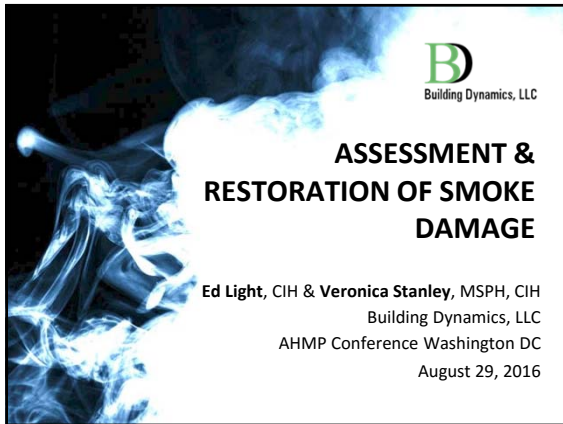




**ASSESSMENT &
RESTORATION OF SMOKE
DAMAGE**

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AHMP Conference Washington DC
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Smoke Exposure After a Fire

- Common source of indoor contaminants
- Incomplete science
- No standards



Presentation Summary

What is smoke residue?

Why is sampling inconclusive?

How are surfaces decontaminated?

Why does smoke odor remain after cleanup?

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Residues After a Fire

- Combustion particles
 - Vary by fire type, materials burned, environmental factors
 - Size: **CHAR** > **ASH** > **SOOT**
 - Settle and re-suspend from surfaces
 - Carbon, PAHs, etc.
 - Haz-Mats (asbestos, lead PCBs)
- Tars
- Volatiles
- Fire suppressants
 - Water damage

Smoke Residue by Material Burned

	Food	Wood	Synthetics
Color	Brownish	Grey/Black	Black
Texture	Greasy	Powdery	Tar-Like

Smoke Odor

- Readily distinguished from other odors
- Varies by type of material burned

Sources

- Emitted by charred surfaces
- Off-gassed from combustion particles
- Residual airborne from fire

Impacts



- Potential health effects
 - Primarily an irritant
 - Carcinogenic?
 - Toxicity?
- Damage
 - Visual
 - Nuisance odor
 - Corrosion



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Risk Assessment

- No dose response (individual sensitivity)
- Qualitative estimate
- Medical Evaluation

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Regulation of Smoke Damage Restoration

- No exposure limits
- No regulatory requirements
- No industry standards

Guidance: Restoration Industry Association (RIA)
www.restorationindustry.org
Guidelines for Fire and Smoke Damage Repair



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Sampling

Limited role: contaminant samples are generally not collected

- No accepted air quality standards
- Relevant parameters?
- Background vs. contamination?
- Variability:
 - Worst-case air sample?
 - Surface sample predictive of overall area?

Hazardous material monitoring

- Asbestos
- Lead
- PCBs
- Documentation to supplement visual/odor
- Exposure assessment

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Objectives of Smoke Cleanup

Traditional

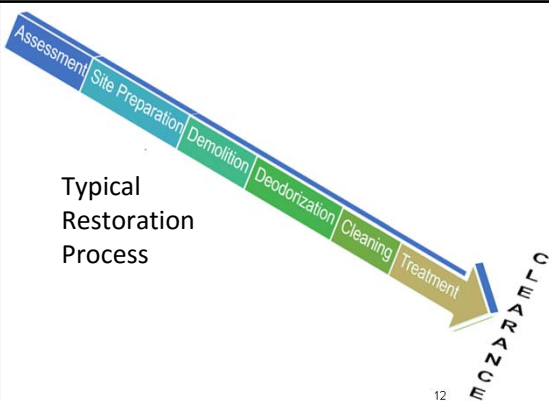
- Eliminate combustion residues
- Eliminate smoke odor
- Return to pre-damage state

IAQ

- Reduce contaminant exposures to acceptable levels

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Typical Restoration Process



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Assessment

- Locate all surfaces with combustion residue
- Specify restorative treatments

Steps

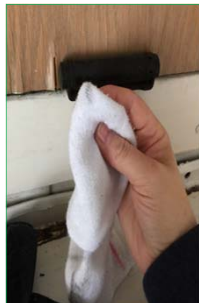
1. Estimate impact area based on:
 - Observed smoke spread
 - Potential pathways
2. Inspect
 - Access all surfaces and contents
 - Destructive entry to interstitial spaces, as needed
3. Evaluate HVAC
4. Prepare plan

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Visual Assessment

Inspection

- Darker surfaces
 - combustion vs. dust, etc.
- Wipe with cloth/sponge
 - ASTM D6602-00?



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Odor Evaluation

- Rate smoke odor on scale of 0 - 3
- Upon initial access to a space
 - Odor threshold varies by individual
 - Periodically refresh outside
 - Odor panel?
 - Sniff specific surfaces/contents
- Headspace odor
 - Cover surface with plastic
 - Seal contents in bag

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An Indoor Environmental Professional's Guide to Fire Damage Restoration
presented by: Cliff Zlotnik

STRUCTURE CLEANING



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Worker Protection

Initial assessment

- General PPE unless special hazards are present
 - Safety glasses, gloves, safety shoes, hard hat, high visibility, coveralls
- Respiratory protection is based on site specific hazards
- Have: lighting & communication equipment
- May not have power

During remediation

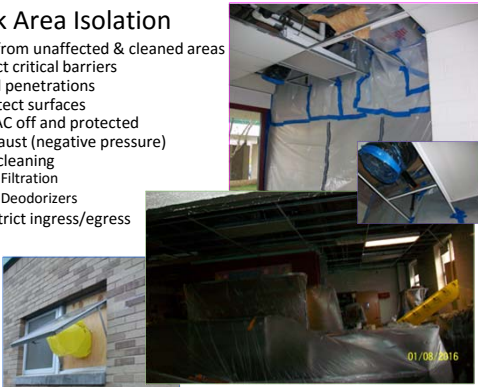
- Hazards change quickly during fast remediation work
- Requires up-to-date hazard assessment of site conditions in combination with assessment of products to be use
- Communication with other trades
- Coordination of work

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Work Area Isolation

Isolate from unaffected & cleaned areas

- Erect critical barriers
- Seal penetrations
- Protect surfaces
- HVAC off and protected
- Exhaust (negative pressure)
- Air cleaning
 - Filtration
 - Deodorizers
- Restrict ingress/egress



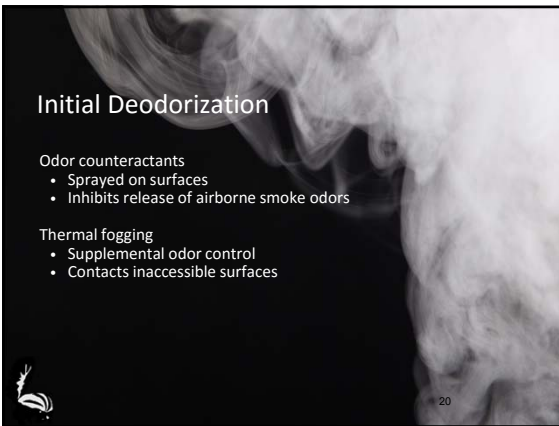
Demolition

- Classify structural materials and contents
- Remove materials which can not be restored



Initial Deodorization

- Odor counteractants
- Sprayed on surfaces
 - Inhibits release of airborne smoke odors
- Thermal fogging
- Supplemental odor control
 - Contacts inaccessible surfaces



Surface Cleaning



Method based on fire origin and surface type

- HEPA-vacuum
- Wipe (dry or with solution)
 - Sponge; cloth; brush
- Power washing
- Abrasive cleaning

Work systematically, top to bottom

Floors

- Mop hard surfaces
- Shampoo/extract carpet
- Contents
 - Clean in place
 - Launder
 - Dry clean

Post-Cleaning Treatment

- Encapsulant
- Fog
- Air cleaning
- Deodorization
- Seal penetrations



HVAC

- Pipe insulation/duct wrap
 - Remove or clean/encapsulate
- Internal lining
 - Remove or HEPA-vac/encapsulate
- Metal surfaces
 - HEPA-vacuum
 - Damp wipe
- Replace filters
- Replace flex duct?
- Seal vents
- Startup filtration



Third Party Oversight



- Specifications
- Work practice monitoring
- Clearance inspections
- Punch-list resolution

Clearance

- No combustion residue
 - Detailed visual inspection
 - Surface wipes

- No detectable smoke odor
 - Check spaces with HVAC off
 - Then, sniff air diffusers at HVAC startup
 - Check warm/wet?



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Restoration Residues?

- Fogging agents
- Deodorizers
- Sealants
- Cleaning solutions
 - Detergents/surfactants
 - Degreasers
 - Sanitizers



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Smoke Odor After Restoration

- Common occurrence
 - Delays reoccupancy
 - Increases cost

- After re-occupancy
 - IAQ complaints
 - Warranted?
 - Some contracts require re-cleaning if detectable smoke odor

Contributing Factors to Post-restoration Odor

- Incomplete assessment
- Incomplete cleaning
- Incomplete sealing
- Contents not cleaned
- Contamination of clean areas



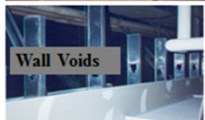
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Troubleshooting

Common Smoke Odor Problem Areas



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Incomplete Assessment

Root causes

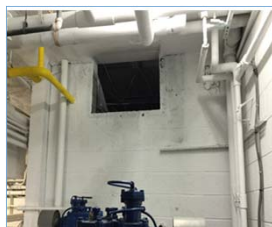
- Too rushed
- Inexperience
- Lack of planning
- Failure to identify impacted surfaces

Mitigation

- Re-check
- Re-clean

Avoidance

- Systematic evaluation by experienced investigators
- Comprehensive remediation plan



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Lack of Deodorization

Root causes

- Surfaces not treated
- Ineffective method
- Lack of access
- Lack of QC

Mitigation

- Do-over

Avoidance

- Appropriate treatments
- Full surface coverage
- Contractor QC



Incomplete Cleaning

Root causes

- Inappropriate method
- Insufficient time
- Inexperience
- Lack of access
- Dirty wipes
- Sequence not top-down
- Lack of QC

Mitigation

- Do-over

Avoidance

- Appropriate procedure
- Full surface coverage
- Frequently change wipes
- Contractor QC



Incomplete Sealing

Root causes

- Inappropriate method
- Insufficient time
- Inexperience
- Lack of access
- Dirty surface
- No QC

Mitigation

- Do-over

Avoidance

- Appropriate procedure
- Systematic technique
- Contractor QC



Poor Content Cleaning

Root causes

- Focus on structure, not contents
- Not protected during structural cleaning
- Lack of inspection
- Not accessed (boxes, cabinets, closets, etc.)
- Inappropriate treatment
- Incomplete treatment



Mitigation

- Access
- Do-over

Avoidance

- Full access
- Thorough inspection
- Appropriate treatment
- QC

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Contamination of Clean Areas

- Combustion residues migrate into unaffected areas
- Cleaned areas become re-impacted

Root causes

- Incomplete barriers
- Penetrations not sealed
- Positive pressure
- HVAC operation
- Worker tracking



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Contamination of Clean Areas (cont.)

Mitigation

- Do-over

Avoidance

- Work area isolation
- Cleaned area isolation
- Worker traffic control
- HVAC off



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Recommendations

Facilitate elimination of smoke odor by

- Conducting detailed assessment of smoke-impacted areas
- Preparing comprehensive restoration plan
- Checking work (contractor QC)
- Considering third party oversight of restoration work
- Clearing for re-occupancy based on systematic visual inspection and odor evaluation

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Recommendations (cont.)

Develop and validate

- Evaluation criteria
- Sampling methods
- Assessment protocol
- Mitigation options
- Clearance procedure

Research

- Health effects
- Exposure assessment

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to be continued...

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