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ENVIRONMENTAL SCIENCE FOR THE EUROPEAN REFINING INDUSTRY

Why dermal exposure assessment?

Concawe H/STF-29

Jan Urbanus, Shell (Chair)

Dermal Exposure Studies on Workers and Consumers for Petroleum Substance REACH Dossiers

Concawe Symposium, Brussels, BE

24th February 2015

Background

Exposure Scenarios are one of the cornerstones of the REACH registration dossiers

- They describe how hazardous substances can be used safely without harm to people or the environment
- Exposures via inhalation and via dermal uptake
  - Compare exposure levels to limit value (the Derived No Effect Level, DNEL); if exposure < DNEL, then 'safe'

Recommended approach:

- Simplistic but conservative estimate based on analogies for comparable substances in comparables circumstances
- If not 'safe', refine exposure estimates with more specific data including measurements from field studies

Main reasons for first batch of studies

- Heavy Fuel Oil (components): proven toxic including CMR effects via the dermal route – very low DNEL for dermal exposure:
  - Expected difficult to prove 'safety' based on conservative, simplistic models
- Diesel fuel, service station attendants: initial estimates > DNEL, had to assume use of gloves in REACH dossier of 2010 to prove 'safety'
  - But attendants in the main do not wear gloves
  - Contaminated gloves not acceptable for customer-facing staff
- Consumer handling of diesel fuel and lubricants: DNELs for consumers lower than DNELs for workers
  - Direct studies on consumers not practicable, therefore used panel of volunteers to simulate exposures

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Heavy Fuel Oil dermal study

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Heavy Fuel Oil study - overview

Conducted before DNELs were known (anticipated to be low, but even lower when established)

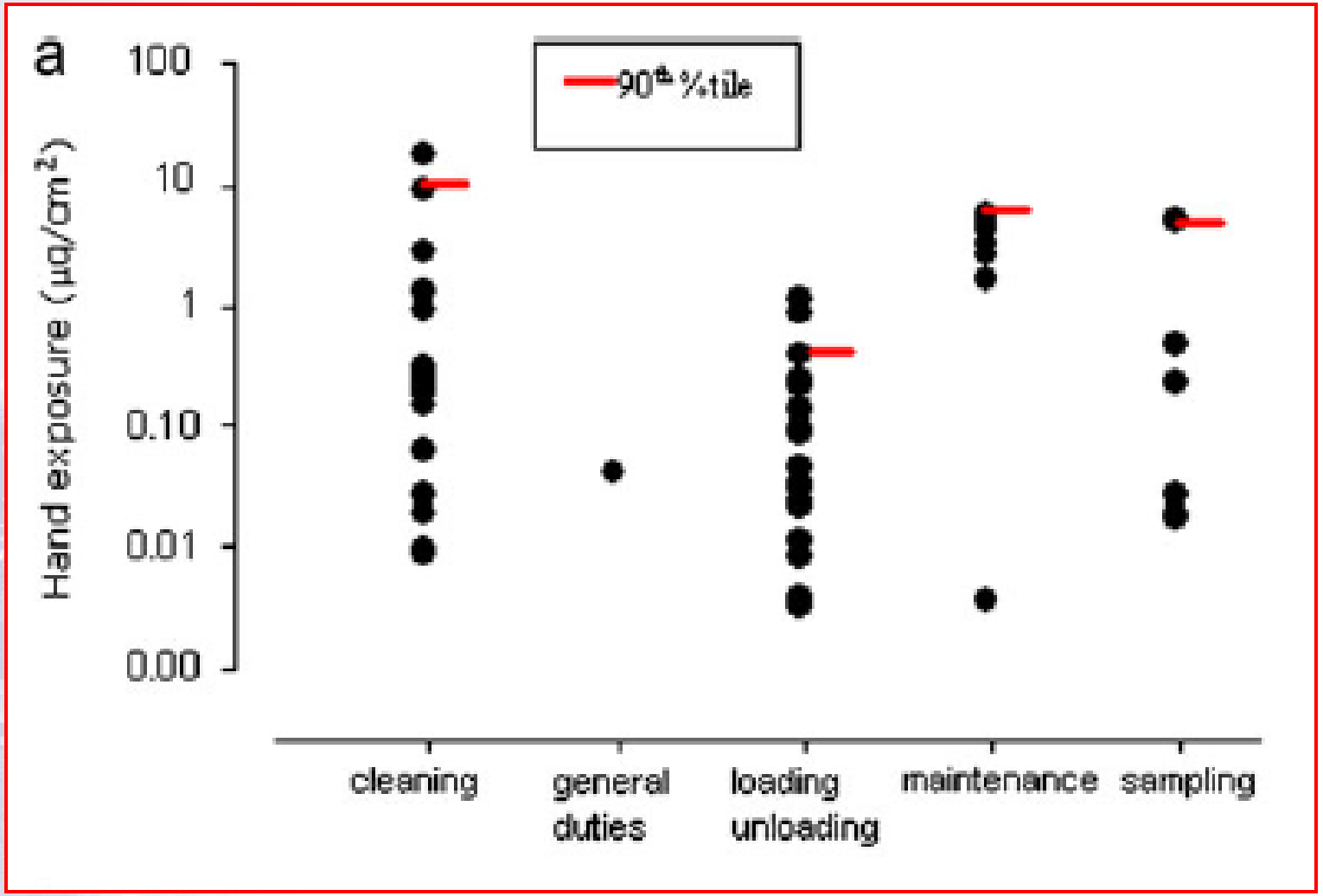
Study took ~2 years, >100K € to sample some 60 workers

- Workplaces and worker tasks studied
  - Refineries: line spading, filter cleaning, product sampling, heat exchanger tubes cleaning
  - Distribution terminals: pump maintenance, ship and truck loading, product sampling
  - Power plant: product unloading, pump maintenance, filter and spillage cleaning, tank dipping
  - Marine engine repair facility: cleaning injector nozzles, drip trays, filter cleaning and changing
  - Almost all workers wore leather or PVC gloves
  - Note: HFO usually at elevated temperature which would cause skin burns
- Developed novel exposure sampling and analytical techniques
  - Wipe sampling of hands, forearms and neck

Heavy Fuel Oil study – main results

- General: HFO was detected in 60% of hand wipe samples
  - And in ~20% of the samples from forearms
  - But only 3% of neck samples
- General: Detected levels on hands were ~10x higher than on forearms
- Industry with highest exposure levels was marine engine repair, followed by distribution terminals
- Worker activities with highest exposure levels were cleaning and maintenance, followed by product sampling
  - No glove use in maintenance involving fine repair work due to dexterity issue – could be overcome with special thin gloves

Heavy Fuel Oil study – main results



Heavy Fuel Oil study – Concluding remarks

- Study execution was challenging, expensive and time consuming
  - >1000 € per sampled worker
- Limited but very informative data set obtained
  - Very good sensitivity by using PAH trace analytical technique
- Exposure levels (much) lower than predicted by simplistic ECHA recommended Tier-1 models – so study was worth doing
  - Able to show that these levels were below the dermal DNEL for HFO
  - > 4 orders of magnitude difference in some data set for a given task
  - High temperature of bulk product will also cause avoidance of contact
    - **Studies with e.g. Metal-working fluids show much higher levels**
- Gloves reduce exposure, but do not prevent it
- Due to the classification as CMR, all exposures to HFO need to be managed to levels as low as reasonably practicable