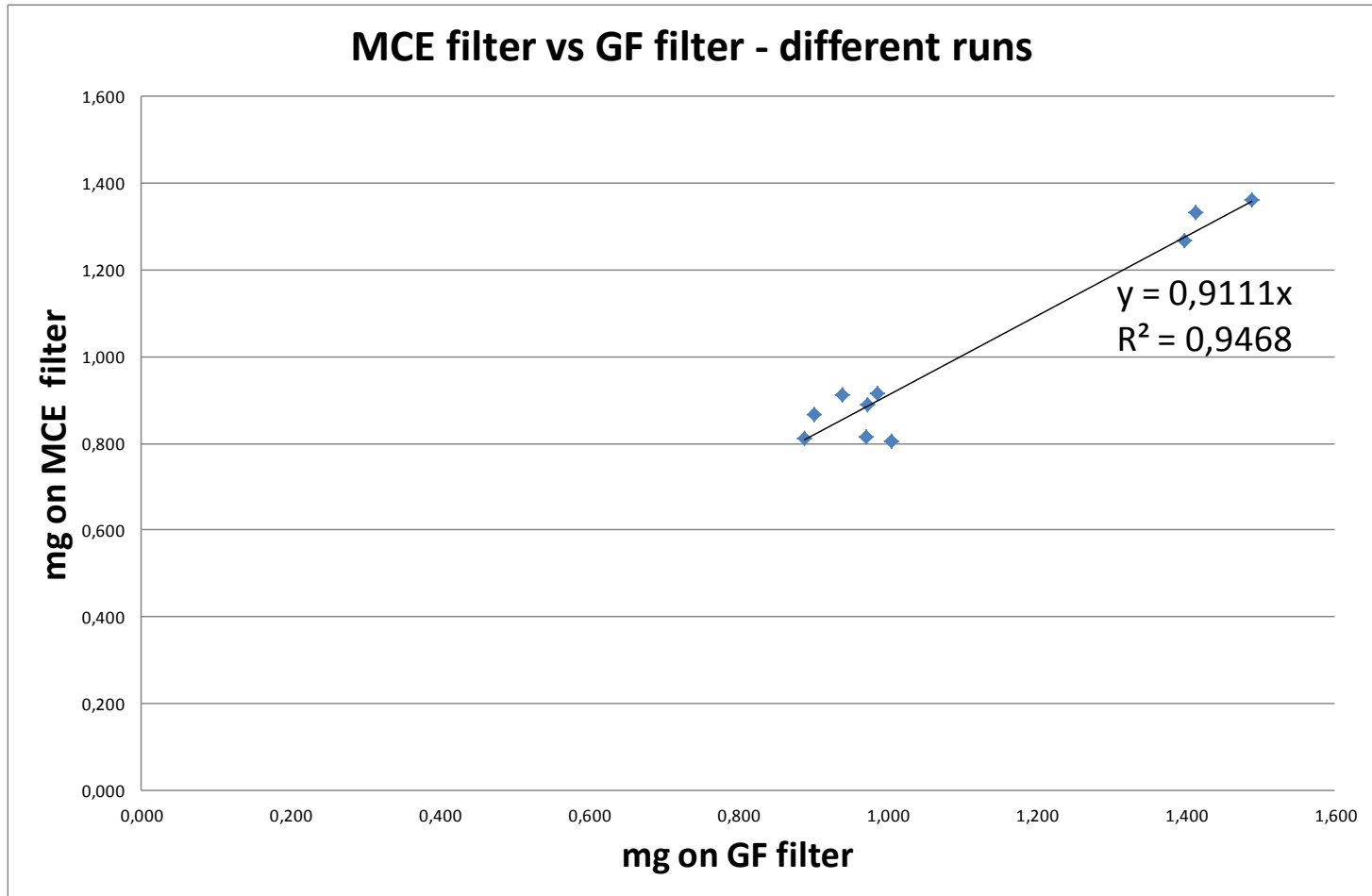
# Results - Comparison filters used



# Results - Comparison filters used



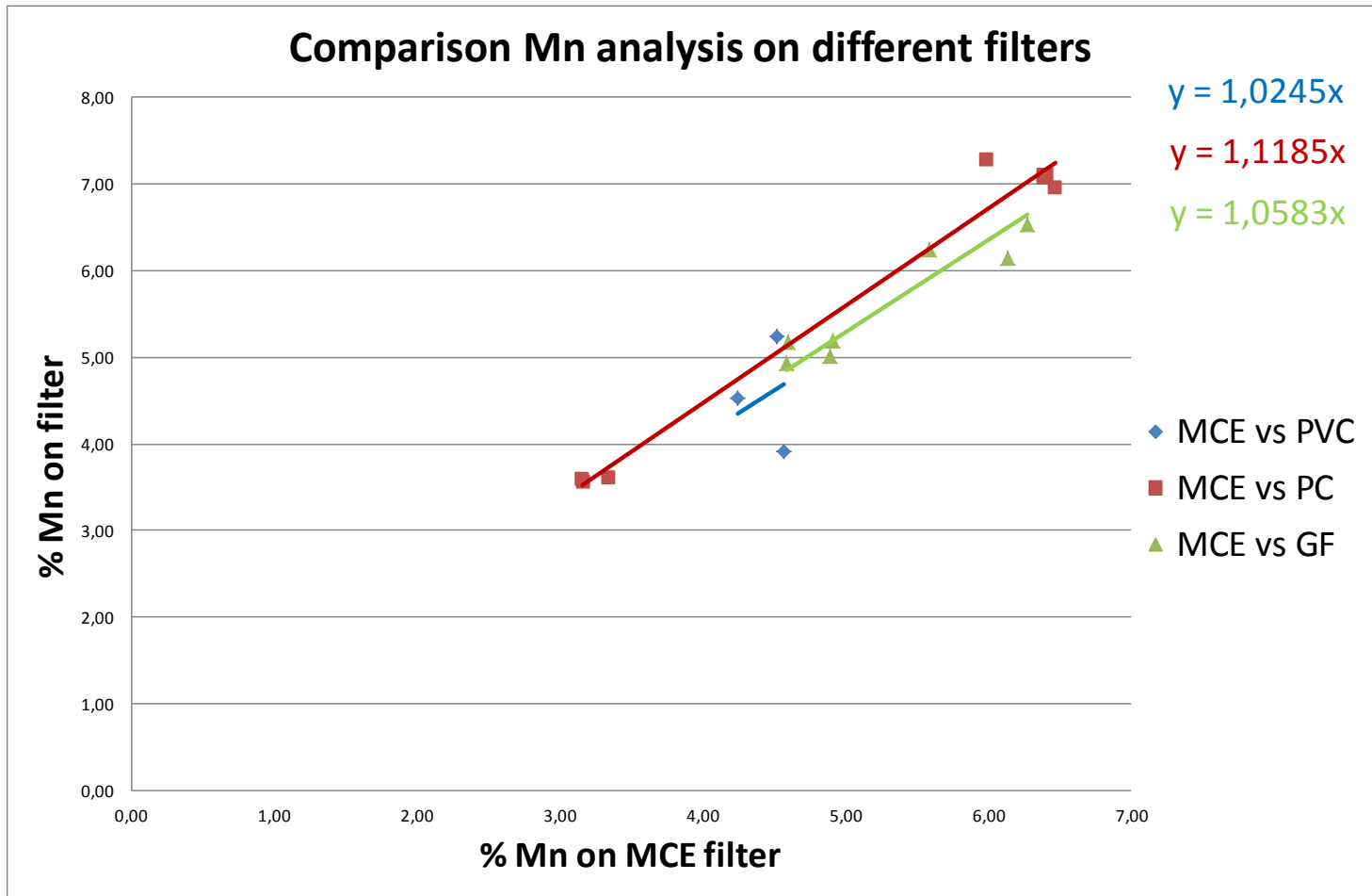
# Results - Comparison filters used



# Results - Comparison Manganese analysis

- Three different laboratories performed the analysis of manganese on the different filters:
  - Using there in house method
  - 2 laboratories used Inductive Coupled Plasma (ICP)
    - One laboratory used ICP-AES
    - One laboratory used ICP-MS
  - 1 laboratory used Atomic Absorption Spectroscopy AAS

# Results - Comparison Manganese analysis





# Conclusion

- Gravimetric analysis found that the MCE filters were under sampling
  - compared to the PVC ( $y=0.88x$ )
  - compared to the PC ( $y = 0.82x$ )
  - compared to the GF ( $y = 0.91x$ )
- No significant differences were found in between the types of filters
- No significant differences were found between the IOM plastic sampler and cassette and the IOM stainless steel sampler and cassette
- No significant differences where found between the methods. Although it seems that lower concentrations are more accurately measured by ICP techniques
- Manganese analysis showed that MCE filters retain more manganese compared to PC and GF

# Conclusion

- Manganese analysis showed that MCE filters retain more manganese compared to the other filters
  - 2% more than PVC filters
  - 6% more compared to GF filters
  - 13% more compared to PC filters
- WAM can be easily used for evaluation and comparisons of samplers in the workplace
- This is necessary to better understand the behaviour and sampling in the workplace
  - New PTS
  - WASP
  - ALASCA
  - How do laboratories perform in analyzing real workplace samples (proficiency)

# Discussion

- Further research is necessary to determine the retention of metals and metalloids on different filters
- More comparisons of analysing techniques for metals and metalloids are necessary to have a better understanding of the differences (low concentration range)
- Could those differences explain the differences in metabolite results? Especially for welding fumes.

# Thank you for your attention

## Please take a look at:

**A Comparison of the Performance of Samplers for Respirable Dust in Workplaces and Laboratory Analysis for Respirable Quartz**

- <http://annhyg.oxfordjournals.org/content/early/2012/07/17/annhyg.mes038.full>

**Differences between samplers for respirable dust and the analysis of quartz - An international study**

[http://www.astm.org/DIGITAL\\_LIBRARY/STP/PAGES/STP156520120188.htm](http://www.astm.org/DIGITAL_LIBRARY/STP/PAGES/STP156520120188.htm)

# Q&A

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