
READ ACROSS OF EXPOSURE DATA
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TNO innovation for life
GUIDE nano

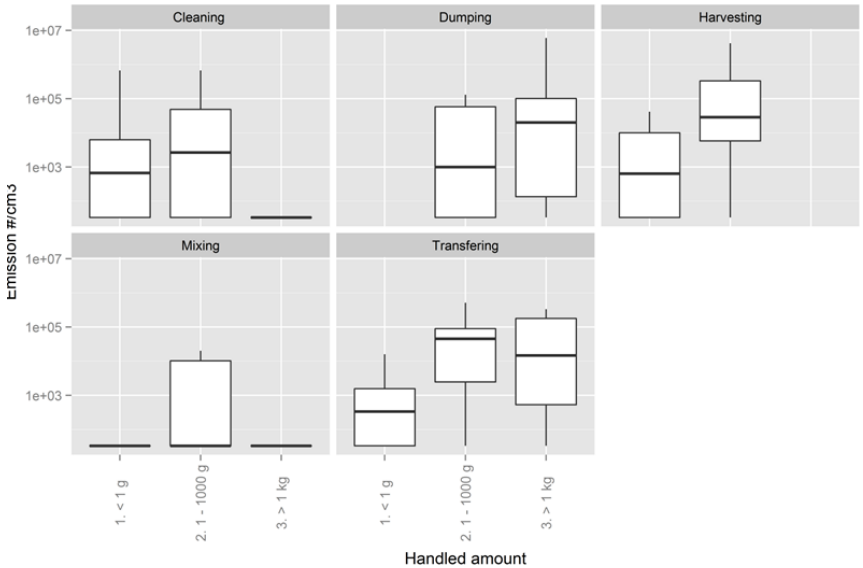
ILLUSTRATING EXAMPLE

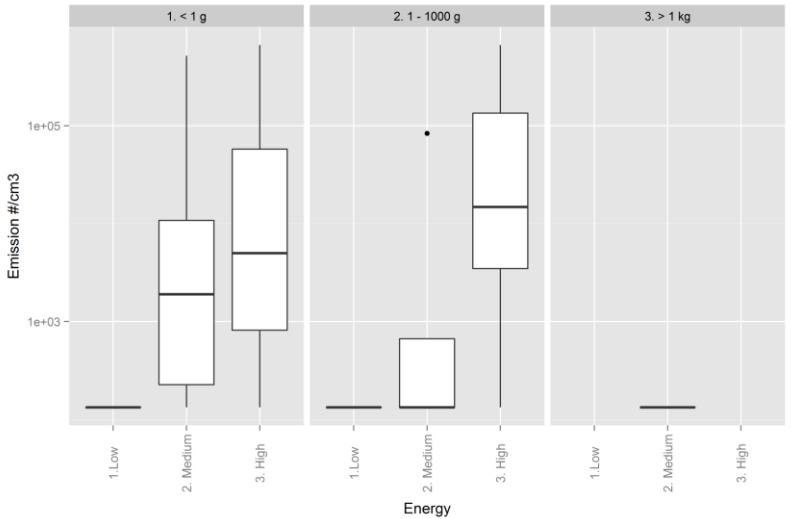
- **Question:**
  - What is the personal exposure during handling of low quantities of MWCNTs in a fume hood?
- **Answer:**
  - No own measurement data available;
  - No quantitative exposure models available;
  - Measurement data described in literature.
- **Question:**
  - How comparable are these measurement data to the real situation?
- **Answer/solution:**
  - We need a read across approach for exposure data!

BACKGROUND – PREVIOUS WORK

Systematic review
131 emission scenarios (SD2)

Literature was ‘normalized’, ‘backwards calculation’ procedure
Correcting for different workplace circumstances





E. Kuijpers, C. Bekker, D. Brouwer, M. le Feber, W. Fransman, Understanding workers’ exposure: Systematic review and data-analysis of emission potential for NOAA, Journal of Occupational & Environmental Hygiene, accepted for publication 21-10-2016

RESEARCH QUESTIONS

- The market for nanomaterials is increasingly expanding with potentially more workers exposed.
- It would be expensive, impracticable and time consuming to carry out case-by-case studies with individual exposure measurements for each chemical under every circumstance .
- For hazard data read-across is used while for exposure read-across is not used (also not for non-nano).
- Control banding tools need more data and understanding of data for development into (semi-) quantitative exposure models.
- An in-depth read-across approach could help both for:
  - Current exposure assessment questions (see example);
  - (Near) future modelling development.

METHOD

1. Expert judgement for the identification of potential relevant variables for similarity, relevance and quality based on current model.
   - Similarity (product/substance/material properties);
   - Relevance (scenario related);
   - Quality (study related).
2. Assessment by review of the relevance of these variables.
3. Determining the similarity, relevance and quality scoring methodology.

4. Expert judgement questionnaire for validation step 1 and 2.
5. Update similarity, relevance and quality scoring.
6. Implementation in GN tool.

RESULTS (1)

Similarity	Relevance	Quality
Chemical composition	**Energy of the activity**	**Measurement type**
Dustiness/viscosity	**Activity type**	**Data description**
Moisture content	**RMM / local controls**	**Measurement duration**
Coating	**Work area information**	**Online/offline measurements**
Weight fraction	**Scale process/production volume**	**Contextual information**
State (liquid/solid)	Exposure route	**Near-field / far-field**
Agglomeration	Exposed population	
Aggregation		
Charge		
Primary particle size		
Density		
Surface area		
Particle form		

RESULTS (2) - SIMILARITY

Equation 1: (CC * MF) + (WF * MF) + (St * MF) + (PPS * MF) + (PF * MF)/MF_{Total}

- CC: chemical composition
- WF: Weight fraction
- St: State of the substance
- PPS: primary particle size
- PF: particle form
- MF: importance multiplier factor
- MF_{TOTAL}: Sum of multipliers

Weight fraction	< 1%	1 – 10 %	11 – 50 %	50 – 90%	>90%
< 1%	1	0.7	0.1	0.1	0.1
1 – 10%	0.7	1	0.7	0.1	0.1
11 – 50%	0.1	0.7	1	0.7	0.1
50 – 90%	0.1	0.1	0.7	1	0.7
>90%	0.1	0.1	0.1	0.7	1

Similarity	Importance	Multiplier
Chemical composition	High	5x
State (solid/liquid)	Very high	10x
Primary particle size	Low	1x
Particle form	Medium	3x
Weight fraction	High	5x

RESULTS (3) - RELEVANCE

Equation 2: $(A_e * MF) + ((SD * A_t) * MF) + (RMM * MF) + (S * MF) + (C * MF) / MF_{Total}$

- A_e: Energy of the activity
- SD: Source domain
- A_t : Activity type
- RMM: Risk management and local controls
- S: Production volume/scale
- C: Work area information
- MF: importance multiplier factor
- MF_{Total} : Total multiplying factor

Energy of the activity	High	Medium	Low
High	1	0.7	0.4
Medium	0.7	1	0.7
Low	0.4	0.7	1

Source domain	Relevance	Importance	Multiplier
1: Syntheses	Activity type	Very High	10x
	RMM/local control	Medium	3x
	Work area information	Low	1x
	Production/use rate	low	1x
2: Handling and transfer of bulk powdered MNO's	Energy of the activity	High	5x
	Activity type	High	5x
	RMM/local control	Medium	3x
	Work area information	Medium	3x
	Production/use rate	Medium	3x

RESULTS (4) - QUALITY

Equation 3: (Bm * MF) + (Mt * MF) + (Om * MF) + (Ci * MF) + (D * MF) + (NfFf * Mf)/MF_{Total}

- Bm: Background measurement
- Mt: Measurement type
- Om: Offline measurements
- Ci: Average score contextual information
- D: Duration
- NfFf: Near-field far-field
- MF: Importance multiplier factor
- $MF_{TOTAL:}$: Sum of multipliers

Contextual information	Score when information is present	Score when information is absent
Description of activity	1	0.5
Substance	1	0.5
Particle size	1	0.7
Indoor / outdoor	1	0.8
Work area	1	0.8
Production volume / use rate	1	0.8
RMM / local controls	1	0.5
Mean contextual information quality		Mean of above scores

Quality	Importance	Multiplier
Bm: Background measurement	High	5x
Mt: Measurement type	High	5x
Om: Offline measurements	Very High	10x
D: Duration	Medium	3x
NfFf: near-field far-field	Low	1x
Contextual information	Medium	3x

RESULTS (5) - OVERALL SCORES

- Sum up the three similarity, relevance and quality scores and divide them by three.

Available studies	Score		Overall score (averaged value)[a]
Study 1	Similarity	0.7	0.83
	Quality	0.8	
	Relevance	1	
Study 2	Similarity	0.6	0.67
	Quality	0.9	
	Relevance	0.5	

- [a] Study accepted when score is > 0.3

RESULTS (6) - UNCERTAINTY

- Similarity, relevance and quality scoring is based on conservative values.
- Uncertainty below combined score is less compared to uncertainty above combined score.

Combined score	Uncertainty factor 5% CI	Uncertainty factor 95% CI
1	0	0
0.8 – 0.99	2x	5x
0.5 – 0.79	5x	10x
0.3 – 0.49	10x	50x
<0.3	out	out

CONCLUSION AND FUTURE RESEARCH

- Read-across for exposure data is **helpful** as:
  - Available measurement data is efficiently used;
  - It is less expensive, practicable and less time consuming compare to own measurements.

- However, it is still **challenging** as:
  - Data availability for certain variables is an issue;
    - If no information is available use the worst case;
  - User friendliness of the system (with many questions) is an important issue.

- Questionnaire need to **validate** current ideas.
- **Balance** need to be tested between the assessed variability and real data.
- Any **input** for improvement is highly appreciated.

THANK YOU FOR YOUR ATTENTION

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