Decontamination Efficacy Validations for Clandestine Site Remediation:

Motivating Development of a Standard Practice

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Background

The National Clandestine Laboratory Register regularly contains over 150 active listings each year indicating locations where law enforcement agencies found chemicals or other items indicating the presence of clandestine drug activities or dump sites. Furthermore, cases of accidental public exposures to highly potent illicit drugs such as fentanyl are routinely reported in places as varied as public libraries, hotel rooms, restrooms, and other places we should feel safe. Many products claim to "effectively clean" these type of sites but no consistent standard or definition exists to validate product claims; this leads to

- Inequitable efficacy statements
- Overstatements, misunderstanding, or misinterpretation
- Varied publicly available data for opioid & clandestine remediations
- Ambiguity of terms

Effective

Degradation, Destruction, & Neutralization

Approach

MRIGlobal scientists routinely evaluate the efficacy of various decontamination products against a variety of chemical and biological threats. While pathogens and chemical weapons have robust and rigorous test methods they must pass prior to claiming efficacy, products making similar claims for clandestine or other chemical cleanup do not. We apply the good practices found in other standards in our decontamination testing, while ensuring relevant operational questions are considered.

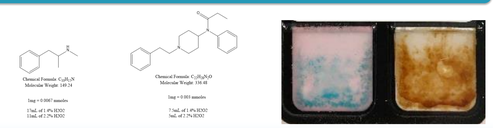
Formulation Development & Proof-of-Concept
- Stoichiometry
- Stirred Reactors
- NMR, Colorimetric

Quantitative Testing
- Method Development & Validation
- Stirred Reactors & Surfaces
- Chromatography w/ MS

Operational testing
- Stirred Reactors & Surfaces
- Quantitative Methods
- Threat Forms
- Application Methods
- Application Ratios
- Contact Times
- Acceptable Remediation Thresholds

Formulation Development & Proof of Concept

Theoretical needs
Singular mechanism at a time
Iterations



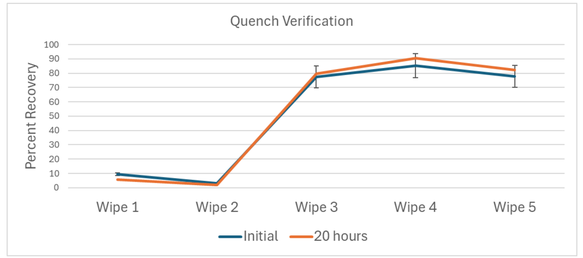
Laboratory Efficacy

The step beyond formulation development and proof of concept activities moves to quantitative laboratory evaluations. The are typically performed via stirred reactors or a single non-porous surface type. Liquid or solid threat materials can be used, but we now typically move past presence/absence/change to quantitative measurements such as GC/MS or LC/MS.

As with any quantitative analysis – statements of method and instrument detection limits are critical and often omitted or overlooked. When such small quantities of opioid pose a health hazard, efficacy test methods must demonstrate an ability to detect the material significantly below the hazard level.

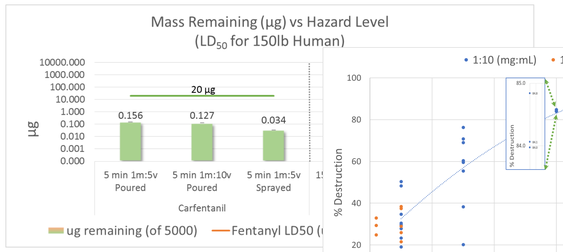
Method	Test Type	LOD @ typical sample size
Colorimetric[1]	Liquid	400ng-20µg
~~FTIR/Raman~~	~~Solid/Liquid~~	~~~ 5-10%, 1mg~~
NMR	Liquids	~1-10µg
GC/MS	Liquids	<5ng
LC/MS	Liquids	<0.01ng

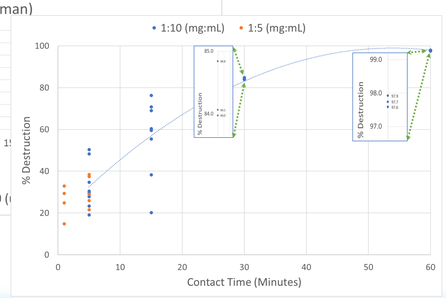
Other aspects of quality test design such as quench verification testing, stability, or solubility must also be considered and validated prior to or during the determinations.



Operational Efficacy

Operationally relevant testing starts with the test materials themselves. Should street grade compositions be used which are typically ~14% pure at an average of 2mg per pill in the case of Fentanyl. Perhaps more pure materials should be used to best replicate a worse scenario. What varied salt forms should be used and does the salt form matter? In all these cases, the starting threat material should be well characterized.





Existing Guidance

There is no current baseline or requirement on the test methods used to validate product efficacy against most chemicals. Key variables like application type, application ratio, contact times, surface types, threat form, and others are not fully characterized prior to a manufacturer claiming efficacy.

At least 23 states have a guidance document for the cleanup of clandestine sites, the majority of which focus on methamphetamine These State-to-state and an EPA voluntary guidance document are well written, but do not prescribe the certification required of the decontamination materials themselves. Clearance thresholds[1,2] also need to be incorporated into the efficacy testing and tied to the method detection limits. If a clearance threshold is <1ng/100cm^2 for fentanyl – are less sensitive analytical techniques appropriate in operational testing?

Biological pathogens must undergo lengthy and rigorous testing to obtain varied forms of FDA and/or EPA use approvals. Chemical warfare agent decontamination products mush follow detailed procedures such as TOP 08-2-061B, which covers all aspects of hazard mitigation from residual, contact, inhalation, and effluent analysis.

These same guardrails do not exist for common chemicals, nor those found in clandestine sites.

Conclusions

Effective

Degradation, Destruction, & Neutralization

Decontamination efficacy in this field needs formal definition or set of definitions. For products to be proven – an industry standard test method is required, the stakes are simply too high for test reports to omit proper caveats, indicate qualitative vs quantitative approaches, and provide operationally relevant use guidance.

1. *Kerry GL, Ross KE, Wright JL, Walker GS. A Review of Methods Used to Detect Methamphetamine from Indoor Air and Textiles in Confined Spaces. Toxics. 2022 Nov 21;10(11):710. doi: 10.3390/toxics10110710. PMID: 36422918; PMCID: PMC9695000.*
2. *EPA-540-B-21-002. Voluntary Guidelines for Methamphetamine and Fentanyl Laboratory Cleanup. August 2021. epa.gov*

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