



Dermal uptake of diisocyanates – evidence from workplace exposures

OEESC 2016

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Aim



- Is skin absorption a significant exposure route for diisocyanates in workplaces?
- Are significant amounts of diamine generated in diisocyanate-using processes
 - does this have an impact on biological monitoring results?

BM for isocyanates

- Based on the analysis of corresponding diamine in urine, after hydrolysis.
- Inhalation uptake and excretion very quick:
 - Metabolites can be detected in urine within 15 minutes of the start of exposure
 - Half-lives range from 2 - 7 hours
- Skin uptake would delay excretion

BM for isocyanates

- Skin absorption possible but importance as a route will vary with exposure scenario and isocyanate.
- Isocyanates are skin sensitisers so skin protection is an important aspect of exposure control.
- Some debate about the possibility of respiratory sensitisation via skin absorption.

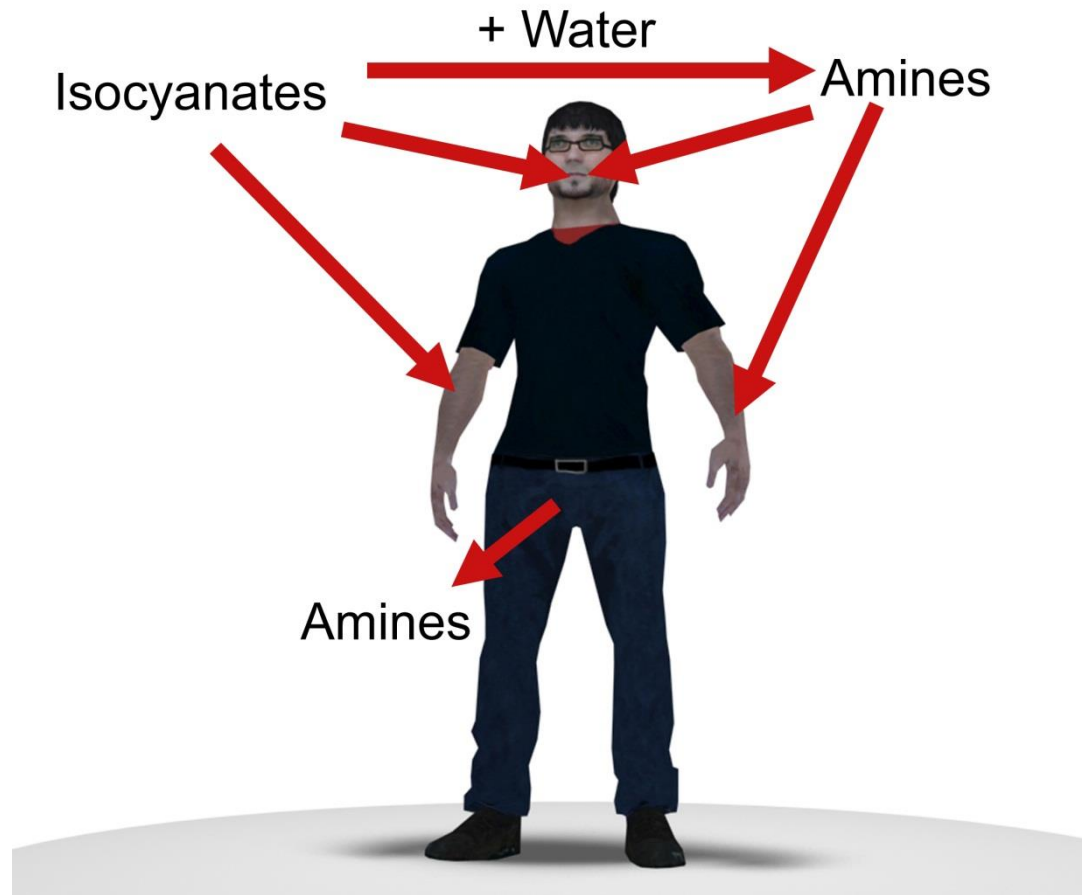
Potential issues

- Cannot distinguish in urine samples between isocyanate and amine exposures.
- Both are hazardous chemicals but
 - Isocyanates
 - Sensitisers, main absorption route possibly inhalation
 - Amines
 - Some are carcinogenic, main absorption route possibly skin absorption

Potential issues

- Some corresponding amines are widely found in industry:
 - MDA and IPDA used as hardeners
- Some corresponding amines may be generated as by-products.

Exposure scenarios



The Visits

- Site visits were undertaken covering a range of isocyanate applications
 - Casting and grouting (MDI)
 - Foam blowing (TDI)
 - Hot Melt Adhesive (MDI)
 - Floor screeding (MDI)

Processes

- Casting
 - Pouring into moulds, extraction
- Foam blowing
 - Cutting and handling of foam blocks
 - Manual extraction from moulds
- Floor screeding
 - Manual spreading
- Hot Melt Adhesive
 - Handling of coated boards

Summary of amine generation

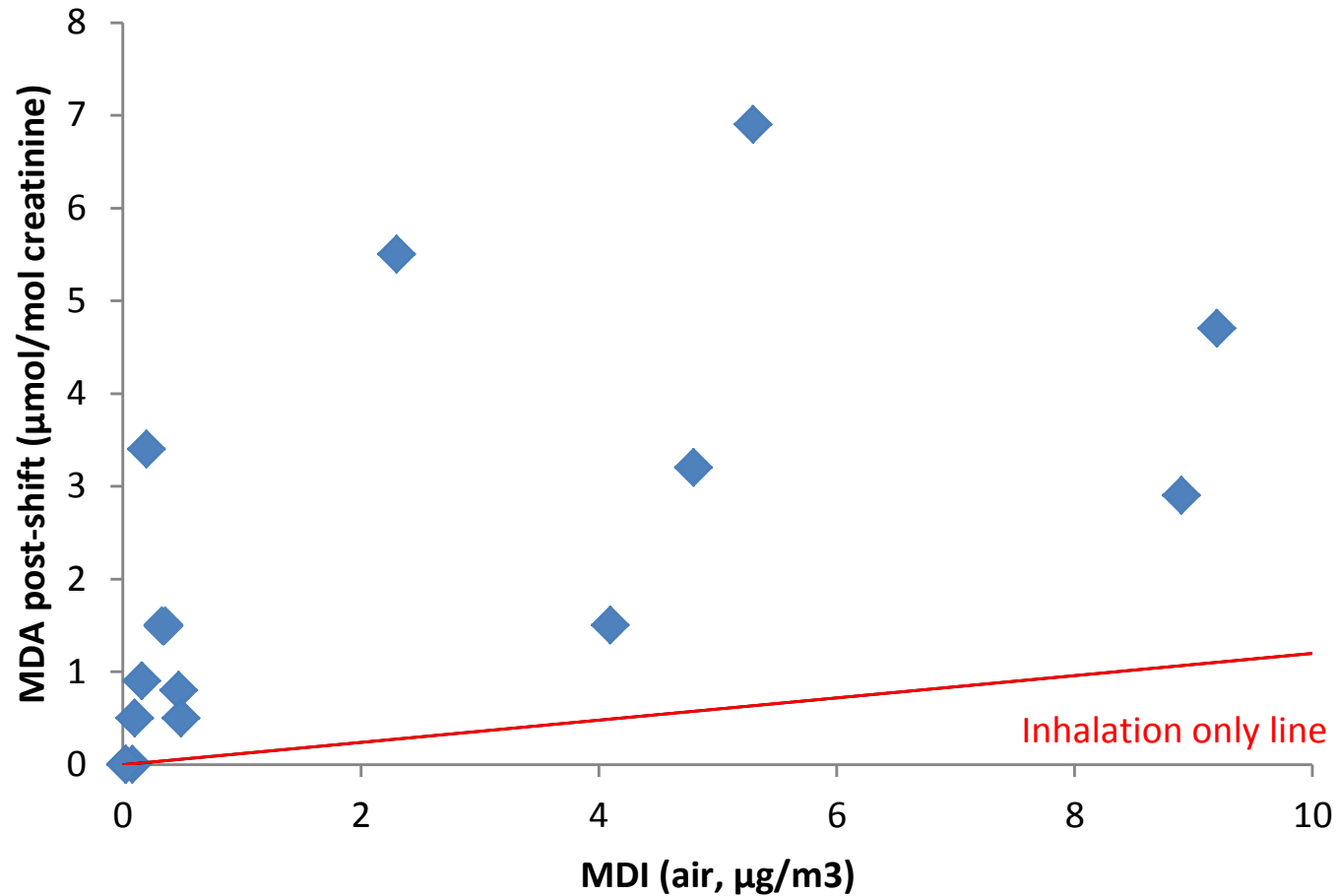
Company	Isocyanate	Process	Aerosols?	Amines?
1	MDI	Casting / grouting	No	No
2	MDI	Casting	No	No
3	MDI	Floor screeding	No	No
4	TDI	Block Foam blowing	Yes	Yes
5	TDI	Moulded Foam blowing	Yes	Yes
6	MDI	Hot Melt Adhesive	No	No
7	TDI	Block Foam blowing	Yes	Yes

Non-aerosol MDI processes

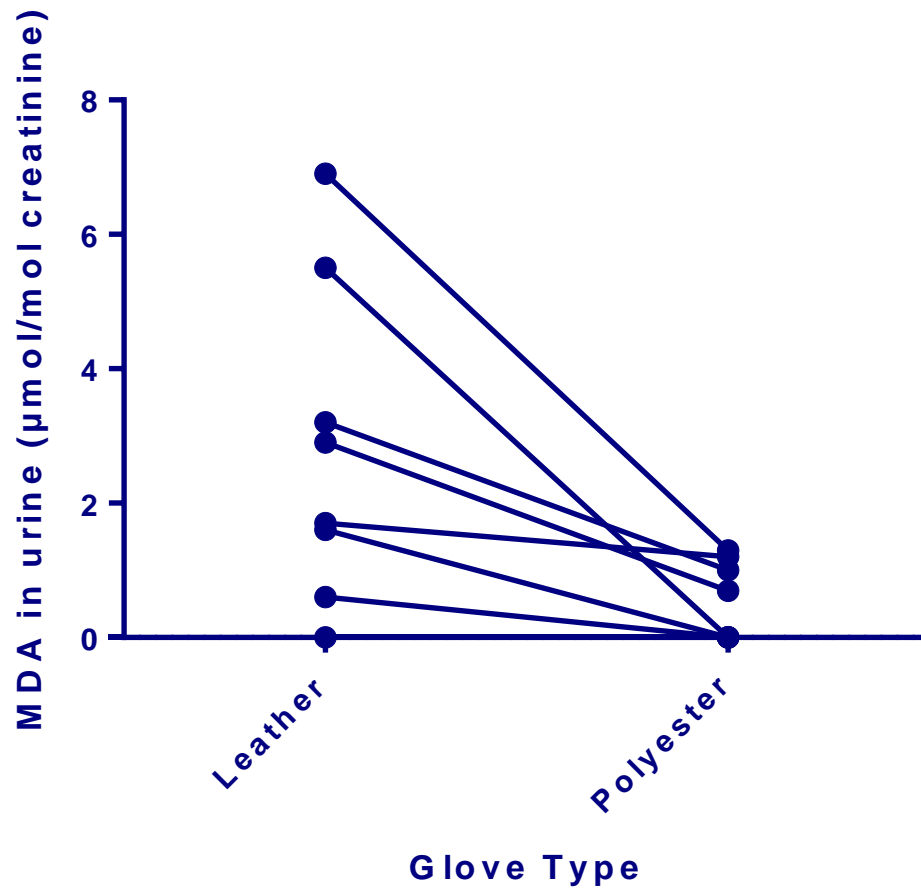
- Very low airborne levels
- Isocyanates detected on glove samples
- BM indicated elevated body burden
 - Indication of dermal absorption?



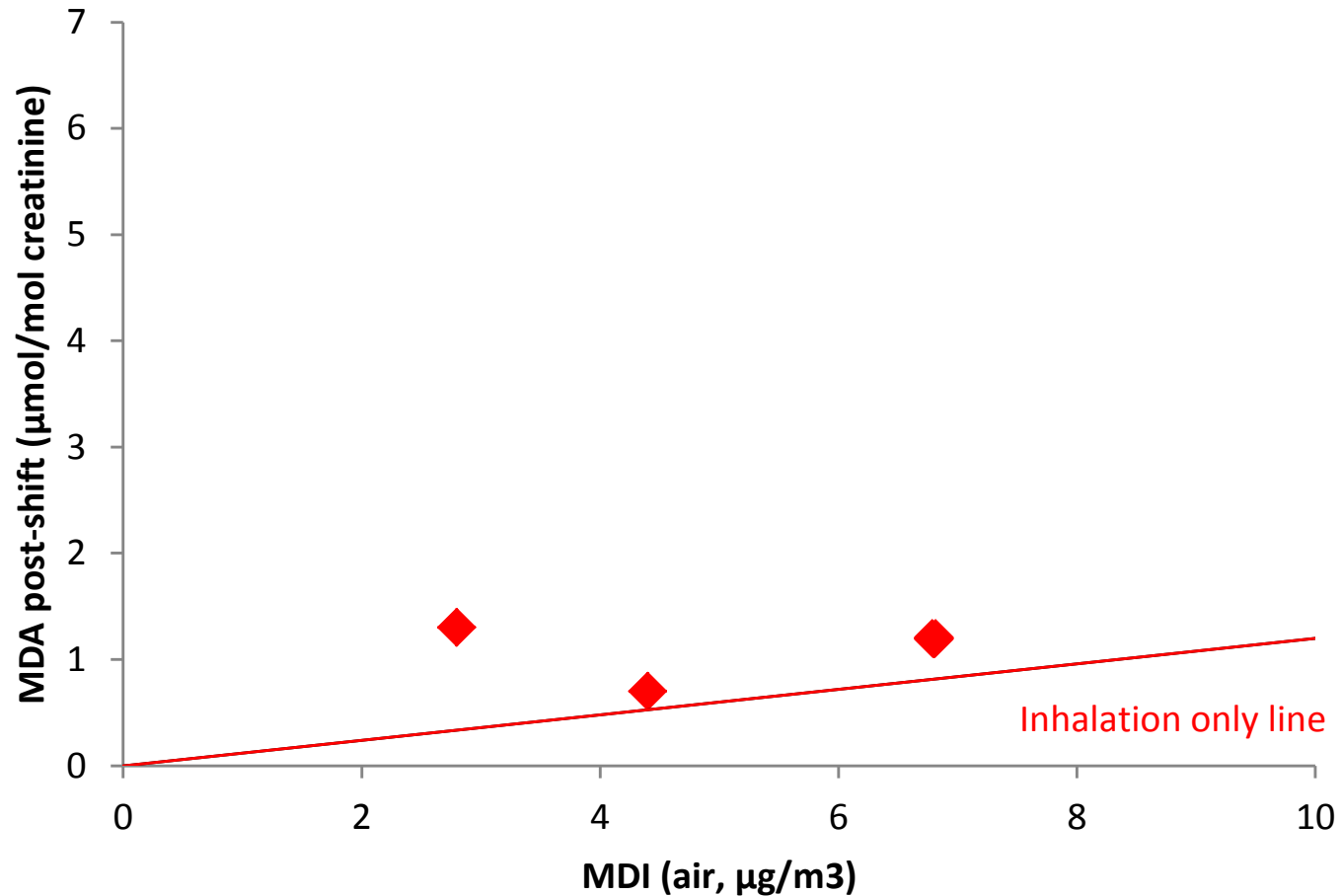
Non-aerosol MDI processes



Further evidence of skin exposure

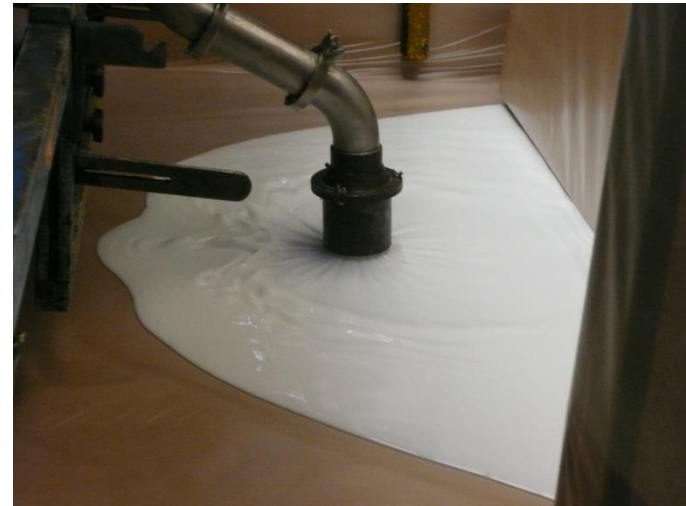
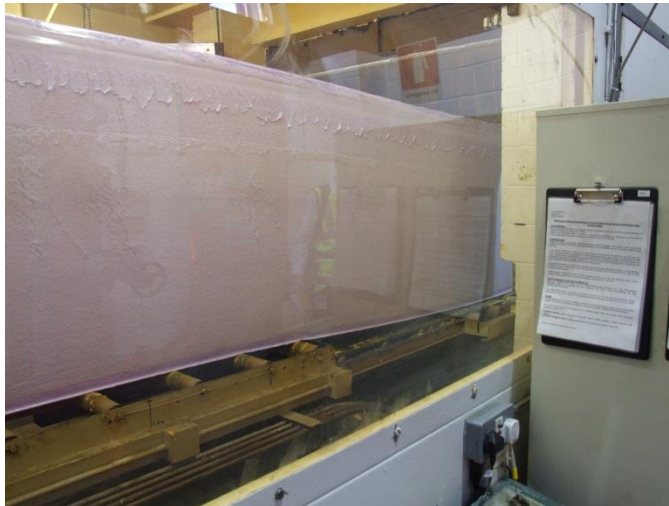


After glove improvements

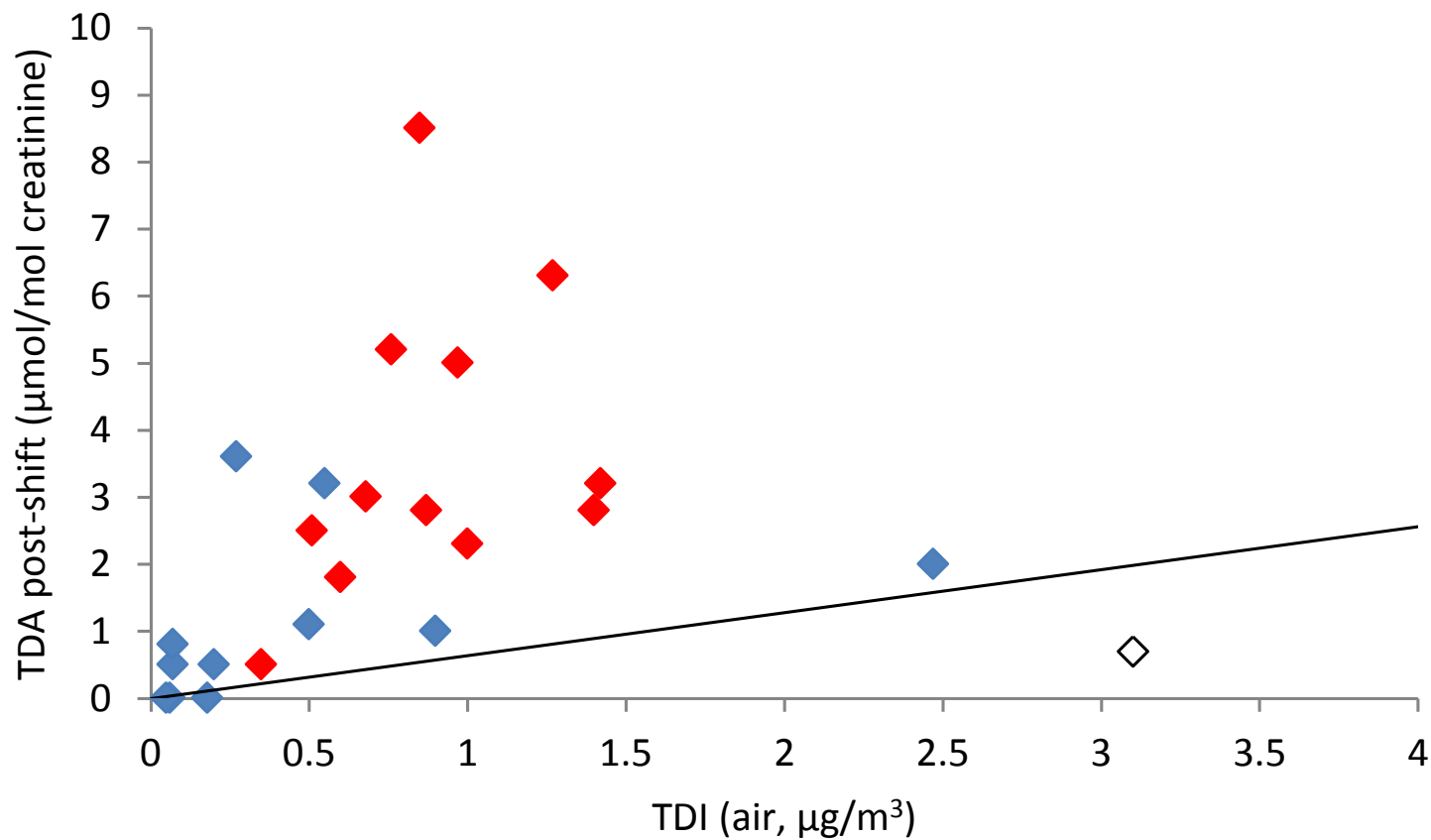


Foam blowing

- Water added to process to generate CO₂
- Isocyanate detected in air and on gloves
- Amine detected in air and on gloves



Foam blowing



Skin Absorption Conclusions

Handling tasks can give rise to higher than expected body burden

- For processes that do **not** generate aerosols
 - Almost certainly due to skin absorption
- For processes that **do** generate aerosols
 - Amines are detected in air and on gloves
 - Statistical model suggests body burden due to isocyanate exposure but amine presence cannot be dismissed

BM Conclusions

- For many tasks, urine sampling is not confounded by amine generation and continues to be straightforward tool for exposure assessment.
- For foam blowing, exposures may be complex. Urine sampling can assess overall body burden resulting from tasks however other data may be required to elucidate the contributing exposure sources and routes.
 - Further data would help to clarify the significance of any confounding

Acknowledgements

- HSE
 - Paul Johnson, John Cocker, Peter Baldwin, Chris Keen, Joan Cooke, Matthew Coldwell, Duncan Smith
- Aspen Environmental Ltd
 - Geoff Buck

Thank you for listening

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