



WORKING FOR A HEALTHY FUTURE

Development of standard method for measuring Mn exposure in the workplace

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Background

- The effects of inhalation of high levels of Mn dust on the human nervous system are well documented.
- In 2004, the IOM, the MRC and the IEH produced a health Criteria Document for Mn and inorganic Mn compounds that suggested OELs of $0.1 \text{ mg}\cdot\text{m}^{-3}$ for respirable Mn and $0.5 \text{ mg}\cdot\text{m}^{-3}$ for inhalable Mn.
- However, a variety of sampling devices are used by the Mn industry to assess exposure to the respirable and inhalable fraction causing a degree of uncertainty when comparing exposure concentrations.

Why a standardised or reference method?

- Implementation of any international OEL for respirable or inhalable dust
- Comparison of exposure information from different companies/sites/countries

Requirements standardised/reference method

- Sampler should meet the CEN/ISO/ACGHI sampling curve for respirable and inhalable health-related fractions.
- Samplers should be easy to use, widely available and cheap (to buy and use)
- Comply with national regulatory requirements

Aim and objectives

Aim

- To propose a standard / reference method for sampling inhalable and respirable Mn.

Objectives

- Literature review of available sampling methods.
- Collection of information on sampling methods used in the Mn industry.
- Field comparison of selected methods.

Candidate samplers



**IOM inhalable
head**

Inhalable dust



**Higgins Dewell
Cyclone**

Respirable dust



**Conical
Inhalable
Sampler (CIS)**

Dual fraction: inhalable
and respirable dust

Methodology: field comparison

Four Mn companies agreed to participate:

- 1) Mn_3CO_3 , MnSO_4 and MnO_4
- 2) Ferromanganese alloys
- 3) Electrolytic Mn
- 4) Silicomanganese and ferromanganese



Methodology: sampling strategy

- Collection of full-shift side-by-side measurements:
 - Personal: CIS & IOM or CIS & CYC
 - Static : CIS & IOM & CYC
- Employees were briefed about the importance of the study.
- Field blanks collected at the 4 sites and used to correct exposed samples.

Methodology

Gravimetric analysis

- Modification of the MDHS 14/3 method (HSE,2000).

Limit of detection (mg)

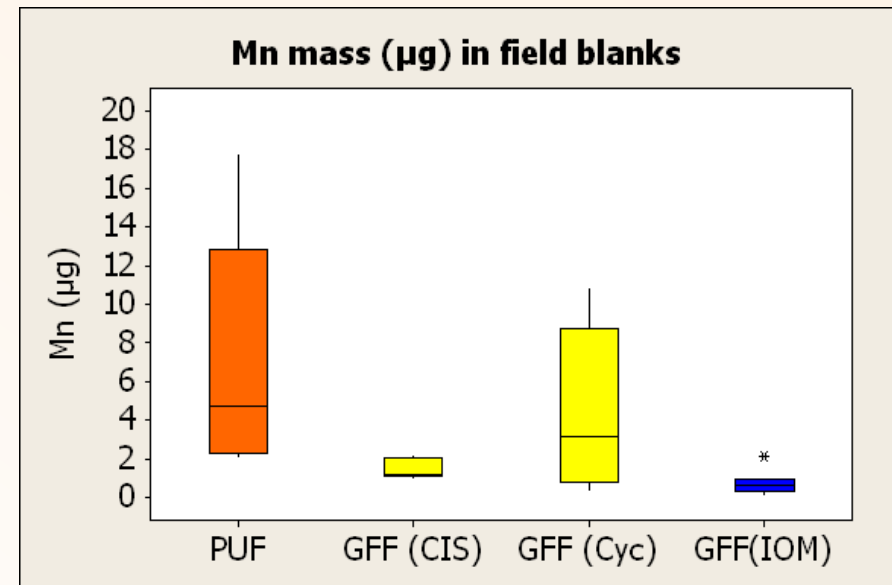
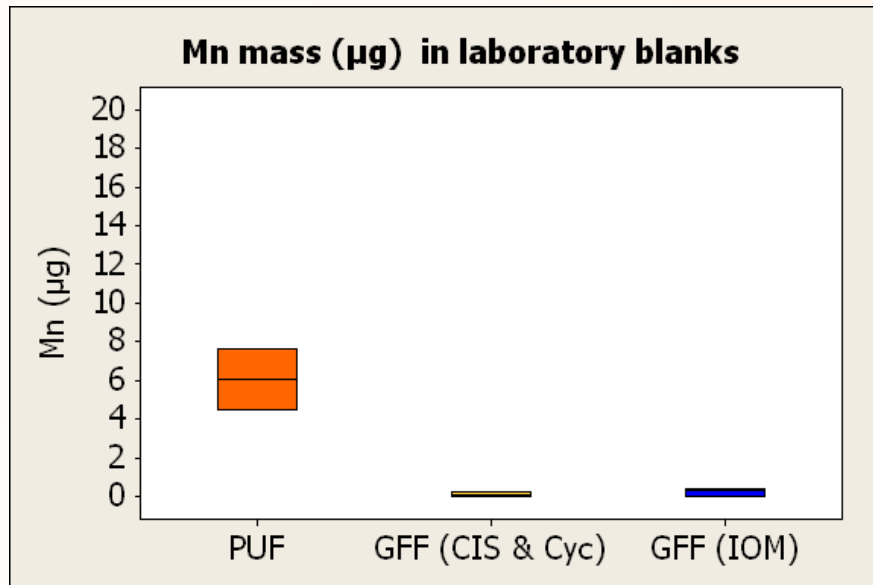
Sampler	IOM	Cyclone	CIS-I	CIS-R
	0.1	0.05	0.1	0.05

Chemical analysis (total Mn)

- Modification of the OSHA AD 121 method (OSHA, 2002)
(acid digestion and analysis by ICP-AES).

LOD= 0.1 µg/ sample

Mn mass in the laboratory & field blanks



PUF: polyurethane foam

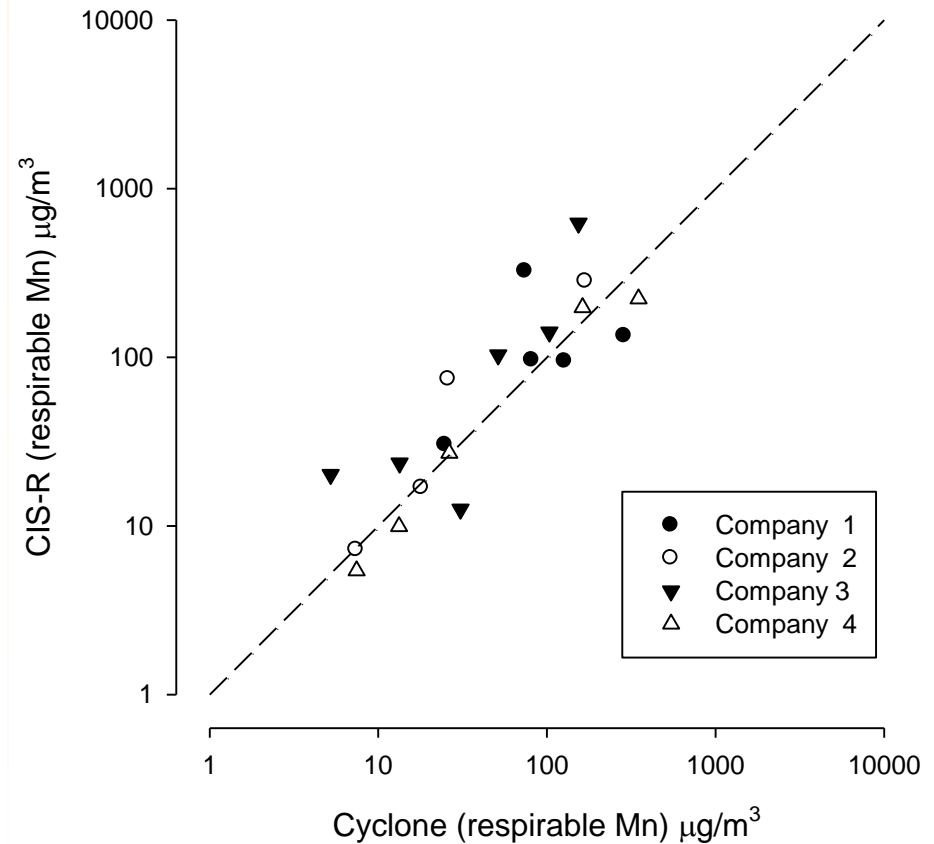
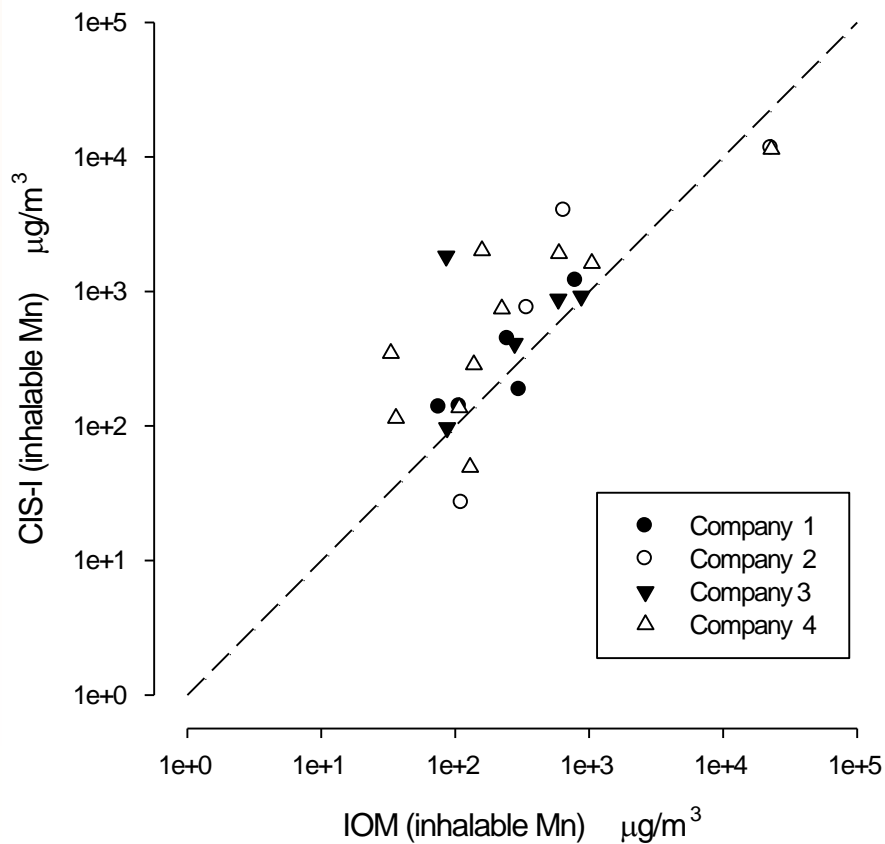
GFF: glass fibre filter

CIS: Conical Inhalable Sampler

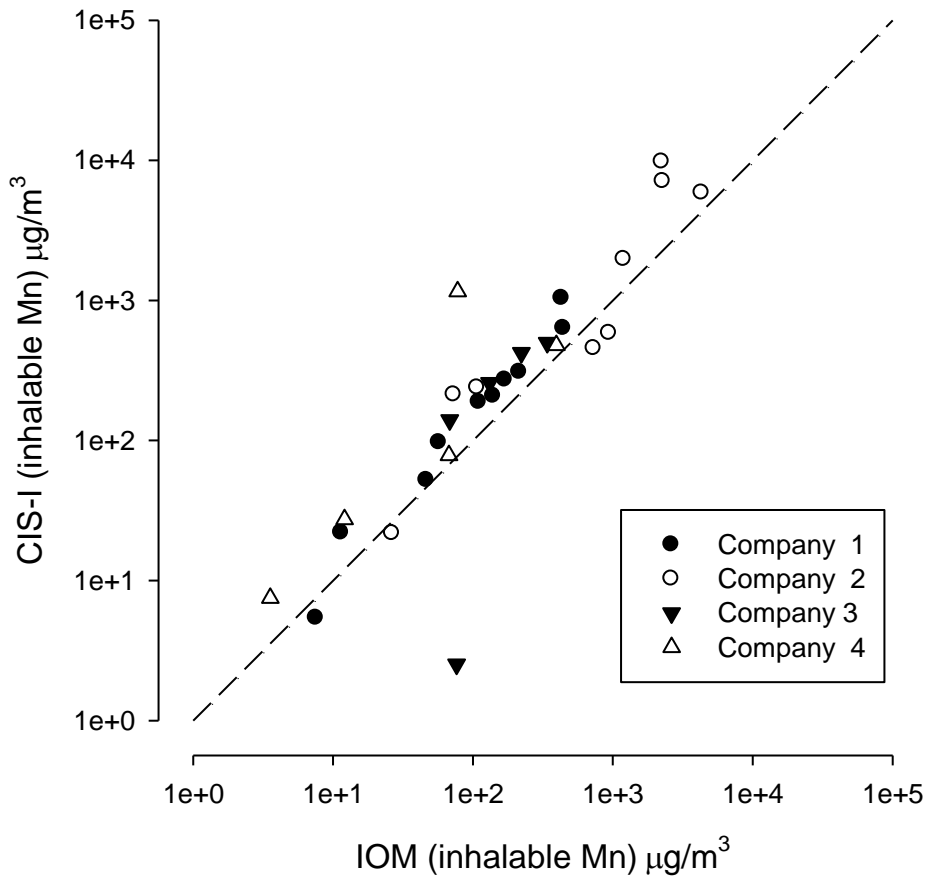
Cyc: cyclone

IOM: Institute of Occupational Medicine sampling head

Personal inhalable and respirable Mn concentrations



Static inhalable and respirable Mn concentrations



Limitations

- Analysis of a limited number of PUF (2 laboratory blanks & 8 field blanks).
- Particle losses during transport.
- Movement of particles from the filter to the PUF in the CIS sampler.

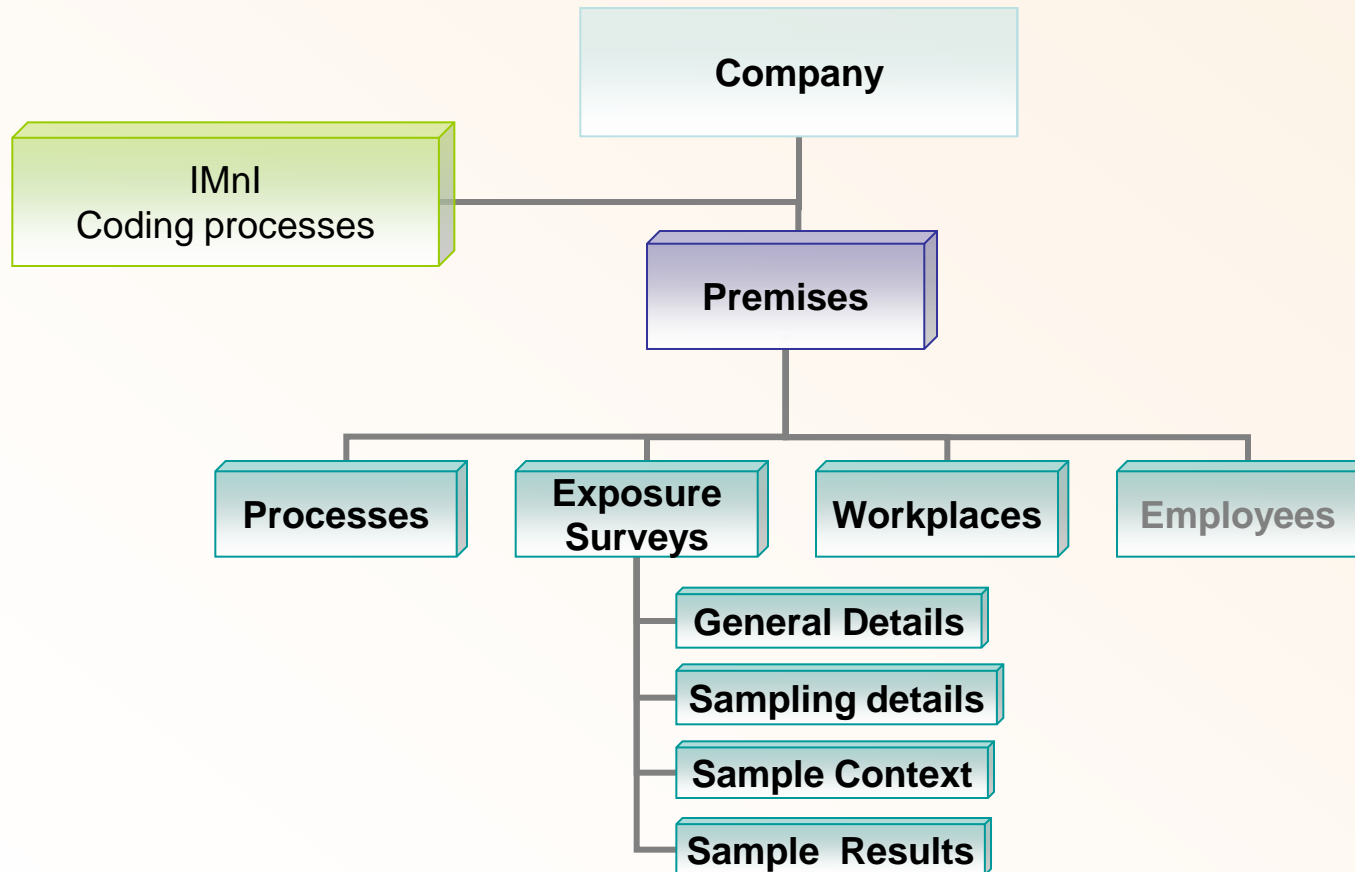
Conclusions

- CIS sampler oversampled compared to the IOM head and Higgins Dewell cyclone.
- High Mn content in PUF used with the CIS.
- IOM and cyclone are more appropriate for collection of inhalable and respirable Mn dust.
- The use of the same sampling methods will allow making comparisons between sites, companies and countries, and with appropriate OELs.

Recommendations for further data collection

- Focus on (full-shift) personal exposure measurements
- Ideally, use the reference methods for inhalable (IOM sampling head) and respirable dust (HD cyclone).
- Or carry out side-by-side sampling with reference and local sampling method to obtain conversion factor.
- Standardise measurement and analytical protocols across companies
- Set-up inter-laboratory comparison for Mn analyses
- Need to standardise collection of contextual information with the measurements
- Use MANGANEX for storage of exposure data

Manganex database



Manganex database: link in IOM website

<http://www.iom-world.org/research/manganex.php>

Database characteristics

- Currently standalone localised system (in Access)
- Multiple company – multiple sites
- Ability to upsize database and easily add new functional aspects
- Other agents, substances and methods could be added
- Coding lists – look ups and maintenance forms

- Thank you for your attention!