The Building as a Source and Vector of Problematic Microorganisms
Dr. Curt White, ÆGIS Environmental Management
A Webber Training Teleclass

The Building:
A Source and Vector of Problematic Microorganisms

W. Curtis White,
ÆGIS Environmental Management

Medical Buildings in Crisis

Sick Building Syndrome
Nosocomial Infections
Black Mold
Drug Resistant Microbes
Legionnaires Disease
Hypersensitivity pneumonitis

Medical Buildings - Crisis or Curative

- Insurance Exits
- Legislative Mandates
- Press Events
- Legal Actions
- Deferred maintenance budgets
- Reduced housekeeping staffs
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The Building:
A Source and Vector of Problematic Microorganisms

Curtis White
Microbiologist (43 years)
CEO and Director of R&D
ÆGIS Environments
2285 Ridgewood Dr.
Midland, MI 48642
800-241-9186
www.aegismicrobeshield.com

New Title from Medetex Press

Microbiological Problems in Buildings:
A Building Hygiene Program
An Operations Manual for Detection,
Remediation, and Avoidance
W. Curtis White
Margaret M Wulf

For order information call:
800.241.9186 X 7111
twhitehouse@microbeshield.com

Indoor Environmental Quality

IEQ is...
The balance of environmental conditions in a building that allows for maximum function of the building and comfort, productivity, and well being of the occupants

BUILDINGS OCCUPANTS

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Buildings
What purpose do they serve?

Human Habitation
• Comfort
• Productivity
• Shelter
• Security
• Healing environment
• Do no harm

Microbes: Impact on Healthcare
Particles and Toxins: Mortality, Morbidity and Discomfort

• Building Utility
• Maintenance Costs
• Staff
• Test Scores
• Lost Time
• Infection Reportables

Indoor Environmental Quality

• Real Costs – Hidden Costs
• Press Events
• Distraction of Resources
• Litigation
• Political Backlash
• Accountability

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The Building Population

We do not choose!

- Asthma
- Respiratory Handicaps
- AIDS
- Immunosuppressed
- Other Communicable Diseases
- At Risk people

Building Exterior

Weather Patterns

Topography

Surrounding Buildings & Activities

Envelope

Roof

Materials of Construction

Architectural Design

Building Interior

Air

Surfaces

HVAC

Water

People

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Types of Indoor Pollutants

<table>
<thead>
<tr>
<th>Particulates</th>
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<tbody>
<tr>
<td>• Asbestos</td>
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<tr>
<td>• Dust</td>
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<tr>
<td>• Paper</td>
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<tr>
<td>• Fibers</td>
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<td>• Lead</td>
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<th>Nuclides</th>
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Types of Indoor Pollutants

Volatile Organic Compounds (VOC's)
- Carbon Monoxide
- Carbon Dioxide
- Formaldehyde
- Pesticides
- Perfumes
- Air Fresheners
- Scented Candles

Factors Affecting IEQ

“But how do we know when there is a problem?”
- Light
- Humidity
- Temperature
- Ventilation (HVAC)
- Noise
- Occupant Activity

Indoor Pollutant Problems

- Building
- Human
- Business
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Types of Indoor Pollutants

**Biological - The worst**
- Bacteria
- Fungi (mold & mildew)
- Algae
- Exotoxins / Endotoxins
- Pathogenic / Nonpathogenic

VOC's & Particulates Too!!

Indoor Pollutant Problems

Building Problems
- Odor
- Staining
- Defacement
- Deterioration

Indoor Pollutant Problems

Human Problems
- Fatigue
- Dizziness
- Nausea
- Headaches
- Irritation of eye, nose, and throat
- Drying of mucus membranes and skin

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Indoor Pollutant Problems

<table>
<thead>
<tr>
<th>Business Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Occupants Lost</td>
</tr>
<tr>
<td>• Insurance Cost</td>
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<tr>
<td>• Sale/Rent Loss</td>
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<tr>
<td>• Productivity Losses</td>
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<tr>
<td>• Workers’ Compensation</td>
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<tr>
<td>• Renovation Schedules</td>
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<tr>
<td>• Energy Costs</td>
</tr>
<tr>
<td>• Maintenance Costs</td>
</tr>
</tbody>
</table>

Microbes and Their Relationship with Building Interiors

- Microbial Growth
- Adaptation
- Changes: Humidity, Chemicals, Surfaces, & Nutrients

Environmental Succession

- Clean & Remediate
- Microbial Colonization
- Natural Resistance
- Time

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### Life Stages of a Building

<table>
<thead>
<tr>
<th>Design</th>
<th>Build</th>
<th>Commission</th>
<th>Occupy</th>
<th>Reconfiguration</th>
<th>Recommission</th>
<th>Occupy</th>
<th>Renovation</th>
<th>Recommission</th>
<th>Demolition</th>
</tr>
</thead>
</table>

### Causes of Mold & Mildew Growth

- **Food**
- **Temperature**
- **Moisture**
- **Receptive Surfaces**

Microbes need 4 things to survive:
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Contributing Factors
Building Shell & Structure

Contributing Factors
Operating Systems

Contributing Factors
Appliances & Equipment
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Contributing Factors
Pets & Plants

Contributing Factors
Occupant Habits & Practices

Contributing Factors
Cleaning Procedures
## Contributing Factors

### Maintenance Practices

<table>
<thead>
<tr>
<th>Maintenance Practices</th>
</tr>
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<tbody>
<tr>
<td><img src="image1.jpg" alt="Image" /></td>
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### Energy Saving Practices

<table>
<thead>
<tr>
<th>Energy Saving Practices</th>
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<tr>
<td><img src="image2.jpg" alt="Image" /></td>
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### Catastrophic Events

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<thead>
<tr>
<th>Catastrophic Events</th>
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<tbody>
<tr>
<td><img src="image3.jpg" alt="Image" /></td>
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</tbody>
</table>
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Where to begin the search

Visible

- Carpet Stains
- Walls & Windows
- Ceilings
- Closets
- Maintenance Report

Odors

Noticeable
- Musty
- Putrid
- Ammonia
- Sour
- Fishy
- Rotten Egg

Where to begin the search
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Occupant Complaints

Stains
Odors
Allergy Symptoms
• Itchy Eyes
• Runny Nose
• Tight Chest

Where is the complaint?

• Certain Rooms
• One Side of the Building
• Outlets/Switch Plates
• Door/Window Jams
• Top Floor or Basement/Crawl
• Near Pipe & Electrical Chases
• Near Stairwell or Elevator Shaft
• Ask Maintenance Personnel

When?

• Time of Day
• Time of Week
• Time of Year
• After a rain

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Building History

- Moisture Events
  - Pipe break/plumbing leak
  - Roof Leak
  - Flooding
  - Condensation Problems
- Structural Damage
  - Roof or Shell problems
  - Cracks

Walk-through Survey

- Layout plan of building
  - blueprint
  - fire escape
- General history of building
- History of problem areas
- History of complaints

Where to Look

Zone of complaint
- Peripheral areas
  - above
  - below
  - around

Non-problem areas
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“Tell Tales” for Problems

<table>
<thead>
<tr>
<th>Personal Heaters</th>
<th>Blocked Ductwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidifiers</td>
<td>HVAC Zone-control</td>
</tr>
<tr>
<td>Air Fresheners</td>
<td>Staining Around Windows</td>
</tr>
<tr>
<td>Fans</td>
<td>Water Stains</td>
</tr>
</tbody>
</table>

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Flooring System

- Backing
- Adhesive or Sealers
- Integral/Seperate Foam Pad
- Base Floor
- On Slab
- Crawl Space
- Lower Floor with Conditioned Space
- Raised Floor (Computer Room)
- Carpet Tufts

Wall System

- breathable Paint or Wallpaper
- Drywall
- Vapor Barrier
- Insulation
- Sill Plate with Seal
- Non-Wicking Moisture Gap/Caulk
- Wind Barrier Sheathing
- Siding
- Drip Cap
- Brick
- Weep Tubes or Wicks
- Floor

ABOVE CEILING SURFACES

- Roof or Floor Deck
- Chases Pipe & Wire
- Pressure Equalization Ducts
- Insulation
- Tile & Support Grid
- Ducted Return
- Supply
- Lights

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Cleanup & Control

Scope of Cleanup?

Nature of Problem

• Natural Buildup?
• Catastrophic?
• Preventative?

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Natural Buildup

- Lack in cleaning procedures?
- Lack in maintenance procedures?
- Will occur!
  - When to intervene

Catastrophic Event

- Contingency Plan
- Shovel & water hose: 99% effective
- Over-the-counter cleaners & disinfectants
  - Mode of action
    - Human risks
    - Building risks
    - Environmental risks

Contingency Plan

- Nature & Size of problem
- Security
- Communications
  - Public & Internal
- Risk Assessment
- Professional Services
  - Pre-qualify with standing P.O. & work release
  - Drying; Decontamination; Physical Restoration
- Protect Peripheral Areas

PROFESSIONAL HELP
VS.
DO IT YOURSELF
### Acceptable Levels of Microbial Exposure

- Permissible Exposure Limits
- Threshold Limit Values
- Least Possible Exposure

*ALARA = As Low As Reasonably Achievable*

### Level of Contamination

- Light
- Medium
- Heavy

### Area Involved

- Large
- Medium
- Small
### Location Involved

- Risk of spread
- At-risk populations
- Risk to workers

### Different Strategies

**General Cleaning**

*or*

**Full Containment**

### Microorganisms in Buildings

**Strategies for Control**

- Control Nutrients
- Control Moisture
- Control Sources
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Mitigation

- Isolation
- Containment
- Elimination

Preventative

- Areas at risk
- After clean-up
- New construction
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An Integrated Program

<table>
<thead>
<tr>
<th>Detection</th>
<th>Analysis</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Communication of Standards</td>
</tr>
<tr>
<td>Surface Pollutants</td>
<td>Air Pollutants</td>
</tr>
</tbody>
</table>

Verification
Monitoring
Response

Case Studies

Florida Hospital

Lee County, Florida

The Problem
• Strong Mildew Odor
• Occupant complaints & health concerns
• Visible growth

The Cause
• Roof leaks
• Unconditioned / unoccupied space
• HVAC system problems
• Spotty envelope problems
Improved Control of Microbial Exposure in Hospitals: A 30 Month Field Study

Background:

- Prior to opening a major water pipe froze and ruptured
- Approximately 500,000 gallons of water flooded the floors below.
- Ceilings, walls, carpeted floors, and furniture were exposed to wet or high humidity conditions

Post-Event Observations

- Day Seven: facility developing distinct musty odor.
- Week 3: Visible fungal colonies on exposed surfaces and behind vinyl wall coverings.
- Floors below were visibly contaminated as the water damage spread.
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Arthur G. James Cancer Hospital and Research Institute Columbus Ohio

Sampling
- Air sampling retrieved >2800 CFU/CuM on most floors of the facility despite aggressive cleaning and air filtration efforts.

Arthur G. James Cancer Hospital and Research Institute Columbus Ohio

Treatment with Antimicrobial
- Ceilings
- Floors
- Walls
- Wall cavities
- Above ceiling space
- Chases
- Furnishings

Arthur G. James Cancer Hospital and Research Institute Columbus Ohio

Results
- During 7 month renovation retrievals were in the range of 0-25 CFU/m³.
- One year later, retrievals averaged .08 CFU/m³.
- 2 years later, retrievals averaged .04 CFU/m³.
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Sultan Ismail Hospital
Johor, Malaysia

• Tropical Environment
• Building Begun in 1999
• ConstructionStopped
• Water Saturation
• Environmental Microbial Contamination

Sultan Ismail Hospital
Johor, Malaysia

• Construction Continues – 2002
• New Materials & New Contamination
• Partial Occupation – July 2004
• People Sick, Pervasive Odors, Visible Growth
• Building Closed – September 25, 2004

Sultan Ismail Hospital
Johor, Malaysia

Aspergillus fumigatus Dominant and Pervasive
All Visible & Out of Sight Spaces Contaminated
Total Clean-Up & Antimicrobial Treatment – March 2005 – July 2005
Clearance Testing – No Problems – November 2005
Staged Occupancy Started – No Current Problems – February 2006
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