Identification and Resolution of IAQ Problems

Global Risk Advisors℠

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Indoor Air Quality

- Sick building
- HVAC issues
- Odors
- Renovations
- Processes- photocopiers, printers, plants

NIOSH Review of IAQ causes 1983

- 50 % ventilation problem
- Process internal – regular / periodic
- Building itself or contents
- Process external
- Smoking - Vaping
- 10% No resolution
- Water infiltration / Fungi / allergen

Indoor Air Quality Investigation

- Energy conservation
- IH needed to learn new skills
- Typically non industrial area- office etc
- Complaints typically eye irritation, nasal congestion, sinus problems, headaches
- Individual or Sick Building

Employee Complaints - Productivity

Who
What – Symptoms, odor
When
How often
How long

Ask questions – Create Log - Questionnaire

IAQ - Major Components

- Outside air - CO2- ASHRAE – 700 above outside
- Temp , Humidity , Breezes (doors, vents)
- Formaldehyde
- Carbon monoxide
- Fungi
- VOC’s
- Dust

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IAQ Other - Common allergens

- Pollen – Seasonal -Tree , weeds
- Cat Dander
- Dust Mite proteins
- Latex proteins
- Dog, mouse, rat, cockroach Dander
- Fungi

Allergy Symptoms

- Itchy watering eyes
- Running nose - congestion
- Rashes - Hives
- Can effect breathing – Swelling - Asthmatics
- 99.9 % temporary
- Anaphylaxis – Shock - Antihistamines

Acceptable levels ? GREAT Latitude

- ASHRAE
- OSHA
- TLV – Ozone?
- Target Indoor Air Levels - Background
- Non Industrial 1/10 TLV
- LEED

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Carbon Dioxide ppm

- OSHA 5000
- TLV 5000 TWA 30000 STEL
- NIOSH IDLH 50000

- ASHRAE 700 over outside WHY??
- Background 1990 350 2019 400

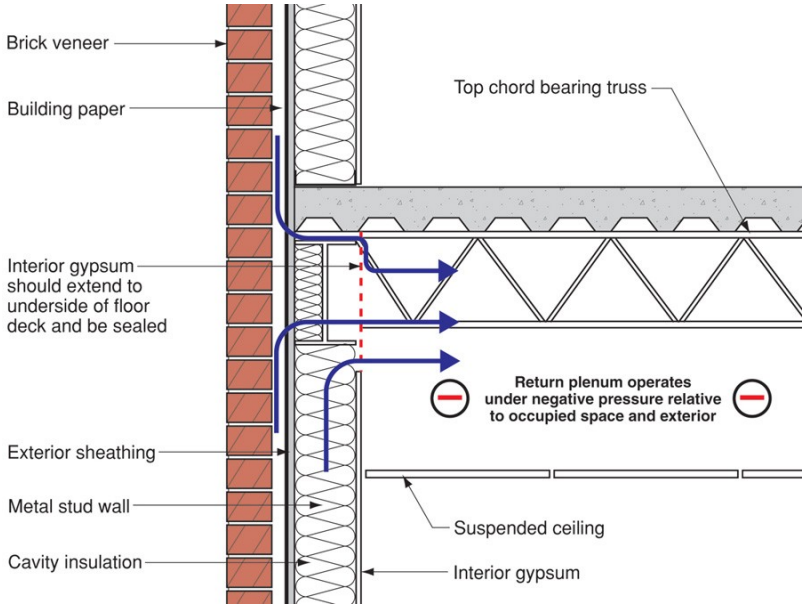
Formaldehyde ppm

- OSHA 0.75 TWA 2 STEL
- TLV 0.30 Ceil (Sen) 0.1ppm TWA
- ASHRAE 0.10 makeup air
- USGBC 0.025 4 hr
- NIOSH REL 0.016 TWA 0.1 STEL
- Background 0.005-0.030

Ventilation

- Rooftop units
- Unit ventilators or Heat pumps
- Radiators
- Combination – VAV boxes - electric
- Air plenum or direct duct returns
- Outdoor air or not – open or closed
- Fans – Auto/Constant on
- 20 cfm / person outdoor air

HVAC Evaluation – Building Science Corp – Joe Lstiburek



Temperature - Office

- ASHRAE- Table indicate range of temps based on humidity
- Summer 72.5 - 81 F
- Winter 68 - 76 F
- 20% dissatisfied no mater what – Set at 70-74 F and let people cloth appropriately
- Over 75-76 F will have complaints
- Expectations Home verses office inconsistency

- My home is 68-72 and 74-76

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Humidity

- 30-60% optimal
- <30 % dry and irritation – Northeast Winter
- >70% condensation and mold possible

- Recommend Humidification?

Employee solutions

- Plants-

- Keep Warm – turn up thermostat or space heater

- Filter the dust/air - DO NO HARM

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- Process external
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Workplace examples – Impact -Take action

- Employee compliant of stuffy and discomfort at work
- Employee complaints over 6 months – others now agree- results in building evacuation
- Occasional odors in recently renovated outpatient clinic- Summa - 1,2 Dichlorethene and pentafluoropropane
- Employee complaints of burn like odors and headaches in afternoon

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Insulation - UFFI, Fibrous glass, Isocyanates

- Energy Conservation
- Saves Money on heating - cooling
- Tighter- less air exchanges
- Potential for higher Formaldehdye and other VOC's
- Potential for off gas of foam itself
- TRADE OFF

Isocyanates

- OSHA NEP
- Used in paints and foams – Blowing agents
- Resp Sensitizer (skin)
- TDI used less than MDI and now HDI
- Use less monomer and more oligomer
- 5ppb TLV 20ppb OSHA STEL

Homeowners cases

- Builder indicates wife experiencing fatigue at home.
- Buyer of home felt slight irritation similar to carpet store irritation – her and daughter sensitive
- Semiretired engineer renovated area above garage. Energy credit but wife cannot stay in room.

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Incidents

- Furnace Blow back -
- Water damage and repair -
- Fire damage - smoke, soot , chemicals , water damage

Flagrances – Do not make things worse

- Masking agents- cover up
- Pinene - pine/turpentine – 20 ppm TLV
- Limonene – lemon, citrus – 30 ppm WEEL
- Benzaldehyde – Almond – 2 ppm WEEL
- Cinnamaldehyde – cinnamon - ????
- Diacetyl – butter odor

Global Markets – Relearn past solutions

- Historical Knowledge gets lost (lead, mercury, UFFI now Isocyanates)
- Lead in toys, consumer products
- CPSC new reg on Lead in consumer products
- Sourcing – cheapest, quality, still meets spec , change origin of chemical

Global Markets – Rapid Demand

- Latex allergy – Blood Bourne Pathogens
- FEMA Trailers – Formaldehyde
- Container Shipments – Formaldehyde , VOCs
- Plant openings – Plant closings
- Chinese Drywall – Sulfur

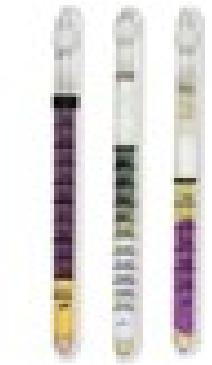
Fungi Evaluation

- Look for moisture- stains, discolored tiles
- Determine if mold present – sticky tape, swab
- Note material type, length of time wet, condition
- Wood, chipboard, particle board, sheetrock
- Mold Candy
- Collect indoor and outdoor/ non problem samples
- Construction sites- water protection

IAQ - CO_2 measurement

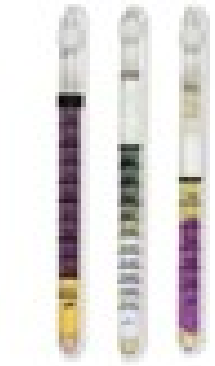
- Direct reading - Interferences

- Drager tubes



Passive Sampling

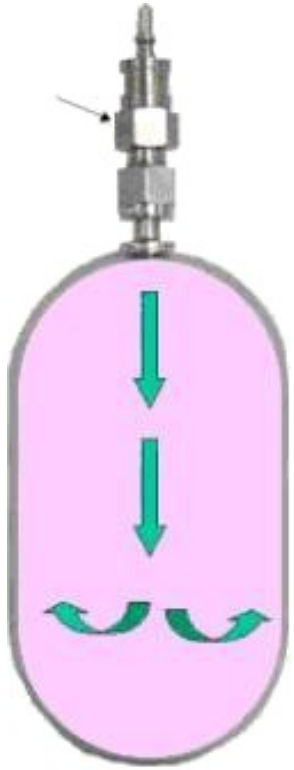
- NO PUMPS - Easy
- Diffusion
- Vapors / Gases
- Colorimetric (active / passive)
- Direct Read vs Lab Analyzed



Classic IH pump-and-tube sampling

- Sample train:
- Solvents or gases captured and recovered from charcoal or other solid sorbent media
- Formaldehyde, phenol and others require a special tube

Benefits of Canisters, EPA TO15



Pumpless Sample Collection

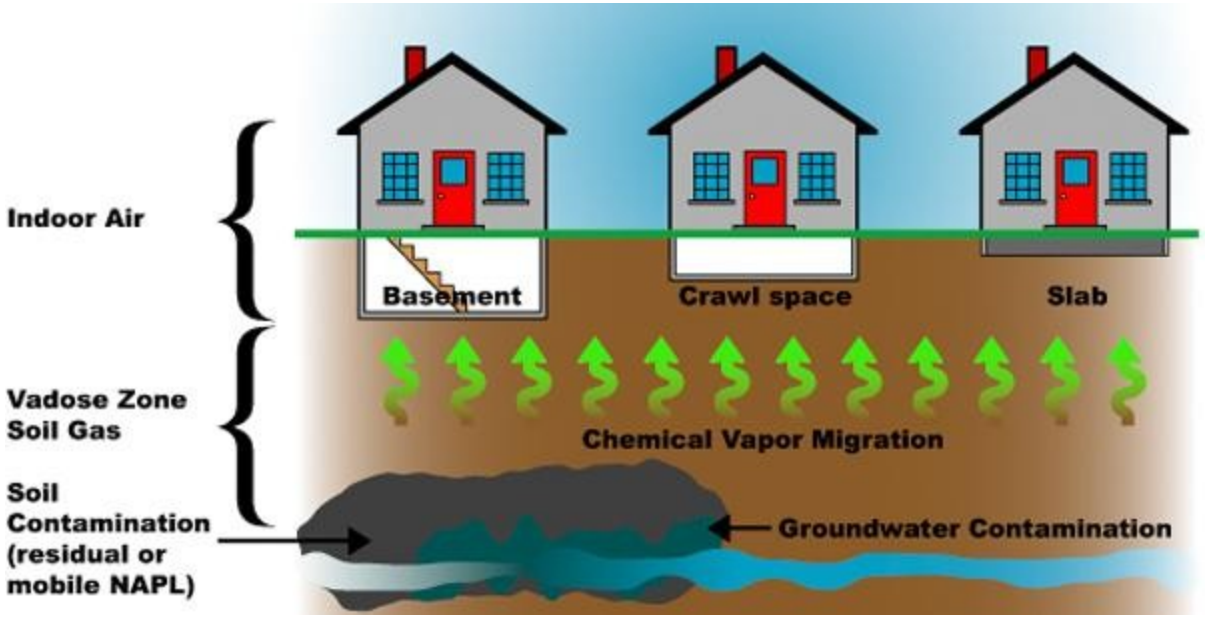
- Can regulate flow from 5 sec to 1 day
- No flow rates to adjust or calculate in field

Ease of Use

- Single Connection or valve
- Non technical person can collect samples

- **Wide Application Range**
- Polars/Alcohols
  - Gases, Freons
  - No multiple tubes
  - No special tubes
- Formaldehyde

Environmental sampling (ppb)
Water, soil vapor, indoor air



Fungi

- Fungi – reproduce by spores
- Spores like seeds
- Germinate to produce new mold colony
- Diverse but same for a specific genus

Fungi defenses -byproducts

- Yeast + sugar = ethanol + 1000 chemicals
- Odors
- Antibiotics – penicillin
- Mycotoxins – Stachybotrys – 1930 animals/poor
- Aflatoxins – Corn – 2005 Diamond Pet food

Fungi – Bacteria Needs

- Fungi - Water activity >0.65
- Bacteria – Water activity > 0.90
- Food – carbohydrates, cellulose
- Temperature – refrigerate , hot water

Fungi Health Effects

- Predominately allergy irritant type symptoms (5%)

- At high levels potential of Anaphylaxis (Asthma)

- Immune compromised (AIDS/Hosp)– lung infection (asp fumigatus/pen marneffei)

- Toxic effects – mycotoxins (stachy), aflatoxin (corn)

Viable vs non viable

- Non Viable (spore trap)

Collects all allergens

Results in 1-3 days

One media collects all

Cannot speciate

Can overload with dust

Viable

Only living will grow

Results in 6-14 days

Multiple plates needed

Can speciate

Colonies overgrow

Other mold tools

- Moisture meter –
- Conductivity and IR capabilities
- Boroscope
- IR scanners/meters

Bulk sample collection

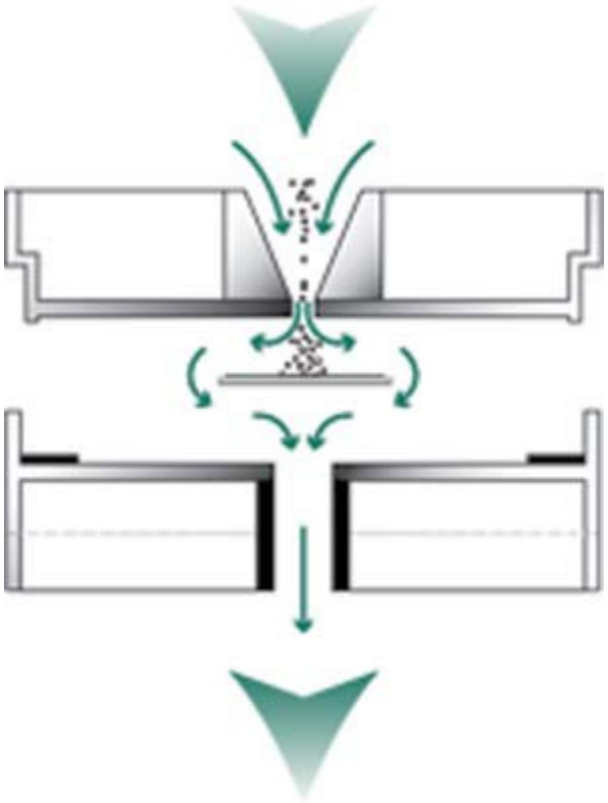
- Sample of bulk material -- destructive

- Sticky tape/slide – direct exam

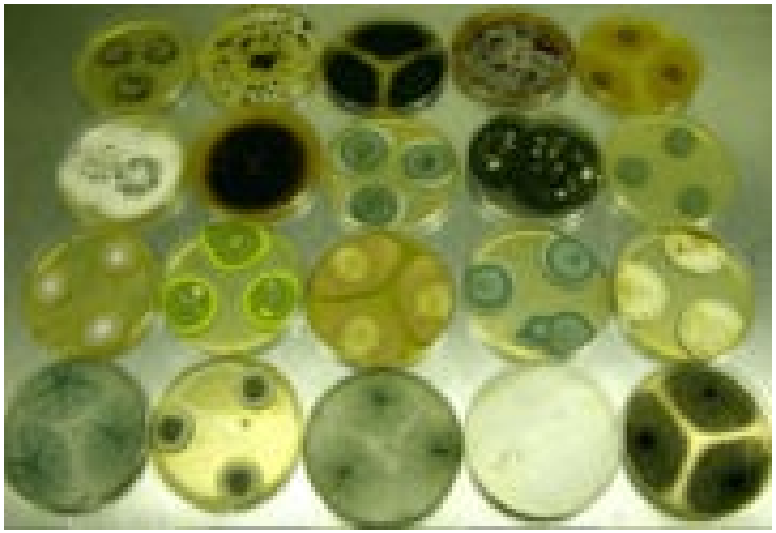
- Swab -- direct exam and/or culture

Spore trap impaction

Flow rate dependant

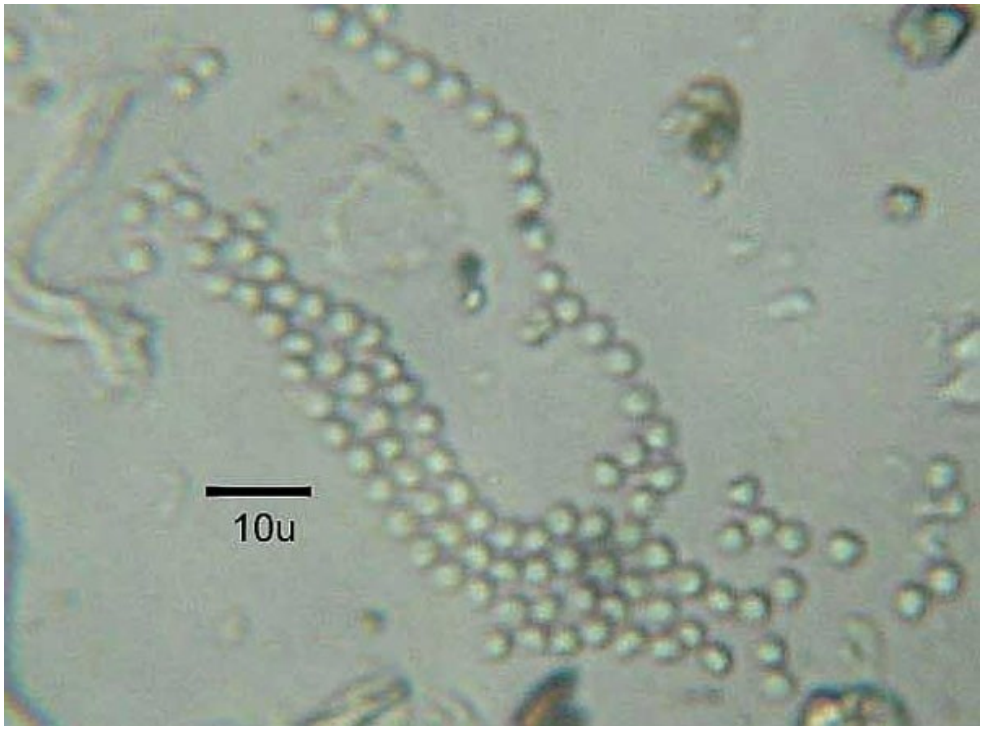


Viable sampling



ID by size, color, shape

- Penicillium
  Curvularia



Typical Fungi Genus

- Indoor

Asp/pen

Cladosporium

Stachy

Outdoor

Cladosporium

Basidiospores

Ascospores

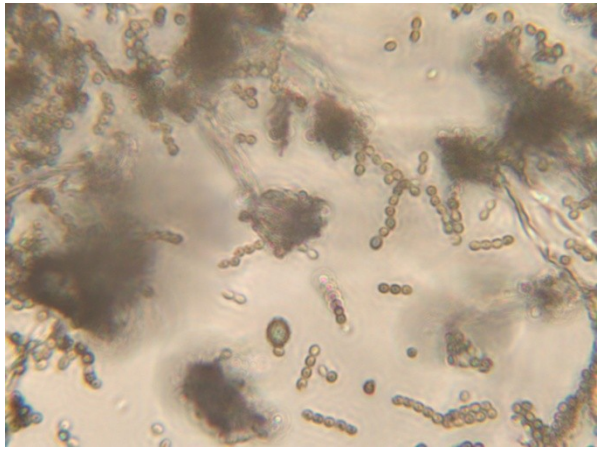
Water Intrusion molds

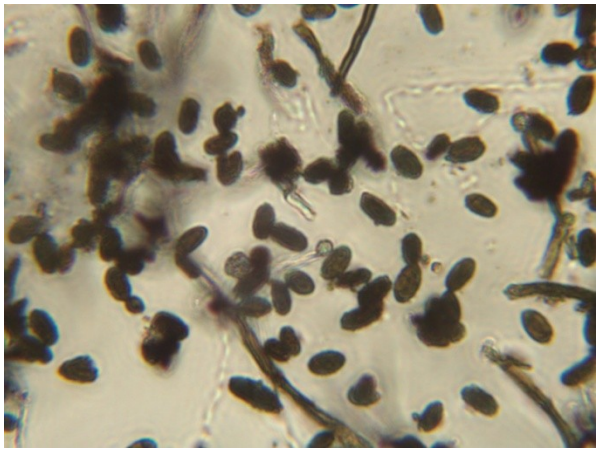
Aspergillus/Penicillium

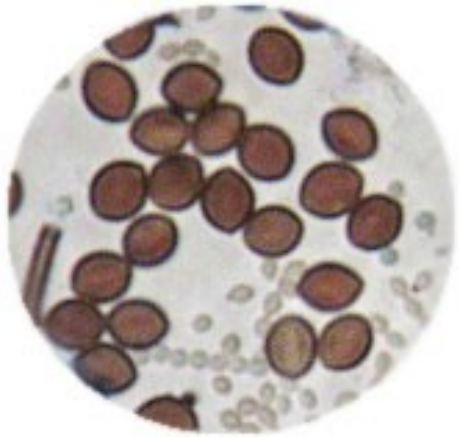
Stachybotrys

Chaetomium

Ulocladium/Stemphylium







Interpreting Air Samples

- NO OSHA STD or TLV
- Genus/species of organisms inside/outside
- Rank order / number
- If good HVAC then inside should be < outside
- Looking for building related source

Recommendations

- Remove/resolve water source problem
- Remove porous materials wet > 24-48 hrs
- Remove with plastic enclosure with neg pressure
- Isolate or cap HVAC systems
- Workers wear protection
- Clearance air sampling

- FUNGI Questions ?

Bacteria (WA >90)

Metal working fluids – Hypersensitivity pneumonitis (endotoxin)

Legionella – Legionella pneumophila

- Hot tubs – Showers
- Drinking water
- Cooling towers

Legionnaires Disease vs. Pontiac Fever

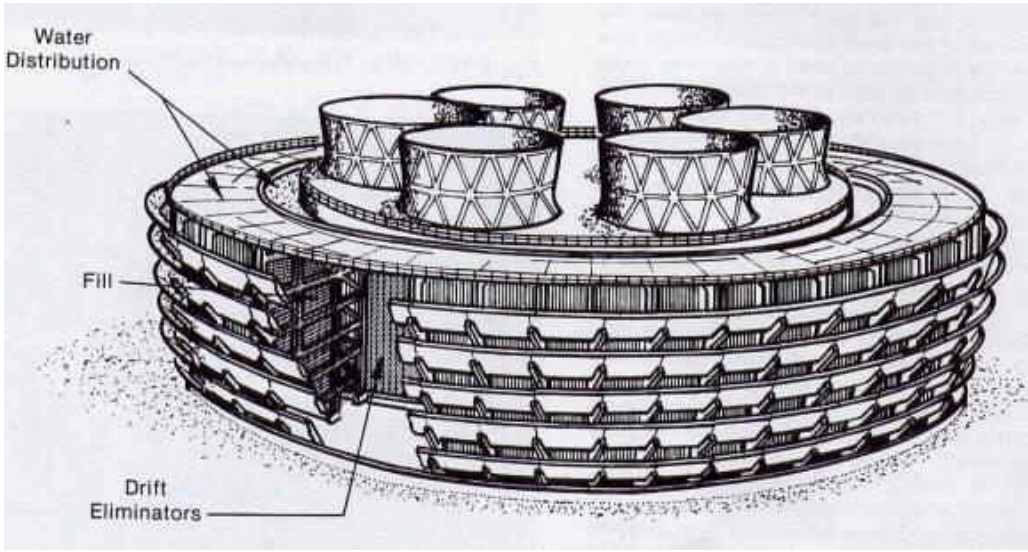
- 5-10% attack rate
- 10-15% mortality
- Incubation 2-14 days
- Fever (102-105 F)
- Headache, muscle aches
- Pneumonia
- Antibiotics

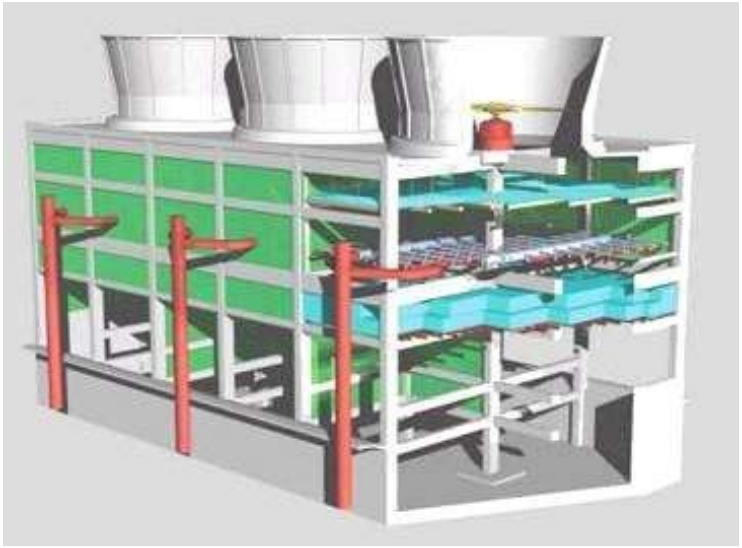
- 90% attack rate
- No Mortality
- Incubation 1-3 days
- Flu Like
- Fever

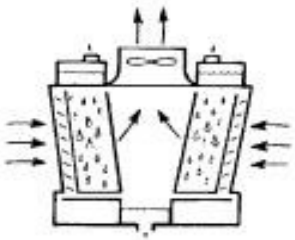
Significant Legionella Outbreaks

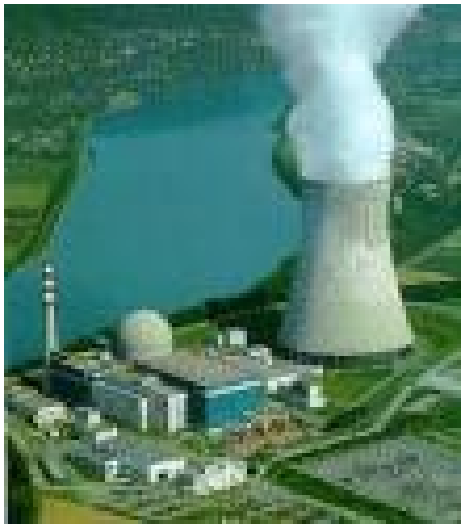
Location of outbreak	Infected	Deaths	Source - Setting
Philadelphia, PA (1976)	240	34	Cooling Tower - Hotel
Lo Que Pas, Az (1995-1997)	7	1	Potable- Hospital
Woodbridge, NJ (1995-1997)	3 (2)	1 (1)	Potable- Motel
Madrid, Spain (1995)	230	16	Cooling Tower
Farmington, MI (1996)	34	4	Evap. Cond. - Auto plant
Christianburge, VA (1995)	23	3	Spa – Store display
Culver City, CA (1999)	11	1	Cooling Tower
Bovenkarspel, Holland (1999)	233	22	Spa – Flower Show display
Melbourne, Australia (2000)	104	4	Cooling Tower- Aquarium
Cleveland, OH (2001)	4	2	???
Muracia, Spain (2001)	638	2	Cooling Tower
Barrow in furnace, UK (2004)	123	3	Cooling Tower

Cooling Towers









Prevalence

- 8,000-18,000 cases/yr in US
- Fraction are reported
- 23% are nosocomial (healthcare associated)
- 10%-20% can be linked to outbreaks
- 10-15% mortality, nosocomial much higher

Prevention

- Dead legs, design, rotation of backup
- Eliminate aerosols
- Maintain treatment systems
- Eliminate biofilms and protozoa
- Testing
- Water temperature

Prevention- Cooling towers vs potable

- Aerosol transmission
- Filtration
- Water treatment
- Testing
- Corrosion
- Sediments
- Water temperature
- Water treatment
- Storage and dead legs
- Aerators
- Handicap shower heads
- Recycle backup systems
- Testing

Chemical Treatment

- Oxidizers- Cl, Br, O3
- Conc., pH , shock , change , corrosivity
- Quats and dithiocarbamates NG
- Non oxidizers- system volume
  - Gluteraldehyde
  - Bromopol
  - Kathon

Guidelines

- British and Australia
- CDC guidelines for JACOH
- Culver City
- OSHA – prompt/immediate action
  - Humidifier 1 and 10 CFU/ml
  - water 10 and 100 CFU/ml
  - tower 100 and 1000 CFU/ml

- Bacteria Questions ?