Air Corrosivity: A New IAQ Parameter

Ed Light, CIH
Building Dynamics, LLC

ELight@Building-Dynamics.com

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Presentation

• Air Corrosivity - general
• Monitoring
• Case Studies:
  1. Chinese Drywall
  2. HVAC Coils (formicary)
  3. HVAC Coils (galvanic)
  4. Museum artifact protection
Corrosion Damage

Air Corrosivity Standards

- Protection of electronic equipment
- Metal damage (industrial)
- Based on air reactivity (corrosion gain on test coupons/day)
Agent-specific sampling

Air Reactivity *(corrosion gain/time)*
Air Corrosivity

• Monitoring of specific chemicals not feasible
• Related to damage *(safety, reliability, visual)*
• Surrogate for irritants?

*Rate* = Metal Loss per time *(Angstroms/30 days)*

Non-Industrial Air Corrosivity

Not previously considered in IAQ
Low concentrations routinely present (acceptable)
**Air Corrosivity**

Reaction of contaminants with metal surfaces
* Oxidation (i.e., moisture, bleach, salt spray)
* Sulfidation (i.e., CDW, sewer gas, water with H2S)

* Integrates the net effect of all reactive airborne pollutants *(similar to “combustible gas”)*

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**Air Corrosivity Probe**
Sample Analysis

- Electrical resistance of probe measured before and after exposure
- Reads by “divisions” which are related to metal loss
- Air Corrosivity Rate calculated in Angstroms per 30 days
  \[ \text{Air Corrosivity Rate} = 0.304 \times \text{probe span} \times \text{metal loss} \times \frac{1}{\text{# days exposed}} \]

- Can be read onsite or sent to lab-

Case One: Chinese Drywall
Corrosive Drywall

- Imported from China (most between 2001 – 2007)
- Used in 10,000’s of homes & buildings (mostly in FL, LA, VA, AL, TX, GA and MS)
- High-Sulfur gypsum reacts, producing mixture of sulfide gasses (ppb range)
- Corrodes electrical and mechanical systems and metal contents

HVAC Coil in CDW Home
CDW Effects

- Burnt-Match Odors
- Irritation of sensitive individuals
- Chronic effects unlikely

CDW Removal
CDW Clearance Testing

Do not conduct air test until:
(a) no dust visible;
(b) no burnt-match odor detected; and
(c) equilibrium restored (~1 – 2 days after remediation)

Sampling Conditions

• Close windows 24 hours prior to and during sampling

• Test with temperature within the comfort range and relative humidity 40 - 80%
Air Corrosivity in CDW vs. non-CDW homes

Conclusions

1. An industrial corrosion monitoring system for air corrosivity was adapted to monitoring indoor air in homes.

2. Background air corrosivity in homes without strong sources of corrosive emissions was generally below 20 A°/30days

3. Most CDW homes exceeded 200 A/30d

4. A three day measurement of air corrosivity can be used to classify IAQ as either normal background, marginal or elevated with respect to CDW emissions

5. A one-day reading of the test probe provides a fairly reliable indicator as to whether remediation will pass or fail the three-day test
Relative Air Corrosivity

- Air corrosivity in homes with CDW was generally an order of magnitude higher than normal background.
- Levels in home vary with temperature, humidity, ventilation and secondary odor sources.
- CDW emissions vary based on humidity, temperature and ventilation.
- Measured rates can be classified as background vs. marginal vs. elevated.

Formicary Corrosion
Corroded Coils

“Ant’s Nest” Corrosion
Apartment Monitoring

Preliminary Findings
Coil Corrosion (galvanic)

Aluminum Oxide
Fin Corrosion

Iron Particles by Pits
Museum Corrosion

Passive Monitors
Carboxylic Acids

Aldehydes
Recommendations

• Avoid using wooden cabinets
• Acceptable levels of carboxylic acids/aldehydes?
• Develop protocol for practical monitoring of air corrosivity in museums

Questions?