ECCII Exposure Control and Containment II

12 & 13 October 2016
Crowne Plaza
Liverpool City Centre
UK

vent-tech
industrial environment control

BOFA
CONCEPT
CSC
CTS
FILTERMIST
IOM
ONFAB
ProSys
SafeBridge
SAI
Safecontainment
VEGA
Wednesday 12 October
Welcome to ECCII 2016

Thank you to our sponsors & exhibitors
BOHS OHSI
Exposure Control & Containment II

#Helping Great Britain
Work Well

Kären Clayton, CChem FRSC
Deputy Director Chemicals Regulations Division
An overview of the new Help GB Work Well strategy and the themes of ‘tackling ill health’ and ‘acting together’; how collaborative initiatives contribute to reducing incidence of occupational ill health
#Help GB Work Well strategy

- We are all part of the health and safety system and can be rightly proud of our achievements to date.

- The future of the health and safety system that will help Great Britain work well to 2020 and beyond belongs to everyone – not just HSE.

- We can all come together to help achieve the strategy aims, maintain the gains made in safety, and seize the opportunity to give health the same priority as safety.
Strategy – Key themes

Acting together
Promoting broader ownership of health and safety in Great Britain

Tackling ill health
Highlighting and tackling the costs of work-related ill health

Managing risk well
Simplifying risk management and helping business to grow

Supporting small employers
Giving SMEs simple advice so that they know what they have to do

Keeping pace with change
Anticipating and tackling new health and safety challenges

Sharing our success
Promoting the benefits of Great Britain’s world-class health and safety system
Themes

• **Acting together** - everyone has a vital role in effectively managing occupational safety and health, thus preventing accidents and ill-health, which damage individuals, businesses and the economy. Health and safety professionals have an important role to play.

• **Tackling the costs of work-related ill health** - this is a problem for every section of society and solving it requires action across all business sectors. It ranges from the long latency disease, to stress and musculo-skeletal disorders. The drive must come from all those with a stake in keeping people healthy and fit for work.
Health and safety at work: Vital statistics 2015

Ill health
1.2 million people who worked during the last year were suffering from a work-related illness
0.8 million former workers (who last worked over 12 months ago) were suffering from a work-related illness
2,538 mesothelioma deaths due to past asbestos exposures

Injuries
142 fatalities at work
611,000 injuries at work
76,000 employee injuries reported under RIDDOR

Working days lost
27.3 million days lost
23.3 million days lost to work-related ill health
4.1 million days lost to workplace injury

Enforcement
728 cases prosecuted in Britain
12,430 enforcement notices issued in Britain

Economic cost
£14.3 billion estimated costs to Britain due to workplace injuries and new cases of work-related ill health
LUNG DISEASE SUMMARY

DISEASE
- Mesothelioma
- Asbestosis (Pleural plaques)
- Lung/respiratory cancer
- Silicosis
- COPD
- Work-related asthma
- Pneumonia
- Extrinsic Allergic Alveolitis
- Legionellosis
- Zoonoses
- Bovine TB

AGENT
- Asbestos
- DEEEs
- Respirable Crystalline Silica (RCS)
- Welding Fume
- Cleaning/cleaning products
- Agricultural dusts Grain/poultry
- Latex
- Wood dust
- Flour dust and improvers
- Isocyanates
- Other hazardous substances
- Metal working fluids
- Legionella spp
- Other biological agents

SECTOR
- Construction
- Quarries
- Foundries
- Brickmaking
- Stone working
- Ceramics
- Agriculture
- Health Care
- Wood working
- Food/baking
- MVR
- Transport and associated workplaces
- Plastics manufacture/processing
- Engineering/manufacturing
- Waste and recycling/composting

Notes:
1. Work-related asthma
2. Latex
3. Welding Fume
Working together to tackle occupational respiratory ill health

• **Occupational hygiene** plays an important role in protecting people from workplace health risks and provide an interface with other health and safety professionals.

• **Employer** - in general, health and safety laws requires employers to put in place arrangements to control health and safety risks.

• **Worker** - listening to and involving employees helps to make the workplace healthier and safer, improve performance and raise standards.
BOHS – ‘Breathe Freely’

• BOHS ‘Breathe Freely’ initiative is another excellent example of working in partnership

• A collaboration with Constructing Better Health, Land Securities, HSE and Mace

• To reduce the incidence of occupational lung disease in the construction industry

• Targeted specifically at managers/site supervisors within large organisations in the construction industry
QPT Stop dust before it stops you
Others getting involved in tackling occupational respiratory disease
‘Acting together’ and ‘Tackling ill health’ - ‘Health and Work’ Strategy
The benefits of control & containment

**Employer** (more immediate cost benefits)
- Increased life of tools and consumables
- Job/task completed quicker
- Reduced clean up time

**Worker**
- Healthier and safer workplace
- Feels valued
- Healthier, longer life
Occupational hygiene community

• The occupational hygiene community can make a real difference

• You are best placed to highlight the importance of risk prevention and control

• I would encourage members of BOHS and OHSI to continue to get across the message that if there is a problem, that there are solutions – and occupational hygienists can help

• Continue to protect people by managing risk and controlling workplace exposure, making workplaces safer and healthier
Thank you for listening
BOHS/OHSI

Containment II
Liverpool October 2016

Pete Marshall
Principal Technology Engineer
AstraZeneca Global Engineering

Torsten Belger
Technical Director
ProSys Containment & Sampling Ltd.
Who are we?

Pete Marshall
Principal Technology Engineer
Astrazeneca Global Engineering
BSc(Eng) Biochem Eng, UCL 1982.
Global SME for Containment (and OSD)
Around 25 years of exposure as Project Manager and SME.
Member of ISPE Containment CoP committee
Co-Author of a number of ISPE Guidelines including containment.
Presented at a number of ISPE, IChemE, IMechE, and BOHS conferences.

Torsten Belger
Technical Director
ProSys Containment & Sampling Ltd. (Cork, Ireland)
B(Eng) Mech Eng (Germany & UK)
More than 20 years experience in the specification and design of containment application solutions.
Member of ISPE and other professional organisations.
Author of a number of containment publications.
Presented at a number of ISPE, IChemE, Konzept Heidelberg, and BOHS conferences.
To Cover

What is containment?

What does it mean?

Why does it matter?
Containment – A Long History?

Pandora – J.W. Waterhouse (1896)
What is ‘Containment’?
Oxford Living Dictionary Definition

containment

NOUN

1. [mass noun] The action of keeping something harmful under control or within limits.
   ‘the containment of the AIDS epidemic’
   + More example sentences

1.1 The action or policy of preventing the expansion of a hostile country or influence.
   ‘a policy of containment and negotiation was the appropriate course of action’
   + More example sentences
Control of Exposure
- Hierarchy of Control

- Elimination - Prevention
- Substitution - Prevention
- Modify process
- Ventilation / Engineering Control*
- Administrative Issues
- Personal Protection
- Or any combination of the above

* Extra emphasis on enclosure for carcinogens & Mutagens in UK
Explanatory Diagram

EMISSION
Caused by
energy input

TRANSMISSION
Airborne or Surface

UPTAKE
Potential ingress
into body
Explanatory Diagram

Control Options:

EMISSION
Caused by energy input

TRANSMISSION
Airborne or Surface

UPTAKE
Potential ingress into body

‘Closed Process’
Engineered Containment

PPE
Transmission Routes Diagram

AIRBORNE DUST CONCENTRATION

AEROSOL GENERATION

INHALATION
(Nose/Mouth)

DEPOSITION
LOCAL AND REMOTE

INGESTION
(Eye and Mouth)

SURFACES

CONTACT TRANSMISSION
LOCAL ONLY

Note
Routes shown as bi-directional as surfaces can be contaminated from manual contact and vice versa

PROCESS / SOURCE

EXPOSED INDIVIDUAL

MANUAL CONTAMINATION
DERMAL ABSORPTION
Engineered Containment Systems

• Work by interdicting transmission route

• Two Mechanisms:
  – **Barrier Blocking** – block transmission route completely
    • Closed process
    • Isolator
    • Glovebag/Flexible Containment
    • Split valves
    • Filters
    • PPE
  
  – **Diversion** – Use air flow to move airborne material elsewhere
    • Fume hood
    • Extract booths or cabinets
    • Biological safety cabinets
    • ‘Elephants Trunk’ Extract
    • Down Draft tables
What is to be protected.

- **Personnel** should be protected from exposure to hazardous agents and solvents.
- The **environment** should be protected against the release of hazardous agents and solvents.
- The **product** should be shielded from these contaminating agents and undesired materials.
Ill Health Prevention From Exposure to Substances Hazardous to Health (HSE 2014)

- Past occupational exposure to known and probable carcinogens is estimated to account for about 5% of cancer deaths and 4% of cancer registrations currently occurring each year in Great Britain.
- This equates to about 8,000 cancer deaths and 13,500 new cancer registrations each year.

In 2014 there were an estimated 132 new cases of occupational asthma seen by chest physicians. Other data sources suggest the total number of new cases each year in the wider category of work-related asthma could be more than 10 times higher than this (LFS, THOR-GP).

About 33,000 people who worked in the last year, and 141,000 who had ever worked currently have breathing or lung problems they thought were caused or made worse by work (LFS).

1336 new cases of work related skin disease were reported in 2014 (79% Contact Dermatitis)

Ref – HSE Website
Why Containment is Important

We don't want to:

- Hurt our (or other) people.
- Contaminate the environment
- Contaminate other products
- Waste useful product.

- Have to explain the above to regulators and the public, and to sort it out.
To misquote Dostoevsky

“The level of safety and GMP on a pharmaceutical production plant can be judged by looking at its levels of containment.”
Four control approaches used in the generic risk assessment scheme

<table>
<thead>
<tr>
<th>Control Approach</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General Ventilation</td>
<td>A good standard of general ventilation</td>
</tr>
<tr>
<td>2</td>
<td>Engineering Control</td>
<td>Typically, local exhaust ventilation ranging from a single point extract close to the source of the hazards to a ventilated partial enclosure. It includes other engineering methods of control, eg cooling coils for vapours, but not complete containment.</td>
</tr>
<tr>
<td>3</td>
<td>Containment</td>
<td>The hazard is contained or enclosed, but small-scale breaches of containment may be acceptable.</td>
</tr>
<tr>
<td>4</td>
<td>Special</td>
<td>Expert advice is needed in selecting control measures.</td>
</tr>
</tbody>
</table>
HOW TO APPROACH A CONTAINMENT PROJECT?

- What is the process (charging, dispensing, container filling, laboratory application, milling, etc.)?
- What containment level is required?
- What quantities of material are involved?
- What is the frequency/time scale of handling these materials?
- What types and size of containers will the materials be handled in?
- Where do the containers come from and where will they go to?
- Is there any special atmosphere required when handling these compounds (low moisture, low oxygen, etc.)?
- ATEX categorisation?
TYPICAL CONTAINMENT PROJECT

Concept

Design

Mock-up

Delivery

Testing
Isolator – Design considerations - ergonomics

Lyophilise API solution → Mix → Lyophilise → Blend → Pack-off

5 possible units

<table>
<thead>
<tr>
<th>Telstar</th>
<th>IMA</th>
<th>BPS/SP</th>
<th>Optima</th>
<th>GEA</th>
</tr>
</thead>
</table>

Images of isolator equipment and processes.
Isolator – Design considerations - Ergonomics

**Conclusion:**
Integrate into isolator base, accessed from half-suit.
Reach below isolator base is difficult even with tools.

Vision of internal surfaces is less than 100%.

Acceptable ergonomic position:

Bin shaft elongated to provide access for making seal through back of isolator wall.

Better ergonomic position:

Complicated bin access, but achievable with purpose designed trolley.

Lyophilisation of API solution → Mix → Lyophilisation → Blend → Pack-off
FINAL DESIGN LYO ISOLATOR
WHAT TECHNIQUES & TOOLS ARE AVAILABLE TO THE CONTAINMENT ENGINEER?

Containment is a break in the route of transmission from the hazard to the human!

Primary Containment: Contains the hazard at the source
Secondary Containment: Contains primary containment device for increased level of protection

• LEV – Local Exhaust Ventilation
• Laminar Flow – Fume Hoods
• DFB - DownFlow Booths
• SBV – Split Butterfly Valves
• Continuous Liner Systems
• Flexible Isolators
• Rigid Isolators
A definition of a local exhaust ventilation (LEV) system is: an engineering control system to reduce exposures to airborne contaminants such as dust, mist, fume, vapour or gas in the workplace. Simply put it is something that sucks an airborne contaminant out of the workplace.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low cost. Simple installation.</td>
<td>Large air volumes that require filtration.</td>
</tr>
<tr>
<td>Good for fumes &amp; vapours.</td>
<td>Less good for dust and heavier particles.</td>
</tr>
<tr>
<td>Simple operation. Little operator training required.</td>
<td>Difficult to position effectively.</td>
</tr>
</tbody>
</table>
LAMINAR FLOW – FUME HOODS

A Fume Hood is a ventilated enclosure designed to contain and exhaust fumes, vapours, mists and particulate matter generated within the hood interior. Fume hood structures are basically boxlike, with an open side (or sides) for access to the interior of the hood. Reliance on airflow and face velocities only.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low cost. Simple installation.</td>
<td>Large air volumes that require filtration.</td>
</tr>
<tr>
<td>Protection of surrounding area.</td>
<td>Operator hands/arms are required to enter containment area.</td>
</tr>
<tr>
<td>Effective as secondary containment.</td>
<td>Spillages and possible mechanical migration of contamination. No physical barrier.</td>
</tr>
</tbody>
</table>
DFB – DOWNFLOW BOOTHs

Any airborne particulates are suppressed by means of downward air movement and are removed via exhaust filters in the back of the booths. The aim of the DFB is to prevent particulates from entering the breathing zone of operators.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>High levels of containment can be achieved.</td>
<td>Large air volumes that require filtration.</td>
</tr>
<tr>
<td>Protection of surrounding area.</td>
<td>Operators are required to enter containment area.</td>
</tr>
<tr>
<td>Effective as secondary containment.</td>
<td>Heavy reliance on SOP and positioning of the operator.</td>
</tr>
</tbody>
</table>
SBV – SPLIT BUTTERFLY VALVES

An SBV consists of two parts, each essentially presenting an ordinary butterfly valve. Once the two parts are brought together, the discs join together to form a ‘single disc’, thus sealing any surfaces, which may be exposed to compound during transfer. The two discs then operate as one disc and can be opened to permit transfer of compound from one container to another.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent primary containment for direct powder transfers.</td>
<td>Powder containers must be suitable for connection to SBV.</td>
</tr>
<tr>
<td>Operators are completely separated from the process.</td>
<td>Potential for powder handling problems, eg bridging on the discs.</td>
</tr>
<tr>
<td>Secondary add on options for higher containment.</td>
<td>Limitations when handling liquids or packaged materials</td>
</tr>
</tbody>
</table>
CONTINUOUS LINER SYSTEMS

‘Endless’ length of polyethylene tubing for powder discharge from processes (similar to making sausages). Individual bags are made by double tying of the liner and cutting between the ties.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent primary containment for direct powder off loading.</td>
<td>High level of operator training is required.</td>
</tr>
<tr>
<td>Operators are completely separated from the process.</td>
<td>Possibility of liner shedding during cutting.</td>
</tr>
<tr>
<td>Secondary add on options for higher containment.</td>
<td>Difficult to pre-determine tare weight of liners.</td>
</tr>
</tbody>
</table>
ISOLATORS

A separative device that provides assured protection by using physical and dynamic barriers to create separation between operation (product) and operator/exterior environment.
**RIGID ISOLATORS**

Fully sealed and contained barrier device with rigid walls (stainless steel, Hastelloy, etc.). Isolators provide controllable micro atmospheres.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longevity. Can handle large throughputs.</td>
<td>High level of operator training is required.</td>
</tr>
<tr>
<td>Can be cleaned in situ and cleanliness can be validated.</td>
<td>Difficult to move to different locations. Difficult to modify for alternate use.</td>
</tr>
<tr>
<td>Robust operator protection.</td>
<td>High initial capital expenditure.</td>
</tr>
</tbody>
</table>
FLEXIBLE ISOLATORS

The Flexible Glovebag/Isolator is a soft walled containment system that can be used as an alternative to a hard walled isolator in many applications.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low initial capital expenditure.</td>
<td>High level of operator training is required.</td>
</tr>
<tr>
<td>Very adaptable to contain complex or existing machinery.</td>
<td>High risk of damage during normal operation.</td>
</tr>
<tr>
<td>Quick project turn around and fast installation.</td>
<td>Difficult to clean and to validate cleanliness. Diminished suitability for handling larger powder quantities.</td>
</tr>
</tbody>
</table>
Alternate method is to use a Task Duration CPT
WORKSHOP
SOLVING A CONTAINMENT PROBLEM

• API materials (solids) arrive in lined drums (drums with sealed bags inside)
• Need to weigh out some of the material
• Charge weighed out material into a blender
• Discharge into an IBC after blending for further processing
• Indoor location

What additional information is needed?
REQUIRED INFORMATION

- **TOXICITY:** 100µg/m³, not a skin sensitizer, fish toxic
- **FREQUENCY:** 4 batches per shift/clean down once per week
- **QUANTITIES**
  - DRUM SIZES: 30kg/drum
  - NUMBER OF DRUMS: 1 per batch
  - AMOUNT TO BE WEIGHED: 15.3kg → ACCURACY OF WEIGHING: +/- 100gr
  - BATCH SIZE: 300kg total, incl. excipients
- **QUALITY/TYPE OF MATERIAL**
  - LEVEL OF DUSTINESS: granular
  - BULK DENSITY: 0.3
  - SPECIAL CHARACTERISTICS → FLAMMABILITY: Yes, HYGROSCOPIC: No, SUBLIME: No
- **WHO ARE THE USERS:** Mixed group of males and females. Trained plant operators.
- **TYPE OF BLENDER:** Agitated with charge nozzle. Not in the same location as dispensing → intermediate transfer container required
- **IS THE PROCESS CLOSED:** Blender vent → Filtration?
ANALYSING THE PROBLEM

What are the sources of emission? What do we need to protect against?

Who/what is at risk of exposure?

What is the transmission route?
Possible Solution?

Downflow Booth with articulated screen option?
Contained Transfers?

Basic Split Butterfly Valve?
Testing Equipment and the Future

With thanks for additional material to:
Justin Mason-Home
CEO, Safebridge Europe
www.safebridge.com
Why Test?

• Legal requirement
  • HASAWA and LEV
  • EN 689 Compliance?
• COSHH Assessment?
  • Designated safety equipment?
• Cross Contamination Risk Assessment
  • Defined quality critical system
• Workforce Requirement
  • Union requirement to demonstrate continued safe working conditions?
• Good Business to know it works
  • It costs an awful lot to remediate impact of non-operation
Confidence Matters!!
The Scientific Method

- Characterisation
- Hypotheses
- Predictions
- Experiments

1. Define a question
2. Gather information and resources (observe)
3. Form an explanatory hypothesis
4. Test the hypothesis by performing an experiment and collecting data in a reproducible manner
5. Analyse the data
6. Interpret the data and draw conclusions that serve as a starting point for new hypothesis
7. Publish results
8. Retest
First We Need a Limit
- What do we have to prove we achieve?

• OEL (EH40) or similar published standard (TLV etc)
• OEL – Toxicologist
• Occupational Health Categorisation (OHC)
• Control or Containment Performance Target (CPT)
A Thought...
How Many Particles is our OEL?

<table>
<thead>
<tr>
<th>Weight of Particles</th>
<th>Assumed equivalent sphere diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 micron</td>
</tr>
<tr>
<td>Diameter (metre)</td>
<td>1.00E-06</td>
</tr>
<tr>
<td>Density (kg/m³)</td>
<td>1500</td>
</tr>
<tr>
<td>Weight of particle (kg)</td>
<td>7.85E-16</td>
</tr>
<tr>
<td>Weight of particle (ng)</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of particles for given OEL</th>
<th>1 micron</th>
<th>10 micron</th>
<th>30 micron</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ng/m³</td>
<td>12734</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>0.1 μg/m³</td>
<td>127340</td>
<td>127</td>
<td>5</td>
</tr>
<tr>
<td>1 μg/m³</td>
<td>1273899</td>
<td>1273</td>
<td>47</td>
</tr>
<tr>
<td>10 μg/m³</td>
<td>12733957</td>
<td>12734</td>
<td>472</td>
</tr>
<tr>
<td>100 μg/m³</td>
<td>127339870</td>
<td>127340</td>
<td>4716</td>
</tr>
</tbody>
</table>

NB – 1 to 30 microns diameter is assumed nominal inhalable range.
Test Methods

• **Qualitative**
  – Quick, real-time or rapid results.
  – Difficult to compare to exposure to defined safe level.
  – Good for trending performance and identifying performance changes

• **Quantitative**
  – Based on sampling
  – Requires expertise to carry out and interpret effectively.
  – Specialised analysis capability required for high hazard system testing
  – Can be expensive and results may takes several weeks to come.
Qualitative/Physical Methods of Testing

**Pressure Hold Test**
- Generally used for isolator systems
- Very sensitive to changes in local environment

**Face Velocity Checks**
- Key element of LEV testing

**Tyndall illumination**
- Real time results, can be easily applied to operating system
- Interpretation of scale of exposure is difficult
Quantitative Testing

- **Real Time Particle Counters**
  - Non-specific – measure all particles, not just material of interest.
  - (Background concentrations often $>>$ material concentration)

- **Air sampling/chemical analysis**
  - Specific for material used for test (real or surrogate/tracer gas)
  - Expensive, specialist task, can take weeks to get results.
  - Results are average over the sample time and need careful interpretation

- **Surface wipe samples (swabs)**
  - Very difficult to interpret.
  - Useful for trending?
Analytical Method

• We need to be able to “see” below the limit and have all the usual validated analytical method attributes – sensitivity, specificity, LOQ, etc

• Methods include:
  – HPLC
  – RIA/ELISA
  – Mass spectrometry

• Surrogate LOQs (SafeBridge Validated Methods):
  – Lactose – 2 ng
  – Mannitol – 1 ng
  – Naproxen sodium – 50 pg
What Containment Performance Can this System Achieve?
Control Performance Envelopes?
How Much Data is Enough?

• We have to chase that mysterious endpoint – confidence

• It is the difficulty in getting sufficient data that defines the difficulty in potent compound safety management.

• Monitoring is generally infrequent and involves small datasets

• Higher uncertainty in most of the steps taken to get this data

What performance do I get from my containment system?
Containment System Testing by Airborne Sampling

• Identify your target limit.
• Develop an appropriate sampling strategy.
  – ISPE good practise guide for surrogate testing.
• When do we test? FAT, SAT, both?
• Static vs personal samples?
• Identify representative and maximal case exposure potentials
• Take samples and analyse appropriately, (and observe!!!)
• Compare results to limit and identify any failure modes.
• Recommend improvements
• Communicate results
Containment Performance Target

When does the device meet the CPT?

- All results above the CPT – **FAIL**
- One result above the CPT – **FAIL**
- All results below the CPT – depends

<table>
<thead>
<tr>
<th>Weighing Isolator (CPT &lt; 1 μg/m³)</th>
<th>Iterations (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Sample Locations</strong></td>
<td></td>
</tr>
<tr>
<td>Left side</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Isolator face</td>
<td>0.10</td>
</tr>
<tr>
<td>Right side by RTP</td>
<td>0.35</td>
</tr>
</tbody>
</table>
• Provides guidance for comparison with limit values
• Adapted for containment testing
• Set the CPT at the OEL, containment OK if:
  – Three sets of results all < 25% of CPT, or
  – All results < 100% of CPT and the geometric mean is < 50% of the CPT.
• One can never guarantee that the CPT won’t be exceeded but this test predicts control to be better than the CPT in the majority of cases
## Containment Performance Target

<table>
<thead>
<tr>
<th>Weighing Isolator (CPT &lt; 1 μg/m³)</th>
<th>Iterations (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>SAMPLE LOCATIONS</strong></td>
<td></td>
</tr>
<tr>
<td>Left side</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Isolator face (GM = 0.19)</td>
<td>0.10</td>
</tr>
<tr>
<td>Right side by RTP (GM = 0.57)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

*FAIL* — geometric mean > 50% of CPT
Communicate the Results

• In the UK it is a regulatory requirement (COSHH Reg. 12) to communicate the results of any personal monitoring, especially if an OEL has been exceeded.

Risk communication is in itself a risky business!
Results are all OK.....When do I test Again?

• Good question!
• Start somewhere and keep going
• Recognise that one will never get the same robustness of data as in continuous testing
• Use data obtained to inform frequency of testing
• Share data internally (and externally?)
• Determination of control performance is in your hands – generate your own containment performance envelope data
Future Trends??

(Definitely my own thoughts…)

• **OEL trends are downwards**
  – Containment and exposure control is becoming more critical.
  – OEB5 is no longer very unusual, lower OELs are starting to appear.

• **Greater Regulatory Expectations for Performance Data?**
  – Update of ISO 689 on data interpretation
  – Extension of LEV regs to other systems re testing frequency
  – Signature Exposure case round the corner?

• **Use of Data for other purposes**
  – Cross contamination assessments
  – Environmental impact compliance.
  – Equipment performance becomes GMP-critical, enhanced validation requirements for equipment.

• **Disposable Containment Systems**
  – Glovebags, disposable docking valves, FIBCs?
  – Reduced scope of cleaning (and effluent treatment)?
THANK YOU!

Containment II
Liverpool October 2016

Pete Marshall
Principal Technology Engineer
AstraZeneca Global Engineering

Torsten Belger
Technical Director
ProSys Containment & Sampling Ltd.