Specifying Sustainable Materials: Laboratory DWV Piping & Neutralization Systems

Objectives

- Changing landscape of LEED and Sustainable Design
- What are the different piping and tank materials available?
- When choosing / specifying material for a sustainable system what should be considered?

The Green Building Movement

LEED™ Certified 2003 · U.S. Green Building Council · Leadership in Energy & Environmental Design

Labs for the 21st Century · www.labs21century.gov

Green Building Initiative

UL Environment™ · Your Partner in Sustainability

I²SL · International Institute for Sustainable Laboratories

GreenFormat · A standardized format for reporting information about the sustainable attributes of construction products

SBIC · Sustainable Buildings Industry Council · Advancing a 'whole building' approach to design™

Green Globes™

The Green Building Movement

The Standards are "Organic"

- LEED Version 3.0 (since 2009)
- LEED Certified Buildings from 5-7years ago would not be certified by today's standard

"LEED energy standards have grown more stringent over the years, and construction like the Youngstown federal building, built in 2002, would not be certified under the current version of the program… The LEED standard goes through periodic revisions, and this year, the minimum energy requirements needed for the basic LEED certification for new buildings were raised."

- *"Some Buildings Not Living Up to Green Label"* NY Times 8/31/09

A Word from the Experts…

"…Low Emitting Materials (LEED EQ Credit 4.1)

The intent of this credit is to reduce the quantity of indoor air contaminants within a facility. Plumbing systems typically include piping systems that require field fabrication and/or joining. A sustainable plumbing design will specify the installation of systems that minimize or *eliminate the need for traditional construction methods such as welding, brazing, soldering, gluing, etc.* *Each of these traditional methods results in the off-gassing of odorous and potentially irritating Volatile Organic Compounds (VOCs).*

A sustainable plumbing engineer will evaluate the feasibility of *using alternative methods of joining materials, such as mechanical joints* … This should be included in the project specifications in an effort to assist the contractors in correctly bidding the project…"

- Paul L. Ham, P.E., LEED® AP
Plumbing Engineer, Issue 7/05

GREEN GLOBES™

Reuse of existing buildings	
Do the construction documents indicate that the design includes existing façades in fully renovated buildings?	
Less than 50%	Selected, never in max
At least 50%	Selected, never in max
At least 75%	Selected, never in max
100% of existing façades in fully renovated buildings	Selected, max
Are 50% of the existing major structures (other than the shell) being reused?	Y/N/NA out
Building durability, adaptability and disassembly	
Are durable and low maintenance building materials and assemblies specified?	Y/N
Describe the materials and assemblies that have been specified for their durability and low maintenance:	If Y and entered
Do the construction documents indicate that the design promotes building adaptability?	Y/N
Describe the main features that promote building adaptability:	If Y and entered
Does the design indicate that materials and fastening systems will allow for easy disassembly?	Y/N
Describe the features that allow disassembly:	If Y and entered
Reuse and recycling of construction/demolition waste	
Is there a construction, demolition and renovation waste management plan?	Y/N
Facilities for recycling and composting	
Do the construction documents indicate that adequate waste handling and storage facilities for recycling and composting are provided?	Y/N
Indicate how much storage area will be provided for storing recyclable waste:	If Y and entered

Understanding the “Noise”

ulenvironment.com

greenformat.com

Third party certification of sustainability claims about materials and products / Offering a clear standard to compare “apples to apples”

A Sustainable Engineered System

Two main components:

- Transportation = Pipe & Fittings
- Treatment = Neutralizing Tank

When engineering the system it must be:

regulatory compliant
cost-effective (long-term)
adaptable in both form and function

Main Materials – Pipe & Fittings

Material	Industry Standard
High Silicon Iron	ASTM A518
Borosilicate Glass	ASTM C1053
Polypropylene (PP)	CAN/CSA-B181.3 or ASTM F1412
Polyvinylidene Fluoride (PVDF)	ASTM F1673

* Other materials: PE, CPVC and Stainless Steel

Main Materials – Neutralization Tanks

Material
Chemical Stoneware
Polypropylene (PP)
Polyethylene (PE)
Polyvinylidene Fluoride (PVDF)

Neutralization Medium:

Adjust pH 4.5 – 7.5

Limestone chips ca. 1”- 3” diameter

Must be accessible for maintenance (monitoring system)

Extra step using caustic possible to achieve a higher pH level

Designing a Sustainable System

Upfront material costs are not the only factor!

Total Costs = Material + Installation + Maintenance/Redesign

- Chemical compatibility of the Lab (long-term)
- In-service temperature requirements within the system
- Fire Protection and Safety
- Adaptability of material regarding modifications & repairs

Designing a Sustainable System

Laboratory Plumbing 101 – PS&D Magazine (April 2010)

"This definitely is not a situation where saving the owner upfront materials costs is the primary consideration. Staff changes occur, and new teachers may devise a curriculum using chemicals not included in the original lab design. Hence, erring on the side of extreme caution is always the base design level for safety and security."

-Jim J. Williams / Basharkhah Engineers
Dallas, TX

Choosing & Specifying: What to consider?

Long Term Chemical Compatibility

Average Lab use 100+ chemicals

Usage and research areas change over life of building

Chemical Resistance Charts from manufactures can be misleading:

- different concentration levels
- different temperature levels (Law of Reaction Kinetics)
- most charts do not account for inter-mixing or require “copious” dilution

Choosing & Specifying: What to consider?

TEMPERATURE, TEMPERATURE, TEMPERATURE

Sources of In-Service Heat & Temperature

Source	Temperature °F	Thermal Variation °F (Ambient 70 °F)
Exothermic Chemical Reactions	200-250	130-180
Condensation from Steam Faucets	212	142
Discharge from Autoclaves	180	110
Hot tap water	140	70
Alternate exposure Hot liquids (180°F) and Cold Water (50°F)	varies	Max 130

Choosing & Specifying: What to consider?

TEMPERATURE, TEMPERATURE, TEMPERATURE

Most devastating factor long term = expansion & contraction

Material	Actual Expansion 100°ΔT/100’	Relative Thermal Expansion	Full recovery after temp reduced?
Borosilicate Glass	0.22”	1	Yes
High Silicon Iron	0.75”	3.5	Yes
Polypropylene (PP)*	6.0”	27.2	No
Polyvinylidene Fluoride (PVDF)*	9.48”	43	No

* Depends on pipe size

Affects: joining method, expansion joints, hanger spacing

Choosing & Specifying: What to consider?

Fire Protection & Safety

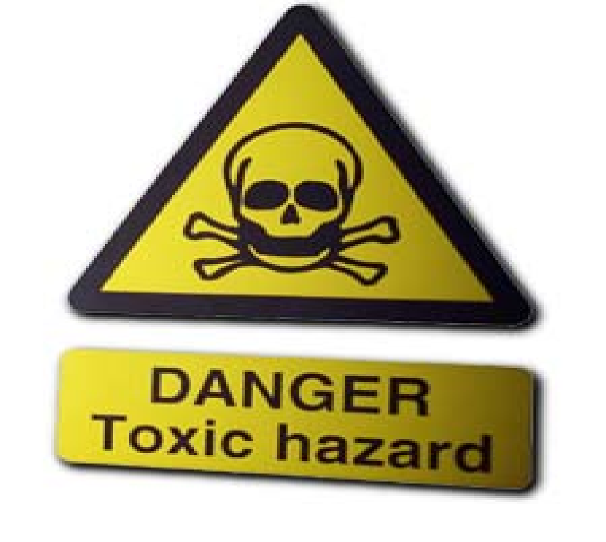
The choice of material should not directly support the spread of flames and/or toxic fumes from floor to floor.

Fire stopping must meet UL 1479 (ASTM E814)

Piping in return air plenums must meet 25/50 smoke rating (UL 723 / ASTM E84)

Only plenum rated materials:

- Borosilicate Glass
- High Silicon Iron
- PVDF



Choosing & Specifying: What to consider?

Is it Adaptable?

Function: Chemical & Temperature compatibility

Form:

- Redesigns due to new research or growing workforce
- In-service modifications can be 2 -3x initial costs
- Costs can be reduced by specing a mechanical joint system and material that could be reused after modifications.
- If not can it be recycled after in-service use?

Choosing & Specifying: Review

Chemical Compatibility:

Long term

Concentration levels

Temperature levels

Intermixing

Fire Protection & Safety:

Don't support flame or toxic fume spread

Fire Stop - UL UL 1479
ASTM E814

Plenum - UL 723 / ASTM E84

Temperature Capabilities:

In-service sources of heat

Biggest threat = thermal expansion

Thermal expansion affects design, joining method, installation costs

Adaptability :

Form – redesign/modifications

Function – long term chem and temp requirements