EVALUATION OF THE TIER 1 DERMAL EXPOSURE ASSESSMENT TOOL: ECETOC TARGETED RISK ASSESSMENT (TRA)

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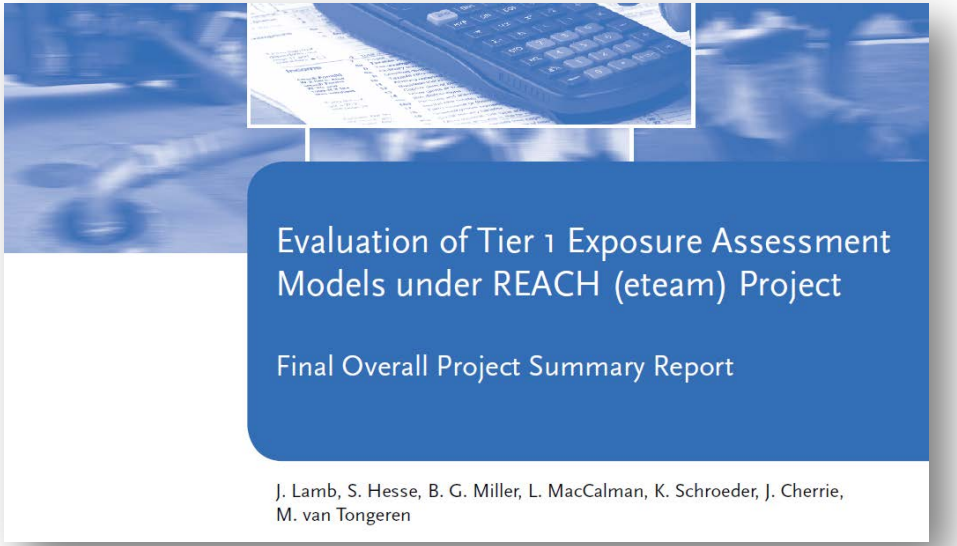
STUDY BACKGROUND

- 1920-1950 exposure instruments were developed to measure exposures
- 1960s personal sampling
- Why exposure modelling?
  - Not possible to measure exposure levels in all situations
- 90s Estimation and Assessment of Substance Exposure (EASE)
- End 90s COSHH essentials
- From 2000 – nowadays a variety of exposure models has been developed.
- However, these models are mostly not, or only to a limited extend, validated.

STUDY BACKGROUND

- Recently, the most frequently used (tier 1) exposure models were evaluated by the BAuA sponsored ETEAM study
- Went well for inhalation models
- Conclusion dermal models:
  - insufficient data for a proper evaluation of the dermal exposure tools.
- CEFIC LRI funded a project to evaluated the dermal model of ECETOC TRA (LRI-B16).



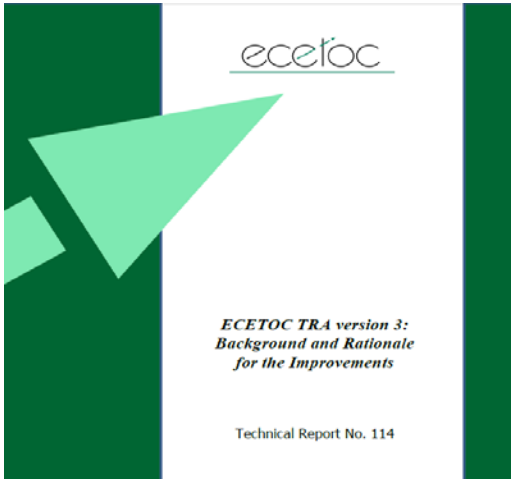
ECETOC TRA

- First tier exposure model for estimating inhalation as well as dermal exposure.
  - Screening
  - Conservative
  - EASE and additional exposure measurement data
  - (limited to) potential dermal hand exposure
- The model is estimating exposure (mg/kg/day):
  - Process categories (PROCs)
  - Industrial or professional use
  - LEV use

  } Base estimate

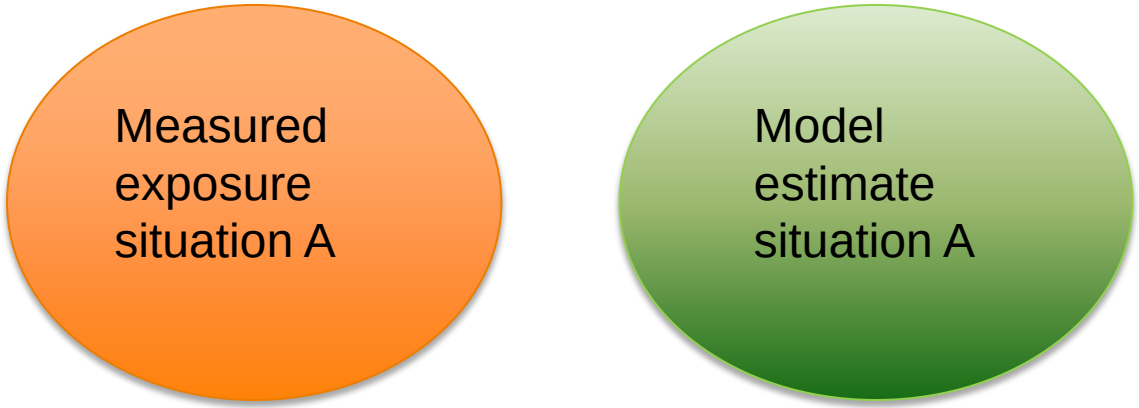
  - Solid / liquid
  - Dustiness / vapour pressure
  - Concentration
  - Duration of exposure
  - Glove use

  } Reduction factors



METHODS

- How can you validate an exposure model?
  - By comparing exposure estimates with model estimates

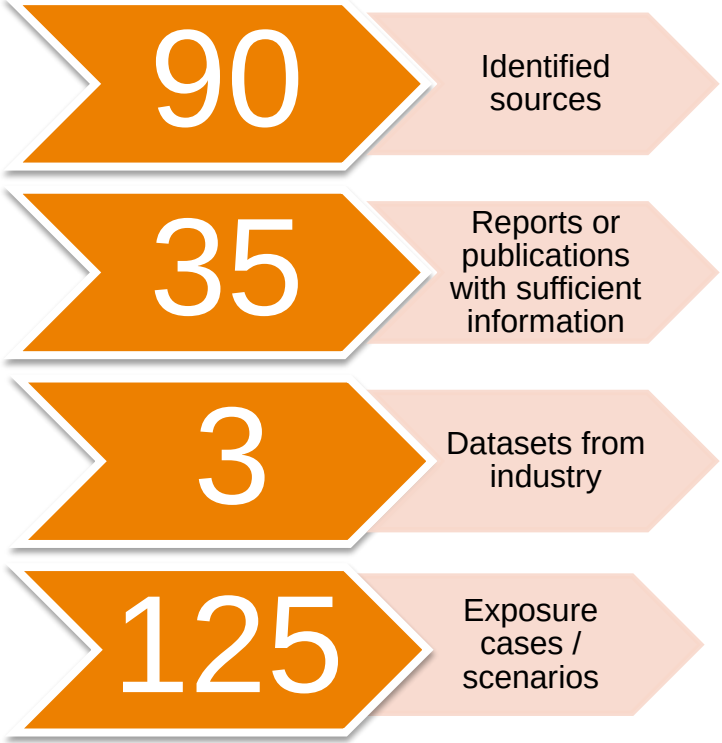


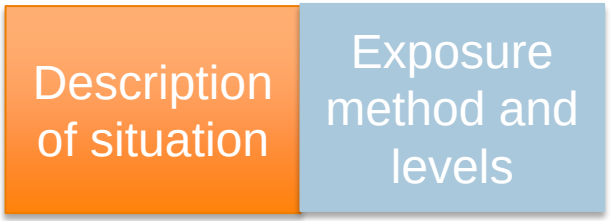
METHODS (EXPOSURE MEASUREMENTS)

- Identification of data sources:
  - From reviewed papers and reports
  - Request for data to industry (42 members of ECETOC)

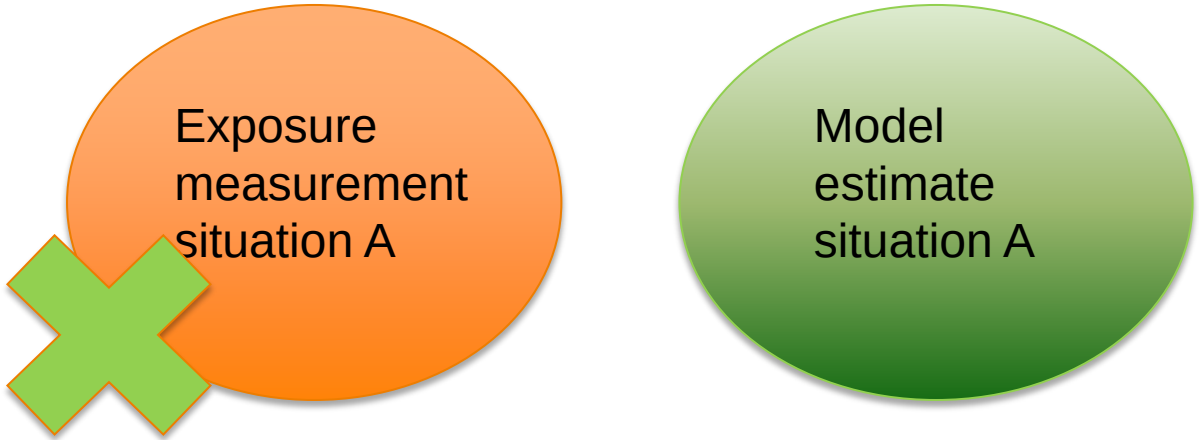
- Information sources screened on:
  - Sufficient documentation of contextual information (reconstruct the measured situation)
  - Sufficient documentation of sampling methods and exposure levels (to judge about the quality of the study)

RESULTS EXPOSURE MEASUREMENTS



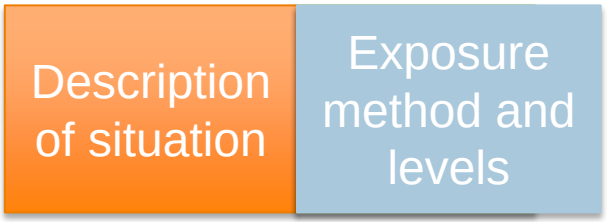


For each scenario, contextual information on exposure determinants, sampling methods and exposure levels were stored in a datasheet


Exposure measurement situation A
Model estimate situation A

METHODS (MODELS ESTIMATES)

- The provided information about the conditions during the measurement study should be translated to model inputs
- Preferably not based on a single experts opinion
- Expert elicitation process was organised
  - Experts were selected (criteria: experience with ECETOC TRA)
  - The 125 scenarios were divided into four groups (approx. 30 scenarios)
  - Each expert was send an excel sheet with information
  - Assessment was blind for measured values
  - Based on the information an input for each TRA determinant should be provided



RESULTS

- 16 contacted experts (75%) participate in the consensus exercise.

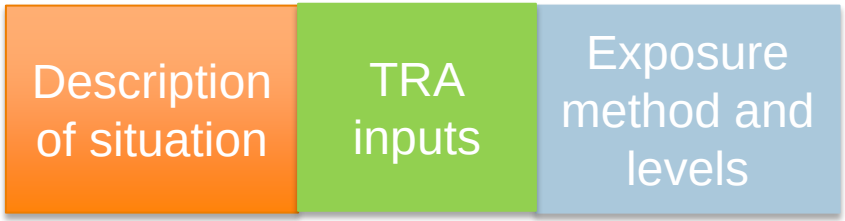
- Each exposure case was assessed by 4 experts.
  - An input scored by 3 or 4 of the experts was decided to be the consensus input

Proc	62% consensus
Professional / industrial use	86%
Solid / liquid	90%
Dustiness / Vapour pressure	64%
Concentration	90%
LEV use	92%
Glove use	97%
Duration	88%
Consensus for all inputs	25%

RESULTS

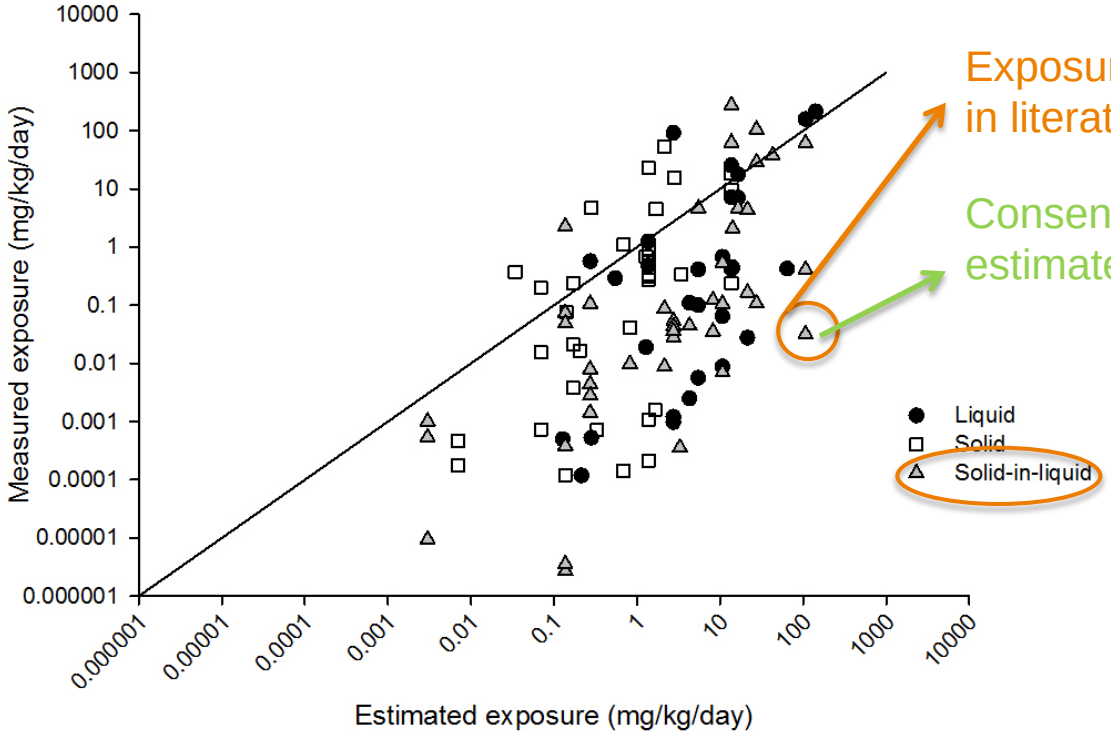
- For the non-consensus scores a telecom was organized with the monitoring group of CEFIC and the project team
  - Each determinant was discussed till a consensus input was derived

- After the consensus procedure 15 cases were excluded because of lack of consensus (due to inconsistent information)



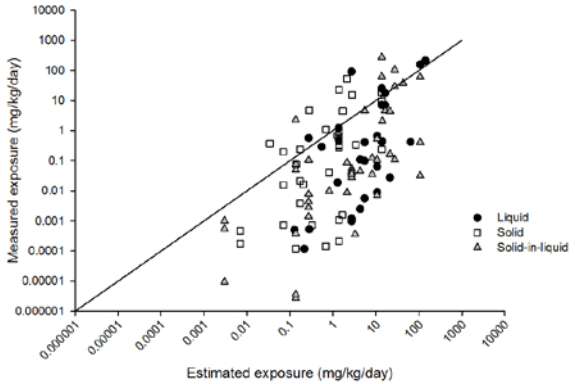
- 110 exposure cases (n=1761 measurements) were available for direct comparison of exposure estimate and 75th percentile of measured values.

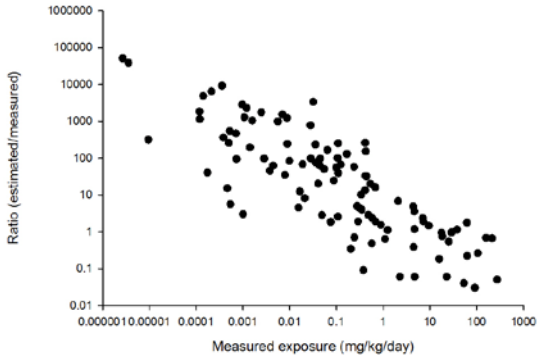
RESULTS


Measured exposure (mg/kg/day)
10000
1000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
0.000001
0.00001
0.0001
0.001
0.01
0.1
1
10
100
1000
10000
Estimated exposure (mg/kg/day)
Liquid
Solid
Solid-in-liquid
Exposure levels found in literature (P75)
Consensus exposure estimate from TRA

RESULTS

- Underestimation in 20% of the cases (Estimate versus P75)
- Model explained 37% of the variance (of the (aggregated) P75)
- ECETOC TRA seems to be applicable for solid in liquids
- Clear trend in overestimation of low exposures and underestimation of high exposures





RESULTS

- Determinant analyses (mixed regression models):
  - Sampling method (removal / interception), glove use, PROC, concentration
  - 62% explained variance (compared to the 37% explained by the model)

- Average effect of gloves: factor 34 (97% in the data versus 80% for professional use and 90% for industrial use in the model)
- Sampling method: interception methods (cotton gloves, patches) 6 times higher compared with removal methods (tape stripping, hand wash).
- Large overestimation for (very) diluted products (lowest category <1% versus pesticides with <0.01%)

- No effect of professional versus industrial use, LEV, vapour/pressure and dustiness
  - Small numbers of LEV use, and volatile substances
  - Dustiness difficult to asses
  - Relative small numbers for most of the PROC

RESULTS

- Relatively large numbers of exposure measurements available for:
  - Product transfer (PROCs 8a, 8b and 9)
  - Spray applications (PROCs 7 and 11)
  - Rolling and brushing (PROC 10)

  - Low volatile substances

- Nearly no data for:
  - Large part of the PROCs estimating low exposures
  - Including manufacturing of chemicals in closed systems (PROCs 1,2,3,4)

  - Volatile substances

CONCLUSIONS

- P75 was under estimated in 20% of the cases
- ECETOC TRA seems to overestimate low exposures and underestimate high exposures
- The model explained 37% of the variance
- The model could also be applied to solid-in-liquid products
- Protection factor for gloves found in the data is higher than taken into account by the model (97% versus 80-90%)
- For interception methods the average exposure was found to be a factor 6 higher compared with removal methods
- Dermal exposure measurement data is lacking in a large set of conditions

GENERAL FINDINGS

- Dermal exposure the little brother of inhalation exposure

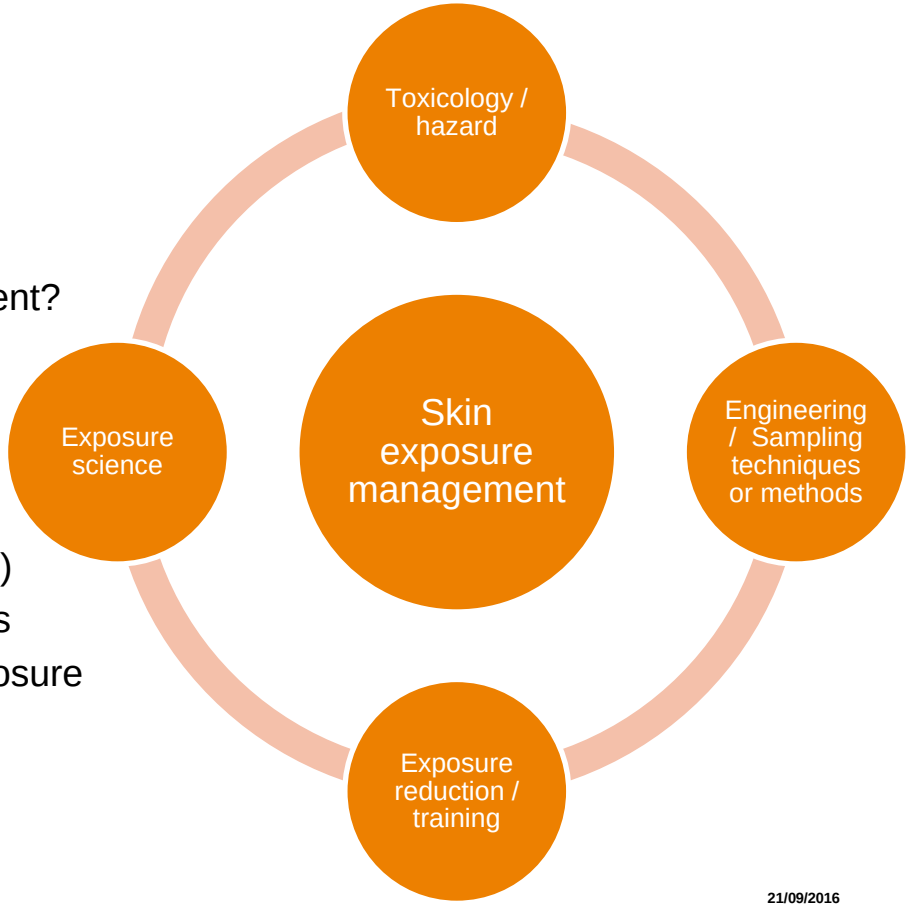
- Historically and nowadays the focus is on inhalation exposure, probably due to the large amount of occupational lung diseases.
  - Dermal sampling methods are not standardised yet
  - Dermal exposure limits are not established in all cases
  - Dermal exposure models are less sophisticated
  - Volatile substances are replaced by low-volatile components
  - (Inhalation diseases are replaced by dermal diseases)

- OEESC 2016: Dermal exposure is highly relevant.
  - We’ve something to do!

WORK TOGETHER!

- How to come up with good skin exposure management?

- Derive relevant exposure limits (based on the effects)
- Develop and standardise accurate sampling methods
- Improve the exposure science related to dermal exposure
- Intervene on the right places and train our workers



THANK YOU FOR YOUR ATTENTION

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