



Use of innovative in-house quantitative risk assessment to determine the requirements for building fabric decontamination during site closure and site sale processes;

OR

How clean is clean?

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Is my site contaminated?

What does this actually mean

- **For soils and groundwater there are good definitions in many countries, i.e.**
 - published numbers or methods
 - accepted / standard variables for types of chemical, exposure pathways, assumptions on receptor sensitivity etc.
- **What if my 'site' includes buildings?**
 - .. and I want to decommission, close or sell the site and buildings
 - .. for a different use, to a separate legal entity – how do I minimise liabilities?



Current approaches to building contamination

Some contaminants have well established guidance, e.g.

- **Asbestos -**
 - Regulatory guidance for air and surface quality
 - established methods for monitoring and assessment
- **Radiation –**
 - Regulation on exposure / dose gives rise to local guidance for surface quality and established methods for monitoring and assessment
- **Some other substances e.g.**
 - lead in paint, lead in dust, PCBs on surfaces
 - however, these are often aimed at the public and are difficult to use for commercial building use

Current approaches to building contamination

- **Work place or occupational exposure limits (WELs / OELs)**
 - limits in air (with sometimes a 'note' re. exposure via dermal route)
 - there are quite a few, but not many for non-volatile organics
- **Industry supplied in-house 'clean-up criteria'**
 - useful to consultants re PI, but often unclear how they were derived
 - can sometimes be overly conservative or unachievable
- **eg. example taken from a client in-house procedure for 'clean-up'**

The clean closure criterion for wipe samples collected using this method are:

- **Non-detectable using the lowest published detection limit for analytical methods as published in US EPA SW-846 Test Methods for Evaluating Solid Wastes, Physical/ Chemical Methods, or**
- **Below background levels for all contaminants of concern.**

**These are
pretty low!**

➤ Gap in this approach for ..

- **Contaminants which are:**

- non-volatile, non-dusty or 'fixed'
- 'fixed' includes trapped or contained within 'normal' dust and grease
- typically organics, particularly
 - **'pesticides'**
 - **pharmaceuticals**

- **i.e. contaminants which can be toxic / undesirable by;**

- dermal absorption and / or
- ingestion via dermal contact

These are large industries undergoing large changes in manufacturing, packaging and storage locations of products – and it all happens in buildings.

Is this a risk? -two approaches typically found

'Qualitative' e.g.

- ignore the issue or pretend it does not exist
- adopt a 'visually clean *is* clean' standard – sometimes taken by contractors
- adopt generic cleaning methods, often not linked to contaminant type or location, and irrespective of pre- and post-cleaning contaminant concentrations

Quantitative

- rarely taken
- some published research into quantitative approaches
- tends to be complicated, if not simplified by 'user guidance' – i.e. the real world
- needs clear explanation for clients, contractors, vendors and buyers
- but .. can give firm basis for significance of risk or clean-up criteria if used sensibly

What the literature says - sampling

- **key variable is data collection – what method do you use to sample surfaces and how reliable is it?**
- **assumption is that swabs or wipes are best – what is ‘best’**
- **literature review confirms assumption, but note sampling efficiency – question raised is ‘what is representative of dermal contact?’**
- **a reasonable + conservative assumption is that uncorrected wipes or swabs are ‘best’ (and give the lab more to analyse)**

Sample method	Wipe (cotton wool ball or medical gauze)	Surface press sampler with filter cassette	Swab (cotton bud type)	Lift tape, forensic tape Adhesive tape	Smear tabs
Sampling efficiency (how much is sampled)	84% – 97% (Bernard et al, 2007)	17% – 55% (Bernard et al, 2007)	81% (USDA ARS, 2003)	<40% (Wheeler & Standiff, 1998)	No data – assumed similar to lift tape

Sample record

Project no. 0081829

ERM Building Plant & Infrastructure Contamination Investigation - Sample Record Sheet

Survey Address	Client Address	Location Address	Survey Personnel/Date

Sample Number	Description of Sample Location	Observations	Qualitative Contamination Assessment Rating	Method of Sampling	Minimum Distance Area Sampled (and general)
Disp6	Dispensary (5), Dispensing Cubicle 2 (47), Fume Cupboard	No staining, residue or dusts visible, no difference noted after scrubbing	1	Swab	10

Location Photo	Detail Photo
	

Qualitative Assessment Rating	
1	No staining, residue or dusts visible, no difference noted after scrubbing.
2	Light staining or settled dust, visible only by comparison of swabbed and unswabbed areas.
3	Moderate staining or settled dust, visible before scrubbing.
4	Heavy staining/residue or settled dust/powder, but not enough to be effectively sampled with spatula.
5	Residue, powder or solid build-ups that can easily be sampled with a spatula, or best/worst way in fragments.

ENVIRONMENTAL RESOURCES MANAGEMENT

SHRETS

What the literature says – risk assessment

- **There are various risk assessment models published, mostly US**
- **various degrees of complexity, e.g. some take account of surface fraction transfer, dermal absorption coefficient, fraction of GI absorption, differing exposure durations, exposure areas etc.**
- **i.e. not very standard + biased towards occupational exposure**
- **but .. most refer back to published toxicity data i.e. reference doses or ADIs e.g.**

LaGoy-Bohrer-Halvorsen	Paull
METCOA	Dibiasio/Klein

Remediation methods



- **sampling, risk assessment etc. is one issue**
- **the other is – remediation**
 - what can you do?
 - which methods?
 - what is cost effective and practical?
 - .. and how much sampling / risk assessment do you need to answer these questions?

Remediation methods

- **Examples of methods (taken from client and UK government guidance)**
- **Physical Methods**
 - Abrasive Blasting
 - Scarifying, Grinding, Planing, Spalling
 - Vibratory Finishing / scrubbing
 - High Pressure Steam and Water Sprays
- **Chemical Methods:**
 - Water Washing and Spraying:
 - Chemical Oxidation: hypochlorite (bleach);
 - Chemical Reduction:
 - Liquid Phase Solvent Extraction:
- **Immobilisation / sealing in**
- **Do any of these work easily in practice – sometimes, but only if well directed**



Example 1 - former pesticide storage warehouse

- to be sold for alternative use
- ERM wipe sampled – high concentrations, increasing with building height
- used simplified risk assessment with assumptions for new users –
- [conc] x daily exposure assumption vs. 20% ADI
- recommended internal cleaning by manual + wet methods (H vac + tac rags + decon90 wipes)
- verified as successful ✓
- documented to protect vendor + assure buyer – everyone happy



Example 2 - former pesticide storage warehouse

- to be sold for alternative use
- previously sampled by another consultant
- assumed detection = contamination = remediation
- recommended cleaning by pressure washing
- verification results were higher than originals!

- ERM re-sampled –
- used simplified risk assessment with assumptions for new users –
- [conc] x daily exposure assumption vs. 20% ADI
- no remediation required
- verified as successful ✓
- client saved all re-cleaning costs

Example 3 - pharmaceutical packaging buildings

- **to be decommissioned and sold for alternative uses**
- **COCs were antibiotics and cytotoxics**
- **used simplified risk assessment with assumptions for new users –**
- **[conc] x daily exposure assumption vs. 20% ADI / NOA**
- **compared with and modified client GLP protocol standards**
- **antibiotics GLP standard lowered, cytotoxics increased**
- **recommended internal cleaning**
 - antibiotics – hypochlorite wash (breakage of β -lactam ring)
 - cytotoxics – H vac tac rags + decon 90 wipe
 - cost effective approach - H vac, hypochlorite spray, H₂O wipe
- **verified as successful ✓**
 - ELISA testing to achieve antibiotic detection limit
- **documented to protect vendor + assure buyer – everyone happy**

Summary

- **Many current approaches not aimed at commercial building re-use / alternative use**
- **Gap for contaminants which are non-volatile, non-dusty or 'fixed'**
- **take pragmatic but informed approach to**
 - generic or contractor guidance
 - sampling regimes
 - risk assessment models
 - remedial methods

References

- Bernard, C. E., Berry, M. R., Wymer, L. J. and Melnyk, L. J. (2008), "Sampling household surfaces for pesticide residues: Comparison between a Press Sampler and solvent-moistened wipes", *Science of The Total Environment*, vol. 389, no. 2-3, pp. 514-521.
- Wheeler, J. P. and Stancliffe, J. D. (1998), "Comparison of methods for monitoring solid particulate surface contamination in the workplace", *The Annals of Occupational Hygiene*, vol. 42, no. 7, pp. 477-488.
- Paull, J. M. (1997), *A Proposed Risk-Based Model for the Evaluation of Surface Contamination, and the Assessment of Potential Dermal Exposure* (unpublished PhD thesis), Johns Hopkins University, Baltimore, Maryland,.
- LaGoy, P. K., Bohrer, R. L. and Halvorsen, F. H. (1992), "The development of cleanup criteria for an acutely toxic pesticide at a contaminated industrial facility", *American Industrial Hygiene Association journal*, vol. 53, no. 5, pp. 298.
- Dibiasio, K. and Klein, K. (2003), "Human Health Risk Evaluation of Structural Surfaces Contaminated with Metals", Human and Ecological Risk Division, Department of Toxic Substances Control, California Environmental Protection Agency, Sacramento, CA, .
- Civil & Environmental Consultants, Inc. (CEC). (1997), *Contaminated Dust Removal Plan, Metcoa Site, Pulaski, Lawrence County Pennsylvania* .