

Inspecting Cargo in Containers with Safety

Brisbane 6th May

Ken Fitzpatrick



Residual Gas in Containers

Global Incidence

- Australian Study: 14,943 containers: 17% unsafe
- NZ Study: 519 containers: 18% unsafe
- EWS Europe: 20,000 containers: 12% unsafe
- Hamburg: 2,113 containers: 37% unsafe (Low Thresholds)
- RIVM Report: 1,000 containers: 21% unsafe triggered in 2010 by gas exposure incidents



Commercial experience of containers tested in the Netherlands

- > **20,000 containers** measured in six month period in Holland and Belgium.
- **12%** of containers above MAC force ventilated
- List of fumigants & toxic vapors found:
 - Toluene (C_7H_8)
 - 1,2 Dichloroethane ($C_2H_4Cl_2$) - Carbon monoxide (CO)
 - Formaldehyde (H_2CO)
 - Styrene (C_8H_8)
 - Benzene (C_6H_6)
 - Xylene (C_8H_{10})
 - Phosphine* (PH_3)
 - Methyl Bromide* (CH_3BR)
 - Chloropicrin* (CCL_3NO_2)
 - Chloro Methane* (CH_3CL)
 - Hydrogen Gas (H_2)



Why Do Containers Have Residual Gas?

- Dangerous concentrations of gases can be found in import shipping containers due to:
 - Residual fumigants
 - Desorption of cargo or production gases
- Transit:
 - Gas emissions in containers rise with temperature inside the container
 - Transit through tropics increases problem



Common Residual Gases Found in Containers – An International Problem

● Fumigants

- Methyl Bromide
- Phosphine (Aluminium phosphide)
- Sulphuryl Fluoride
- Ethylene Oxide
- Hydrogen Cyanide
- Chloropicrin
- CO₂ (Controlled Atmosphere)

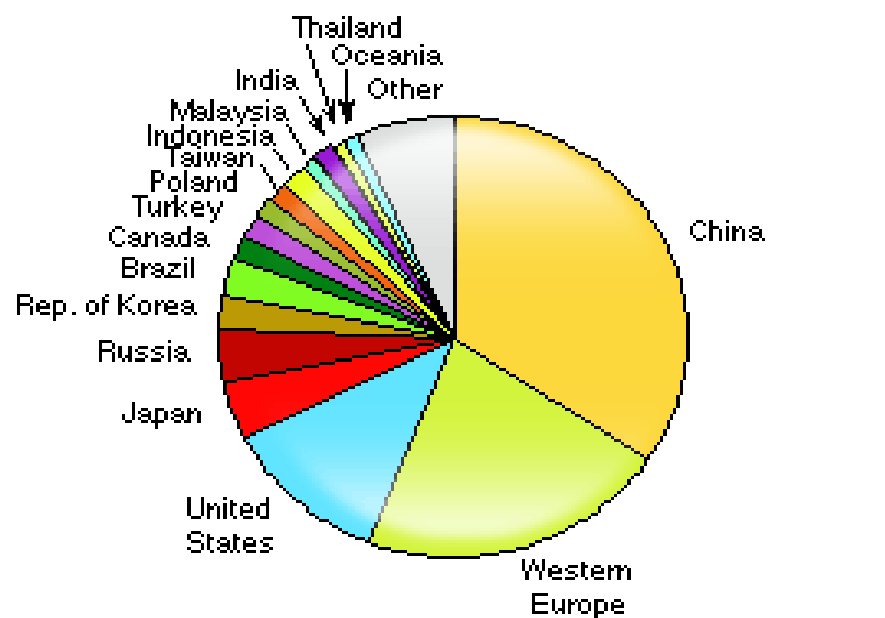
● TICs (Toxic Industrials)

- Toluene
- Benzene
- Formaldehyde
- Di Chloroethane
- Carbon monoxide
- Hydrogen
- Ethylene di-bromide
- Xylene
- Acetone
- Phenol
- Methanol
- And many more



Production and Consumption of Formaldehyde – Common residual Gas

World Consumption of 37% Formaldehyde—2011



Predicted total figure 30.5 million tons



An Australian Study Results

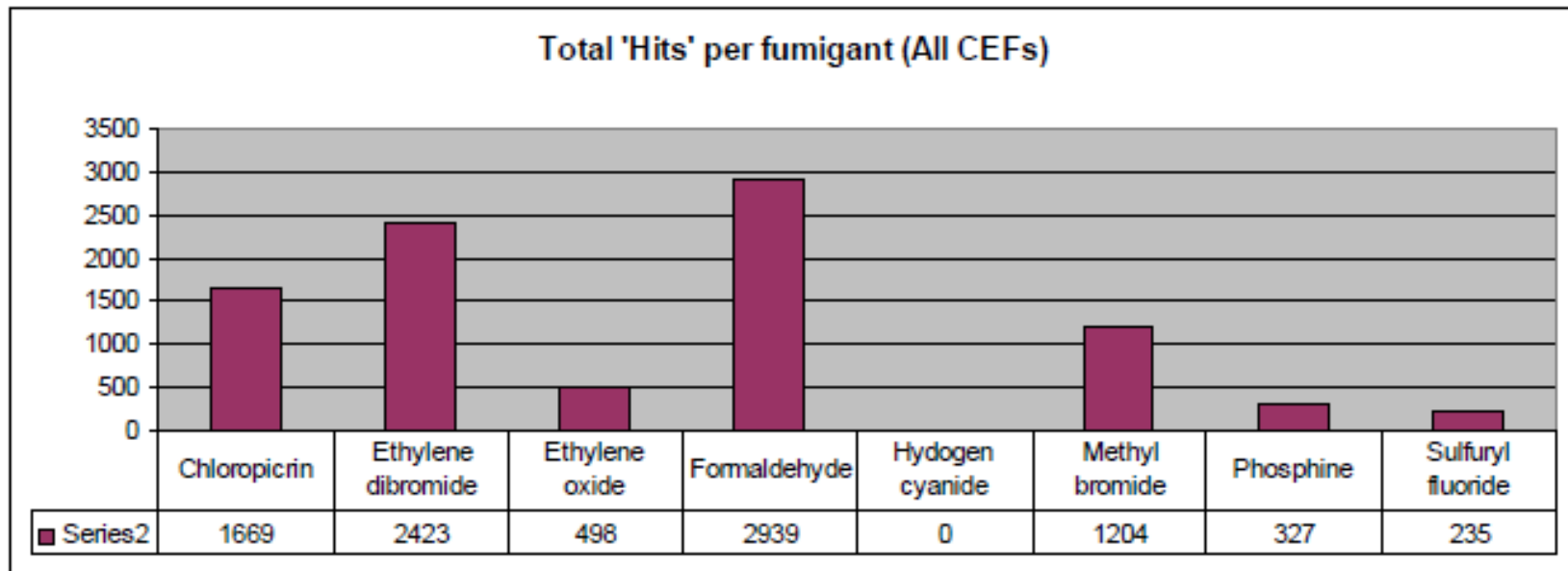


Figure 4: Out of a total of 45,826 scans, 9,295 'hits' were recorded . This table shows the breakdown of those hits per fumigant



Managing the Problem

There are two steps in managing the problem of residual gas.

- *The first step* is to Monitor inbound containers with suitable testing equipment. Then risk profile the containers to identify what risks exist on a continuing basis
- Gas monitoring can be complex and costly
- Target gases and profiles can depend upon container contents and origins
- A mix of monitoring tools can be used: PID, detector tubes, GCMS etc



Gas Monitoring

It is *important* to measure gas concentrations before inspecting containers or devanning cargoes:


- Higher Volume: accurate and fast:
eg Syft Voice 200/ portable GC
- Low volume: tubes/PID/other devices



Container Gas Testing



Dräger tube reading:	ppm	p	time:	temp:	humidi
concentration:	ppm	n			
Dräger tube reading:	ppm	p	time:	temp:	humidi
concentration:	ppm	n			
Dräger tube reading:	ppm	p	time:	temp:	humidi
concentration:	ppm	n			
Comments					
Interim report sent to IKEA <input type="checkbox"/>					



Managing the Problem

The second step is to remove residual gases found in the container:

- Swedish recommended solution: force ventilate all containers
- Natural ventilation does not remove all gases, can be very slow. There is also a considerable security and weather risk
- Natural ventilation can leave gas pockets in the container
- Forced ventilation allows option to ventilate indoors (in warehouse or dock) and is much faster
- Forced ventilation is much faster and effectively removes trapped pockets of gas in the container

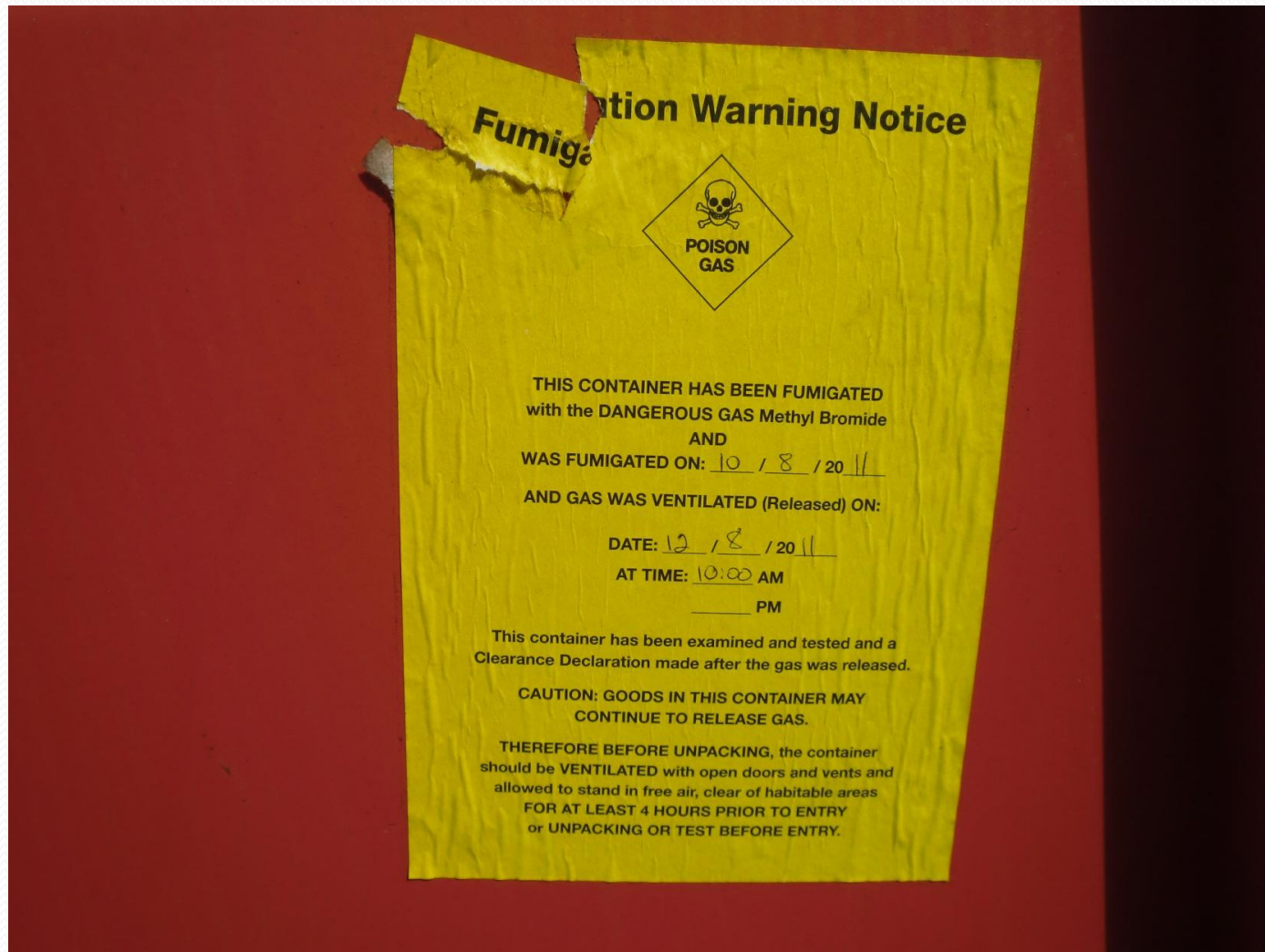


Typical Containers with residual Gas

- Any Fumigated Containers
 - Offshore fumigation – must be checked but lower risk
 - Onshore fumigation – must be checked – HIGHER risk
 - Fumigation container should be labeled but mostly they are not
- Wooden products, furniture, laminated timber, chip or particle board can all container formaldehyde
- Shoes – benzene or toluene to protect leather
- Textile – often finished with formaldehyde
- Coir Matting, rubber products – HCN and Ammonia
- Grains, cereals – may have been fumigated
- Fresh produce – may have been fumigated
- Batteries – hydrogen
- Personal effects – possible fumigation



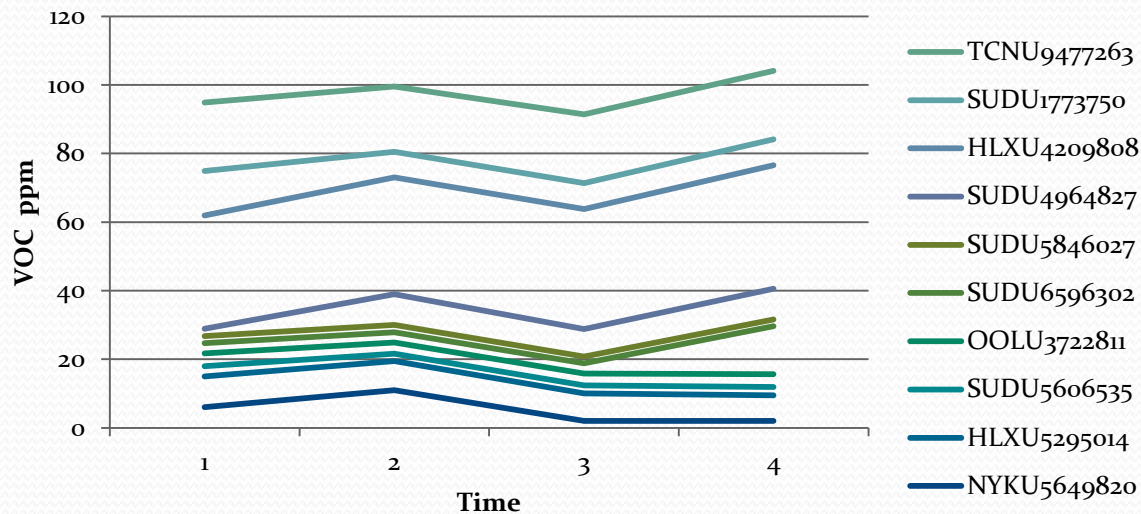
Fumigation Warning on Containers



Passive Ventilation of Containers

Containers can be ventilated by passive or mechanical means. Mechanical or forced ventilation is a much faster option.

VOC concentration at the back of containers: Natural (Passive) ventilation



What equipment do we use?

- Gas Measurement
 - SYFT
 - Portable GC occasionally
 - PIDs, Rae, Multirae etc
- Gas Extraction
 - Aluminium console
 - High density foam Ultra light console wedge
 - Plastic console

All with options to extract to atmosphere or to capture gas on a carbon filter



Equipment for Degassing



Aluminium Console



Plastic Console



ULC wedge console



Typical residual gas readings and TLV

- Readings can range from anything from 1 to 2 ppm in the lower ranges to in excess of 500 ppm
- The highest reading we saw exceeded 1500 ppm of methyl bromide. That is rare
- Threshold limits vary according to country but for instance Formaldehyde limits have fallen from 5 ppm to 0.1 ppm in many countries. Methyl bromide sits between 0.25 and 5 ppm depending on the country
- Phosphine is 0.3 ppm generally but 0.1 ppm in some areas



Current users of equipment

- Some Customs & Border Protection Authorities (including Quarantine)
- Some large multinationals
- Service providers, fumigation companies
- European importers in general
 - Spain/Holland/France/Germany/Denmark etc
- Organisations seeking to protect the health and safety of staff
- A variety of small importers either measure and degas containers themselves or outsource to service providers



Regulators starting to Spread the Message



A Health and Safety Solution




Fumigated shipping containers –
Venting prior to unpacking (by end user)


What is the problem?

Shipping containers ventilated by a significant quantity of fumigant gas in the container may present a risk to persons involved in unpacking these containers.

1. Close shipping container in a designated area.



A Health and Safety Solution



Fumigated shipping containers –
Clearance of methyl bromide (by fumigators)

What is the problem?

Shipping containers that are fumigated and ventilated may still contain a significant quantity of methyl bromide (MeBr) due to poor venting procedures, desorption or entrapment of the gas in packaging. This may present a risk to persons involved in unpacking these containers.

2. Set up mechanical ventilation within the container to circulate the MeBr during fumigation and to vent the container on completion of fumigation.
3. Set up sampling tubes within the container (at a depth of at least 1.5–2.0 metres from the door) to monitor the level of MeBr.
4. Fumigate the container as required by the



Summary

- Inspection of Shipping Containers can be hazardous but can be mitigated through
 - **Measurement** of gas levels before opening
 - **Removal** of gas if detected
- Hazards can come from both **Fumigants and Toxic Industrial Chemicals**
- **Risk Awareness** of the problem is a key factor in providing a safer workplace



Thank You For your attention



Come and see us at Stand C3 – look for the Nordiko Hat