Residual Chemicals in Shipping Containers

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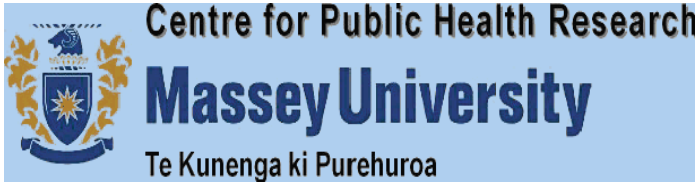
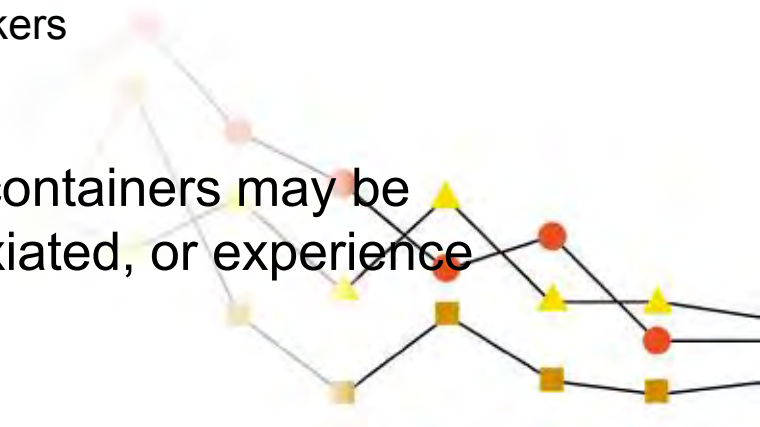


Background

- Imported shipping containers may pose a number of hazards
  - Residual gases
    - Pesticides - introduced into the container prior to shipping to prevent pest and mould infestations and include MeBr, phosphine, sulfuryl diflouride
    - Industrial chemicals – released by goods that are loaded into the container and include formaldehyde, benzene, toluene and xylenes
  - Other issues:
    - Air mixtures that are explosive or are O_2 deficient
    - Level of awareness of potential risks amongst workers
- Workers who open, inspect or unpack shipping containers may be injured as a result of explosions, become asphyxiated, or experience other respiratory or neurological effects



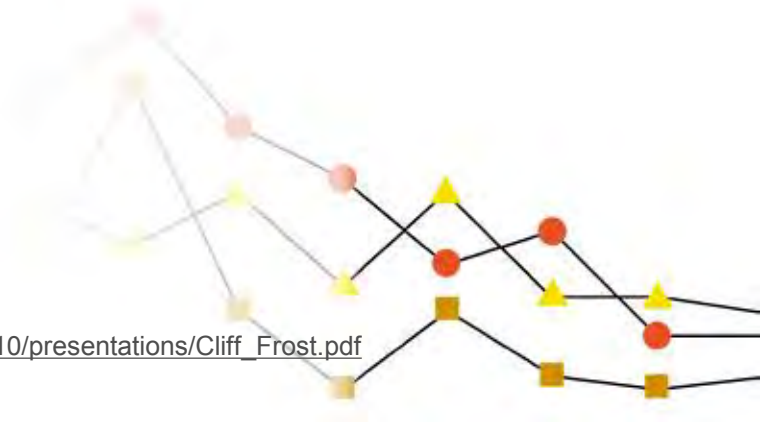
Relation between type of cargo and chemicals – EWS 2010

Substance	No	MAC		Max	Type of cargo
VOC	682	100	ppm	12000	Shoes, Electronics, Wood, Toys, Consumables, Textiles, Food, Decoration, Polyresin, Rubber, Packaging
Formaldehyde	1106	0.1	ppm	40	Shoes, Electronics, Wood, Consumables, Textiles, Rubber, Concrete, Polyresin, Rubber, Packaging
Methyl Bromide	302	0.25	ppm	88	Shoes, Electronics, Wood, Consumables, Food, Packaging, Toys
Carbon Monoxide	1168	25	ppm	25	Shoes, Electronics, Wood, Toys, Consumables, Textiles, Food, Packaging
Phosphine	393	0.1	ppm	368	Wood, Consumables, Textiles, Food, Packaging

Reported Residual Gas Levels Australia

Testing carried out by Australian Customs and Border Protection Services:

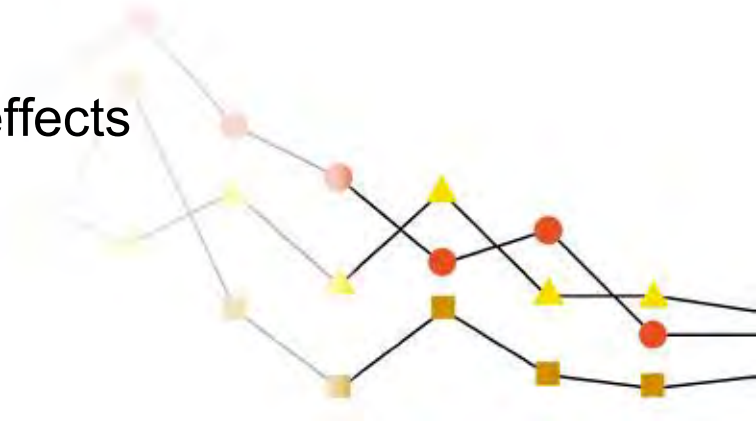
- 14,943 containers were tested for fumigants between July 2007 to December 2008
- 2,503 (17%) returned positive indication for fumigants above TWA
- Fumigants detected included:
  - Formaldehyde
  - Ethylene dibromide
  - Chloropicrin
  - Methyl bromide



Source: http://www.wcoomd.org/files/2.%20Event%20files/PDFs/Technology%20Forum/2_4_nov_2010/presentations/Cliff_Frost.pdf

Aims of the Project

- Determine if workers are exposed to methyl bromide and other residual chemicals when shipping containers are opened or unpacked
- Identify workplace activities or tasks that contribute greatest to overall exposure using workplace observations and real-time monitoring techniques
- Identify methods to reduce exposures, particularly peak exposures
- Determine if workers self-report adverse health effects

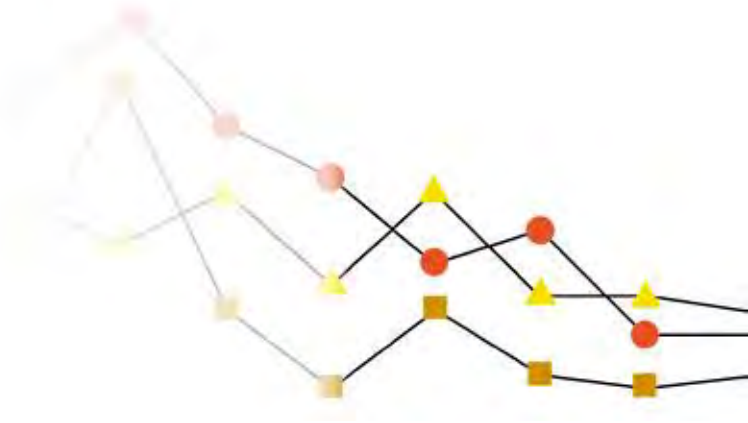


Importance of Peak Exposures

- Workplace exposures can be:
  - consistent over a work shift
  - quite variable depending on tasks or activities
- Variability in exposure patterns is generally not measured
- It has been suggested that peak exposures may be associated with more severe health effects.
- Reducing peak exposures may significantly reduce overall (time-weighted average) exposures

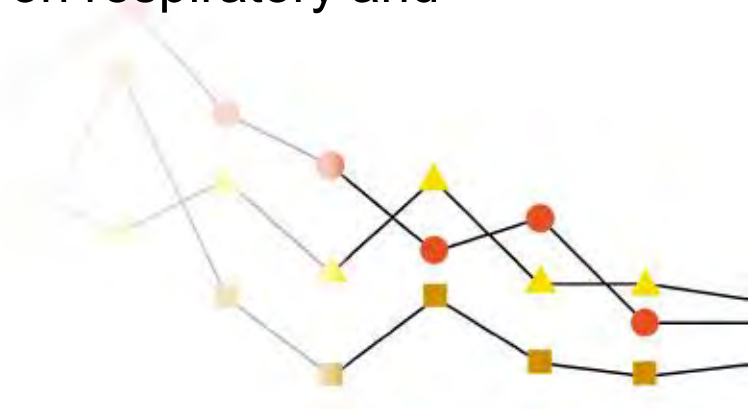
Gas Sample Collection and Analyses

- Gas samples will be collected remotely when peak exposures and other events of interest are observed
- Gas samples will also be collected overnight from areas where unpacked goods are stored
- Samples will be analyzed using SIFT-MS



Other Elements

- Measure initial residual gas levels when the container is opened
  - may facilitate comparison with existing data
- Evaluate current controls by observing work practices
  - compare to existing guidance materials
- Health questionnaire focussing on respiratory and neurological health



Analysis

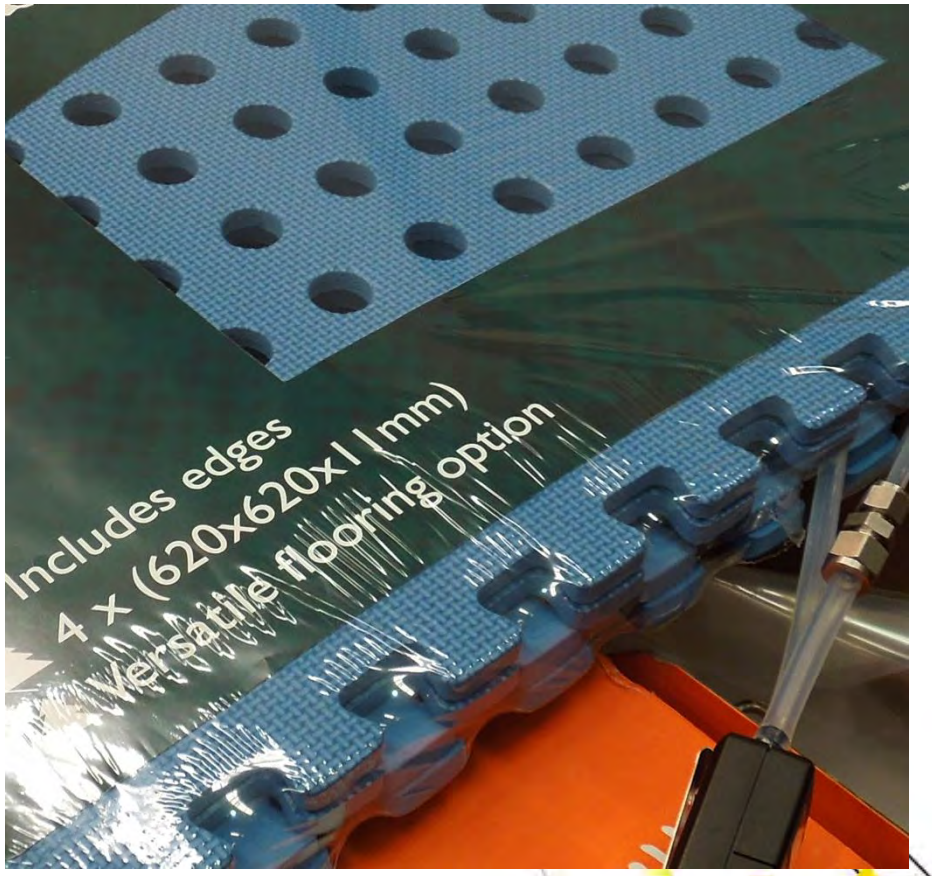
TABLE 1: "Container Air Analysis" analytical method (METH-F.IS)				
Compound	**Molecular formula**	**CAS #**	**LoQ requirement* (ppb)**	**Calibration Comments**
Methyl bromide	CH_3Br	74-83-9	100	Included in **METH-F.IS**
Hydrogen phosphide	PH_3	7803-51-2	100	Included in **METH-F.IS**
Chloropicrin	Cl_3CNO_2	76-06-2	100	Included in **METH-F.IS**
Ethylene oxide	$C_2H_4O_2$	75-21-8	100	Included in **METH-F.IS**
1,2-Dichloroethane	$C_2H_4Cl_2$	107-06-2	100	Included in **METH-F.IS**
1,2-Dibromoethane	$C_2H_4Br_2$	106-93-4	100	Included in **METH-F.IS**
Hydrogen cyanide	HCN	74-90-8	100	Included in **METH-F.IS**
Formaldehyde	H_2CO	50-00-0	100	Included in **METH-F.IS**
Benzene	C_6H_6	71-43-2	100	Included in **METH-F.IS**
Toluene	C_7H_8	108-88-3	100	Included in **METH-F.IS**
C2-alkylbenzenes*	C_8H_{10}		100	Included in **METH-F.IS**
m-xylene		108-38-3		
o-xylene		95-47-6		
p-xylene		106-42-3		
ethyl benzene		100-41-4		
Styrene	C_8H_8	100-42-5	100	Included in **METH-F.IS**
Ammonia	NH_3	7664-41-7	10 000	Included in **METH-F.IS** / not calibrated

Technical Issues

- Connectivity
- Taking grab air samples for observed VOC peaks at the appropriate time
- Analysis of air samples in a timely manner
- „Tracking' fumigated containers

Observations

- Workers are reporting health issues related to both fumigants and off gassing from products within the container.
- Zero/low readings inside the container with higher levels inside product boxes/wrapping
- High levels of ammonia inside foam mats



Observations

- Less pallets used but increased MSD risks
- High temperature inside the containers
  - 35 degrees at the front of the container versus 45 degrees at the rear

Observations

- Difficulty in determining where the fumigation took place
- Use of various container types
- Casual workers versus full time workers

Acknowledgements

- Research commissioned and funded by Safe Work Australia

- Purdue University – Professor Jim McGlothlin and Mark Sharpe
  - From “Wow” to “What’s Next? The Future of Video Exposure Monitoring - http://www.aihasynergist-digital.org/aihasynergist/201001?pg=30#pg30

- Centre for Public Health Research, Massey University
  - **Professor Jeroen Douwes**
  - **Professor Bill Glass**
  - **Samuel Keer**
  - **Dr Naomi Brewer**
  - **Brad Prezant**
  - **Kerry Cheung**