

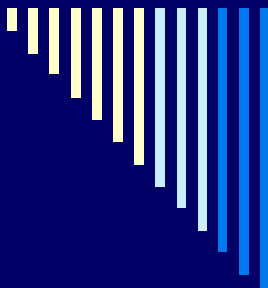

Update on Meth Lab Cleanup Standards

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Meth Lab Cleanup Standard Update

Today

- Overview Meth cleanup act 2005
 - Recommended Target Remediation Standard
 - Sampling and Analysis
-



CA Current Requirements

Reoccupancy Standards

- 0.1 ug/100 sq. cm. – Methamphetamine
- 20 ug/ sq. ft. – Lead
- 50 ng/ cu. meter – Mercury

Ch. 6.9.1 25400.16 (a) (b) HSC



Meth Remediation Standards

Current – Technology based

- OR, AR: 0.05 $\mu\text{g}/100\text{ cm}^2$
- WA, eight others: 0.1 $\mu\text{g}/100\text{ cm}^2$
- CO, MI: 0.5 $\mu\text{g}/100\text{ cm}^2$
- California: 0.1 $\mu\text{g}/100\text{ cm}^2$

Recommendation – Health Based

- California: 1.0 – 1.5 $\mu\text{g}/100\text{ cm}^2$
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Current Requirements

- Statutory reoccupancy standards become inoperative when DTSC adopts with OEHHA's guidance a Methamphetamine Health-Based Target Remediation (Cleanup) Standard
- Lead and mercury standards become inoperative too

Ch. 6.9.1 25400.16 (c) HSC



Methamphetamine Contaminated Property Cleanup Act of 2005

2005 Legislative Session - Effective 1/1/06

- AB 1078 (Keene/Liu)
 - Chapter 6.9.1, HSC
- SB 536 (Bowen)

2006 Legislative Session – Effective 1/1/07

- AB 2587 (Keene/Liu)
-



Methamphetamine Contaminated Property Cleanup Act of 2005

- DTSC
 - Local Health Officer (LHO) / Designee
 - Real Property Owner/Registered Owners
 - Mobile/Manuf. Housing/RV Park Owners
 - Contractors
 - Law Enforcement
-



Methamphetamine Contaminated Property Cleanup Act of 2005

Applicability: Meth contaminated property

- Land, structures or part of structure (houses, garages, etc.)
 - Mobile homes, manufactured housing, and RVs located in mobile / RV parks
 - Mobile / manufactured homes parks and RV parks
-



Methamphetamine Contaminated Property Cleanup Act of 2005

Requires

- Cleanup of meth contaminated property from meth labs or storage of meth precursors before human re-occupancy
 - Use of cleanup process outlined in law
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Methamphetamine Contaminated Property Cleanup Act of 2005

Sets interim re-occupancy standards

- Methamphetamine (0.1 ug/100 cm²)
 - If applicable, lead (20 ug/ft²) and mercury (50 ng/m³ air)

 - A health-based meth standard will replace interim standards when adopted by DTSC
-



Methamphetamine Contaminated Property Cleanup Act of 2005

DTSC responsibilities (SB 536 – HSC 24354.5(e))

- 10/1/07: Health-based meth standard
 - Developed, but not “adopted” by 10/1/07

 - If funding is available
 - Sampling and analytical procedures
 - 10/1/08: Health-based standards for phosphine, methyl iodide, iodine
 - 10/1/09: Investigation / cleanup procedures
-



Methamphetamine Contaminated Property Cleanup Act of 2005

Responsibilities

- Local Health Officer (LHO) or Designee
 - Implementation of law
 - Inspect property and determine whether contaminated or not
 - Cleanup oversight
 - No further action (NFA) determination
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Methamphetamine Contaminated Property Cleanup Act of 2005

Responsibilities

□ Property Owner

- Cleanup and LHO oversight costs
 - Use of authorized contractors
 - Disclosure to prospective tenants and buyers until the LHO issues a NFA
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Methamphetamine Contaminated Property Cleanup Act of 2005

Responsibilities

□ Contractors

- Remediation contractors and CIH
 - Preliminary site assessment (PSA) work plan
 - Implement approved work plan - Cleanup
 - PSA report
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Methamphetamine Contaminated Property Cleanup Act of 2005

Responsibilities

- Law Enforcement
 - Arrest, collect evidence, triage with locals to deal with other inhabitants in house (DEC, CPS, family services, etc.), dispose of bulk chemicals, etc.
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Methamphetamine Contaminated Property Cleanup Act of 2005

Law Enf. “Good Faith” Responsibilities

- NOTIFY LHO
 - Starts the meth cleanup process
 - Provide as much information as you can to the LHO without compromising your case
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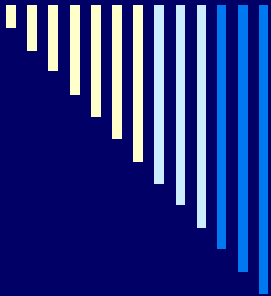


Methamphetamine Contaminated Property Cleanup Act of 2005

After notification from Law Enforcement

- LHO determines whether the property is contaminated or not

 - PSA Work plan
 - Determination of contaminants
 - Extent of contamination
 - Cleanup recommendations
-



Recommended Target Remediation Standard

Office of Environmental Health Hazard Assessment
Cal/EPA, DTSC
(January 2007)



CA Current Requirements

Meth Reoccupancy Standards

- 0.1 ug/100 sq. cm.
 - Ch. 6.9.1 25400.16 (a) (b) HSC

OEHHA Recommendation – Health Based

- 1.0 – 1.5 $\mu\text{g}/100\text{ cm}^2$
 - Two Scientific Documents
 - Basis of the target remediation standard
 - Reference Dose and Risk Assessment
-



“Adoption” Process

- Two Scientific Documents undergo open and rigorous reviews
 - OEHHA internal scientific peer review
 - External scientific peer review
 - Public review and comment
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Status of Public Review

- First public review and comment completed
 - Public Notice – 12/12/2007
 - Public Workshops – 1/2008
 - Second public review and comment coming
 - Response to comments
 - Changes to the RfD and Risk Assessment documents
-



Status of External Scientific Peer Review

- UC peer review of both documents just completed
 - Responses to comments on the RfD report are being reviewed
 - Responses to comments on the exposure report are being prepared
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RfD Scientific Peer Review

- Dr. Tim Wiegand, Assistant Adjunct Professor of Medicine and the California Poison Control Center - San Francisco Division (comments received: 1/2008)
 - Dr. Kent Olsen, Medical Director of the San Francisco Division of the California Poison Control System and Clinical Professor of Medicine and Pharmacy at UC San Francisco (comments received: 1/2008)
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Risk Assessment Scientific Peer Review

- Dr. Tim Wiegand, Assistant Adjunct Professor of Medicine and the California Poison Control Center - San Francisco Division (received comments: 5/2008)
 - Dr. Richard Fenske, Professor and Associate Chair, Department of Environmental and Occupational Health Sciences, University of Washington (received comments: 7/2008)
-



Status of External Scientific Peer Review

- Revised documents available in 2 months
 - Second public review and comment
 - Target Remediation Standard recommendation fully publicly and academically scrutinized
 - “Adoption”?
 - Legal
 - Time
-



Cleanup Standard Strategy

- Requires quantitative estimates of toxicity and exposure
 - Develop an **RfD** for methamphetamine
 - Estimate **exposure** from surface residues
 - Identify a surface residue level that produces a daily dose \leq the RfD
-



Reference Dose (RfD)

“...an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects.”

- Reflects toxicity and data uncertainty
 - Calculation:
No Effect Level / Uncertainty Factor(s) = RfD
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Identifying an RfD for Meth

- Based on the most sensitive endpoint for toxicity
 - For methamphetamine, we considered any effect to be a toxic effect
 - Rationale: a dose low enough to prevent the occurrence of the most sensitive toxicity endpoint will prevent the occurrence of all other toxic effects00
-



Principal Study: Basis of RfD

Control of Weight Gain in Pregnancy, Utilizing Methamphetamine

(Chapman, 1961)

- Not an evaluation of birth outcomes; maternal weight gain and side effects were the endpoints of concern
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Study Design

- Desoxyn[®] Gradumet[®] (Abbott)
 - Sustained release formulation
 - Three doses: 5, 10 and 15 mg/day
 - Placebo control, double blind
 - Total of 84 participants
 - Initial dose: 22nd - 25th gestation week
 - Dosing duration: 15-16 weeks
-



Results

- Dose-related reduction in weight gain, highly statistically significant
- EKG and lab tests normal
- No consistent dose-related side effects
- Lowest Observed Adverse Effect Level (LOAEL) = 5 mg/day
= 0.08 mg/kg-day



Uncertainty Factors

- **10** – LOAEL to NOAEL extrapolation
 - **10** – variation in human sensitivity
 - **3** – incompleteness of toxicity database
 - Particular concern: potential neuro-developmental toxicity in young children
 - Total aggregate uncertainty factor: **300**
-



RfD Calculation

$$\begin{aligned}\text{LOAEL} / \text{UF} &= 0.08 \text{ mg/kg-day} / \\ &10 \times 10 \times 3 \\ &= 2.7 \times 10^{-4} \text{ mg/kg-day} \\ &= \mathbf{0.3 \text{ } \mu\text{g/kg-day}}\end{aligned}$$



Toxicity: Issues & Unknowns

- Primary concern: neurodevelopmental tox
 - RfD included 3x UF added to account for this
 - Human studies are problematic
 - Study population: frequent meth users or addicts
 - Dose estimates are highly uncertain
 - Concurrent exposure to other psychoactive substances is common
-



Post-Cleanup Exposure

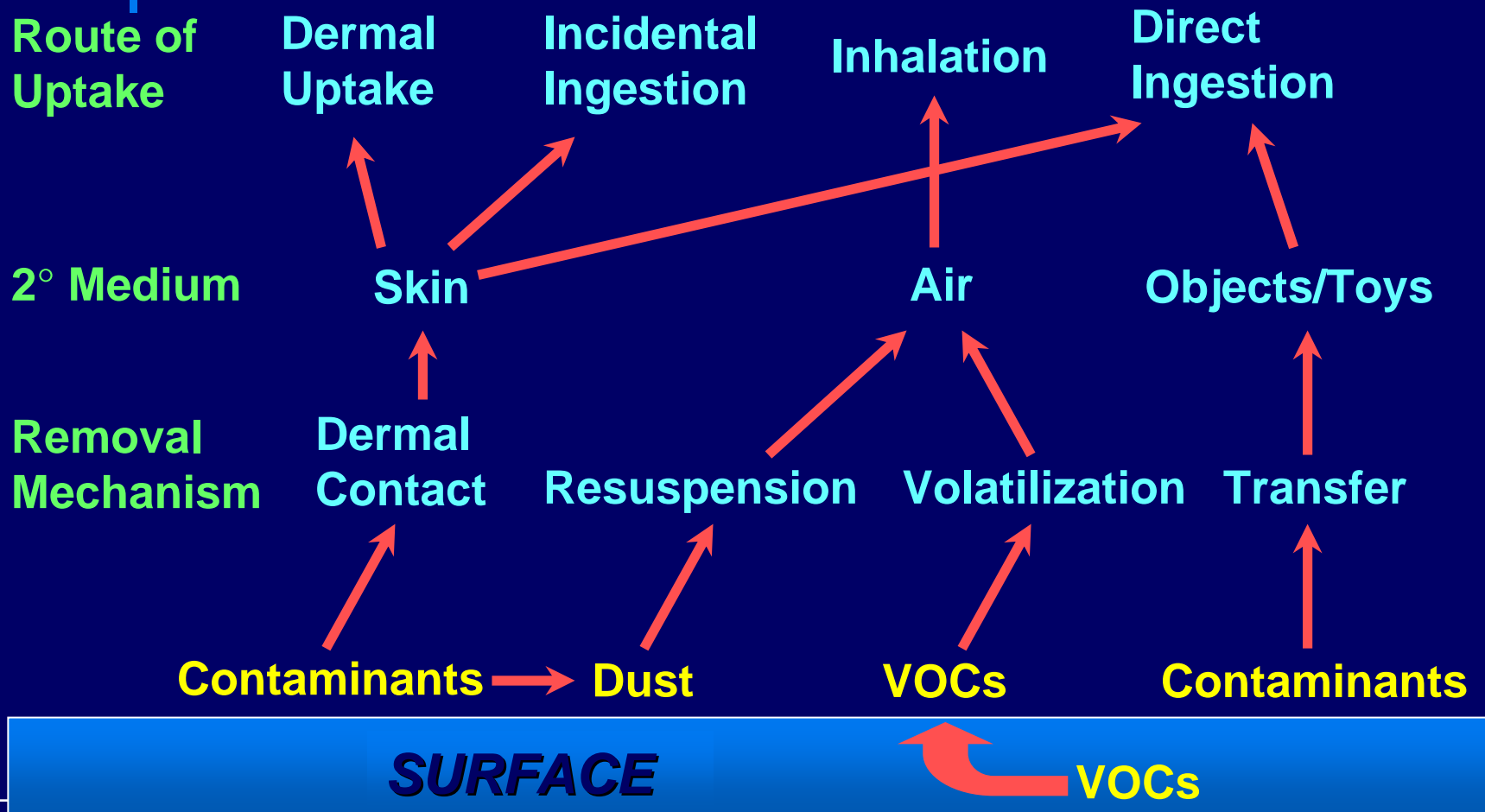
- Populations of greatest concern: babies, toddlers, young children
 - Their behavior increases their exposure to surface contaminants
 - Frequent skin contact with floors and walls
 - Frequent mouthing activities
-



Scenario Assumptions

- Uniform concentration on all surfaces
 - Non-depleting source concentration
 - Target population: 6-18 months old
 - No airborne methamphetamine
 - Duration of exposure: 90 days
 - No unremediated sources (e.g., air ducts) that could increase surface load
-

Surface Exposure Model





SHEDS-Multimedia

- Stochastic Human Exposure and Dose Simulation (U.S. EPA, 2007)
 - Stochastic: most parameters represented by a distribution, not point values
 - Monte Carlo simulation: distributions sampled 100-1000 times to generate a distribution of absorbed dose estimates
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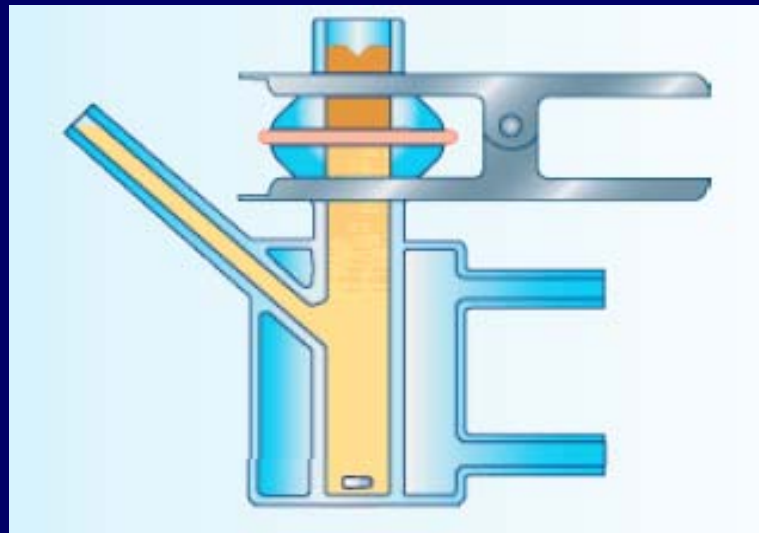


Cleanup Standard Calculation

- RfD = 0.3 $\mu\text{g}/\text{kg}\text{-day}$
 - SHEDS was run iteratively at increasing surface concentrations until the 95th percentile dose estimate was \leq RfD
 - Target remediation standard:
0.015 $\mu\text{g}/\text{cm}^2$, or 1.5 $\mu\text{g}/100 \text{ cm}^2$
 - Subject to peer review and comments
-

Dermal Uptake Experiments

- *In vitro* studies conducted at UC San Francisco using Franz diffusion cells





Dermal Uptake Methods

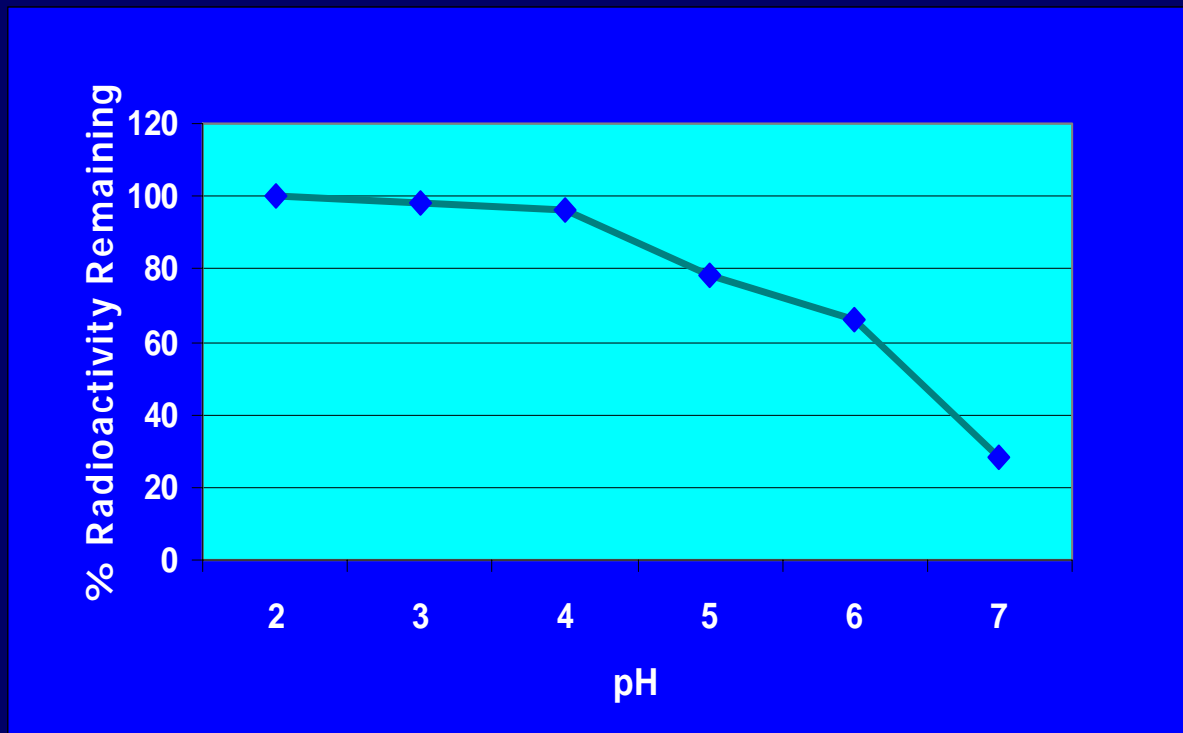
- Methamphetamine radiolabeled with carbon-14 applied to skin surface
 - Receptor fluid collected every 4 hours
 - After 24 hours, samples collected from
 - Surface (skin wash)
 - Skin (stratum corneum, epidermis & dermis)
 - Receptor fluid
-



Meth-HCl Stability Studies

- 10 μl (0.5 μCi) ^{14}C -*d*-meth-HCl added to each of six vials containing 1 ml water
 - pH pre-adjusted to 2, 3, 4, 5, 6 or 7
 - Vials placed in fume hood for 20 hours
 - Radioactivity remaining in vials counted
-

pH and Meth-HCl Stability



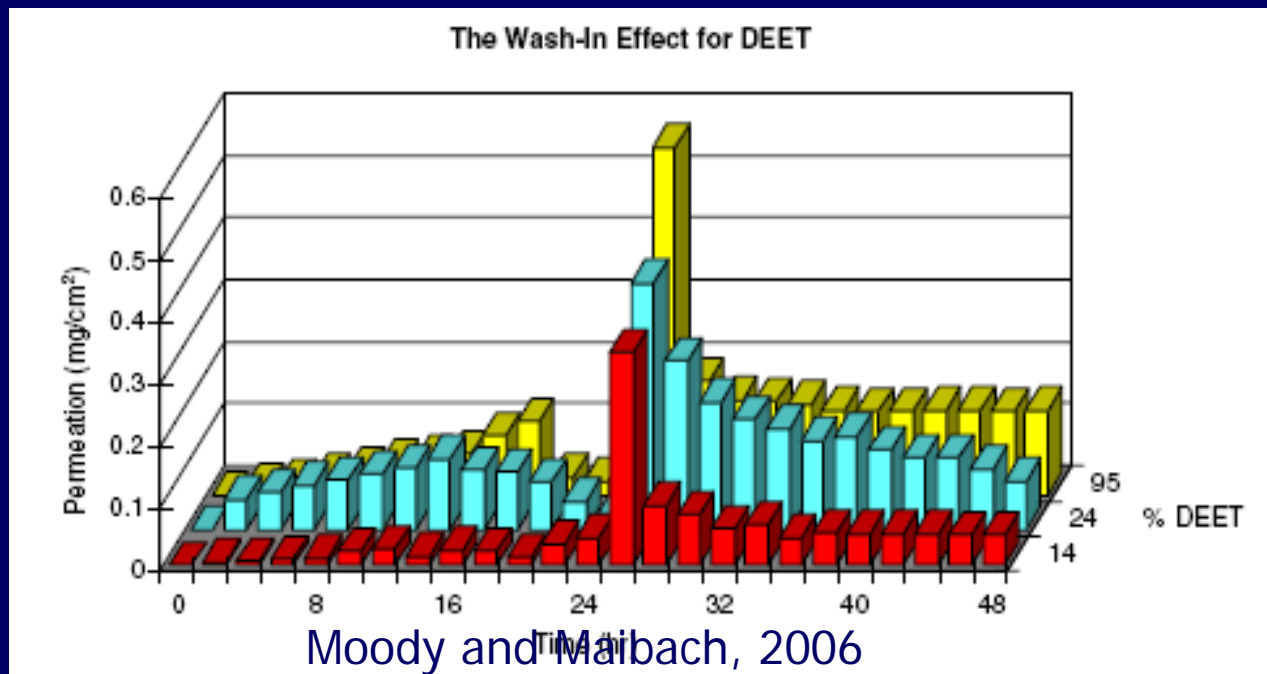


pH and Dermal Absorption

- In the standard *in vitro* protocol for dermal uptake, the pH of receptor fluid and skin is 7
 - At pH 7, most ^{14}C -meth HCl evaporates
 - Normal skin pH is ~ 5
 - If skin pH is 4-5, evaporative loss is small and dermal uptake is high
 - Data suggest the free base is dermally absorbed and the hydrochloride salt is not
-

Decontamination and Wash-In

- Wash-in: increased dermal absorption caused by skin washing/decontamination





Transfer Efficiency

- Quantitative estimate of the amount of surface residue removed with each contact
 - SHEDS assumption: average 7% transfer
 - based on results of two experimental studies
 - Cal/EPA assumptions: constant transfer efficiency, non-depleting source concentration
 - Meth-specific data would enhance reliability of exposure estimates
-



Surface Residue Depletion

	<i>Surface Residue</i> (%)	<i>Surface Residue</i> ($\mu\text{g}/100\text{ cm}^2$)	<i>Skin Residue</i> ($\mu\text{g}/100\text{ cm}^2$)
	100	1.50	
<i>1st transfer</i>	93	1.40	0.10
<i>2nd transfer</i>	86.5	1.30	0.10
<i>3rd transfer</i>	80.4	1.21	0.09
<i>4th transfer</i>	74.8	1.12	0.09
<i>5th transfer</i>	69.6	1.04	0.08
<i>6th transfer</i>	64.7	0.97	0.07
<i>7th transfer</i>	60.2	0.90	0.07
<i>8th transfer</i>	56.0	0.84	0.06
<i>9th transfer</i>	52.0	0.78	0.06
<i>10th transfer</i>	48.4	0.73	0.05



Exposure Issues & Unknowns

- Dermal absorption: additional studies needed
 - Wash-in effect: relevant for meth?
 - Transfer efficiency:
 - Available data are very limited
 - No data specifically for surface meth residues
 - Pre- and post-remediation conditions
 - Pre- and post-remediation studies of airborne meth needed to improve exposure estimates
-



Sampling and Analysis

Determination of Methamphetamine Residue on Wipes by Liquid-Liquid Extractions

Environmental Contamination Laboratory

Cal/EPA, DTSC

(August, 2007)



Recovery Study Protocol

- Four test surfaces spiked with meth:
 - Glass
 - Semi-gloss painted drywall
 - Flat painted drywall
 - Fabric
 - **Wet spike**: meth in methanol
 - **Dry spike**: meth solution applied to Teflon, dried, inverted onto test surface and rubbed
-



Sampling Protocol

- Area: 25 or 100 cm²
 - Collection medium: 12-ply cotton gauze, 3"x3"
 - Solvent: methanol, 3-4 ml, excess wrung out
 - Wiping pattern
 - Concentric squares (smooth non-porous surfaces)
 - Side-to-side, "Z" pattern (rough porous surfaces)
 - Pressure: "firm"
-



Extraction & Derivatization

- Based on **NIOSH Method 9106**
 - Internal standard spike (methamphetamine-d₁₄) and surrogate spike (amphetamine-d₁₁)
 - Acidify with 0.2 N H₂SO₄ (sample pH < 4)
 - Clean-up with n-hexane (if needed)
 - Raise pH to > 9 - 9.5 with NaOH, extract with methylene chloride, dry with K₂CO₃/Na₂SO₄
 - Derivatize with chlorodifluoroacetic anhydride
-



Wet Spike Recovery

Spike amount: 0.6 µg/plate

	<i>n</i>	<i>% Recovery (GC/MS)</i>	<i>%RSD</i>	<i>% Recovery (GC/MS/MS)</i>	<i>%RSD</i>
<i>Glass</i>	5	86	12	99	11
<i>Flat Painted Drywall</i>	5	51	4.6	55	4.3
<i>Semi-Gloss Painted Drywall</i>	5	93	5.2	90	5.3
<i>Fabric</i>	3	16	17	**	**

** Poor recovery from fabric; MS/MS spectrum not stable



Dry Spike Recovery

Spike amount: 0.6 µg/plate

	<i>n</i>	<i>% Recovery (GC/MS)</i>	<i>%RSD</i>	<i>% Recovery (GC/MS/MS)</i>	<i>%RSD</i>
<i>Glass</i>	*	*	*	*	*
<i>Flat Painted Drywall</i>	5	74	11	84	10
<i>Semi-Gloss Painted Drywall</i>	5	92	10	94	13
<i>Fabric</i>	3	20	22	**	**

* Dry spike technique not conducted due to high recovery with wet spike.



Additional Findings

- 81-95% recovery from glass plates for spike amounts ranging from 0.05 to 0.60 ug/plate
- >90% recovery following extraction of spiked absorptive materials (paper, gypsum, fabric)
- Results of limit of quantitation (LOQ) study:

	<i>n</i>	<i>% Recovery (GC/MS)</i>	<i>%RSD</i>	<i>% Recovery (GC/MS/MS)</i>	<i>%RSD</i>
Glass (0.05 µg/plate)	20	94	17	95	25

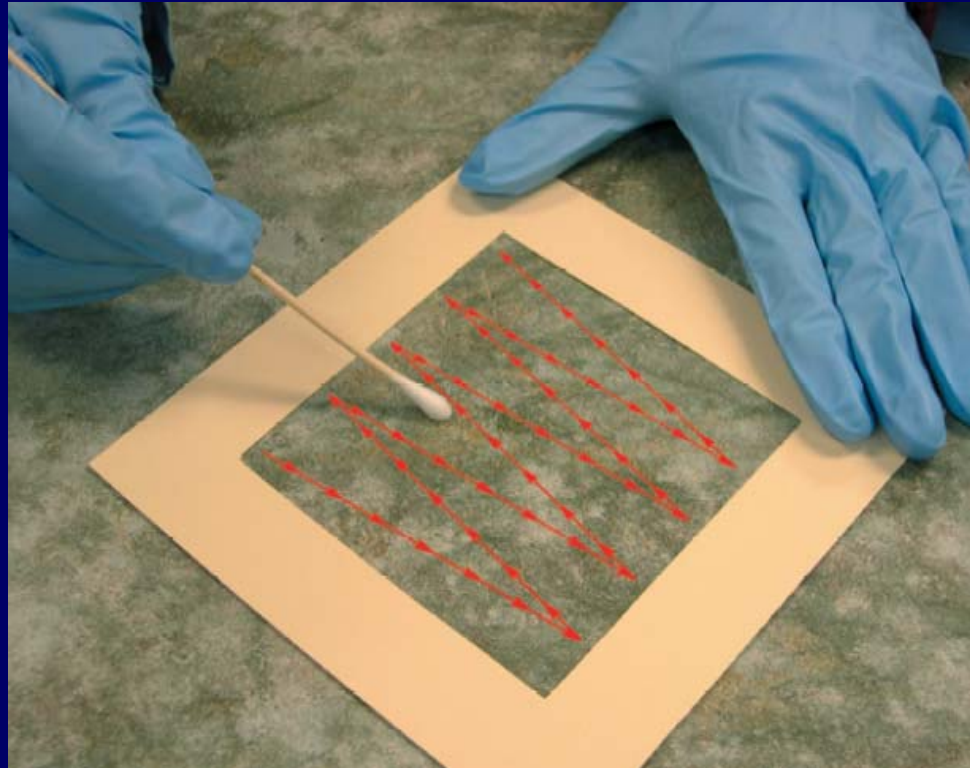


Data Gaps & Issues

- Sampler-to-sampler variation
 - Potential sources of matrix interference
 - Contaminants in street meth
 - Dirt and contaminants on surfaces
 - Surface coatings besides paint (e.g., shellac)
 - Relevance of data from extraction of porous media needs to be determined
 - Sampling methods: improved efficiency?
-



Standard Sampling Method





Immunoassay Studies - 1

- Evaluation of SKC's MethChek 100 test kit
 - “limit of identification” = 0.1 $\mu\text{g}/100\text{ cm}^2$
 - Test surface: semi-gloss painted drywall
 - Surface loading: wet spike technique
 - Results
 - 150, 130 and 100 ng: all positive
 - 80, 70, 50 and 20 ng: all uncertain
-



Immunoassay Studies - 2

- Evaluation of SKC's MethChek 500 test kit
 - Surface loading: wet & dry spike techniques
 - Results – drywall (semi-gloss painted)
500, 400, and 350 ng: all positive
 - Results – fabric
500 ng (wet or dry spike): all positive
500 ng (wet spike, dried): uncertain
350 ng (dry spike): uncertain
-



Immunoassay Studies - 3

- Evaluation of SKC's MethChek 100 test kit
 - Surface loading: wet & dry spike techniques
 - Results – fabric
 - 100 ng (wet or dry spike): uncertain
 - 130 & 150 ng (wet or dry spike): uncertain
 - Results – glass
 - 100 ng (wet spike): uncertain
-



Immunoassay Conclusions - 1

- On semi-gloss painted drywall, MethChek 100
 - Gave a positive result only when the residue level was ≥ 100 ng
 - Gave an uncertain result when the residue level was < 100 ng
 - On fabric, MethChek 100
 - Gave an uncertain result even when the residue level was as high as 150 ng
 - Reflects lower sampling efficiency with fabric
-



Immunoassay Conclusions - 2

- On semi-gloss painted drywall, MethChek 500
 - Gave a positive result when the residue level was ≥ 350 ng
 - On fabric, MethChek 500
 - Gave a positive result even when the residue level was 500 ng
 - Gave an uncertain result when the residue level was 350 ng, or when a 500 ng spike was dried
 - Also reflects lower sampling efficiency with fabric
-



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