Putting Energy Hogs on a Diet: Filtered Fume Hoods

by Ken Crooks
Director, GreenFumeHood Technology

Learning Outcomes

- Review the latest technology advances for filtered fume hoods.
- Explain the requirements of a filtered fume hood.
- Propose a selection matrix for NC and Renovation
- Discuss the results of installations.

Some of Your Clients' Needs

- Reduce construction costs
- Reduce operational costs
- Reduce carbon footprint
- Provide flexibility for changes and growth

While INCREASING safety!

Laboratory Design News
U of Rochester

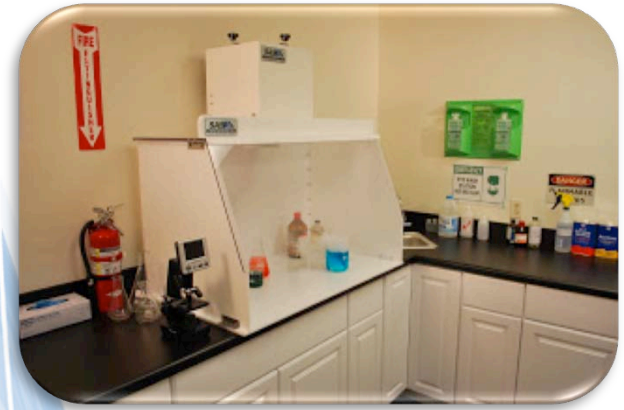
“Ductless” vs. “Filtered”

“Ductless” vs. “Filtered”

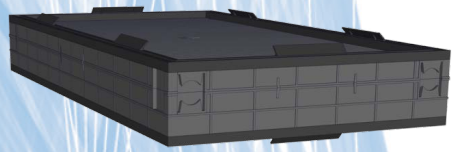
A Little History

Ductless Fume Hoods:

- Started in the late 60's
- Hundreds of thousands in use today
- Right tool for the right job



Ductless Hood Filter Options



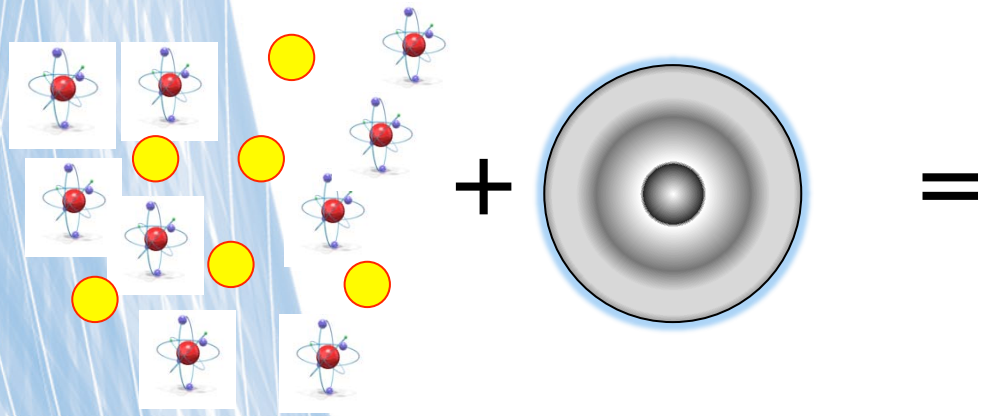
Filter Name	Trapped chemicals
AS	Organic solvents
BE	Acids
F	Formaldehyde
K	Ammonia
G	Radioactive iodine

Filtered Fume Hoods Must:

- **Filter** a broad range and mixture of chemicals
- **Detect** when filtration ceases, while always maintaining safety
- **Communicate** its status to EH&S / Facilities
- **Integrate** into the culture/applications successfully

Mechanics of Adsorption

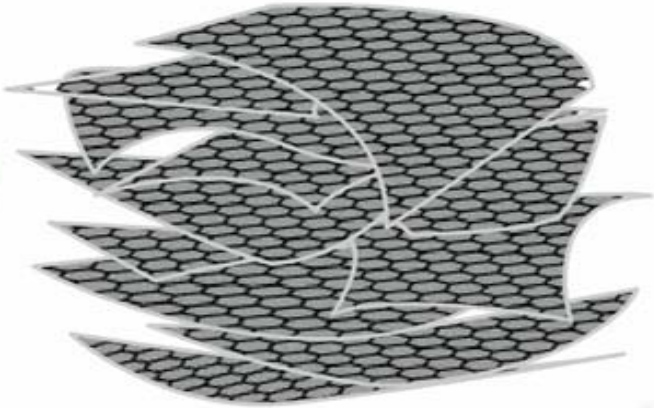
Polluted Air Adsorbent Clean Air



= Contaminant

Activation Process

- Organized structure
- Steam & Heat create spaces between carbon layers
- 15,000 SqFt/g internal surface area!

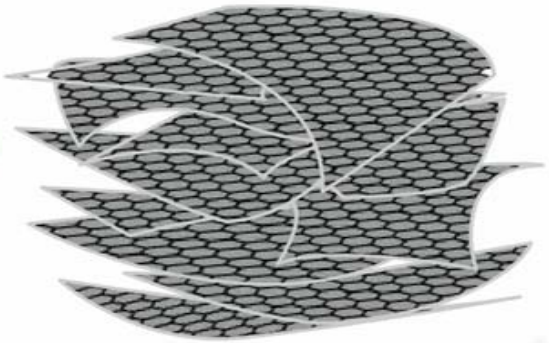



N
Image © 2009 New York GIS
Gray Buildings © 2008 Sanborn
Image © 2009 DigitalGlobe
Image © 2009 Sanborn
40°42'13.98" N 74°00'28.36" W elev 562 ft
©2009 Google
Eye alt 2689 ft


Don Komarechka

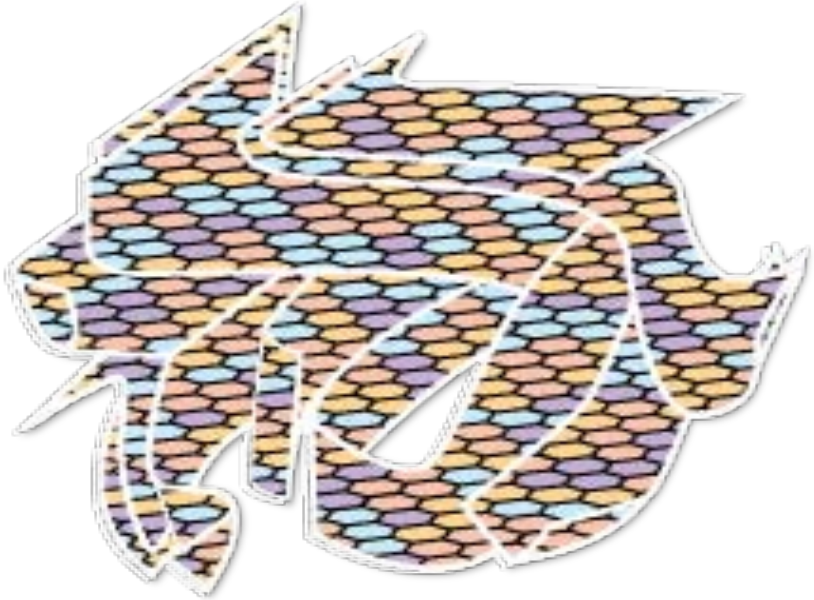
Old Activation Process

- Impregnation problem: decreases capacity
- Use of heavy metals to increase retention capacity
- Specific filters (AS, BE…)



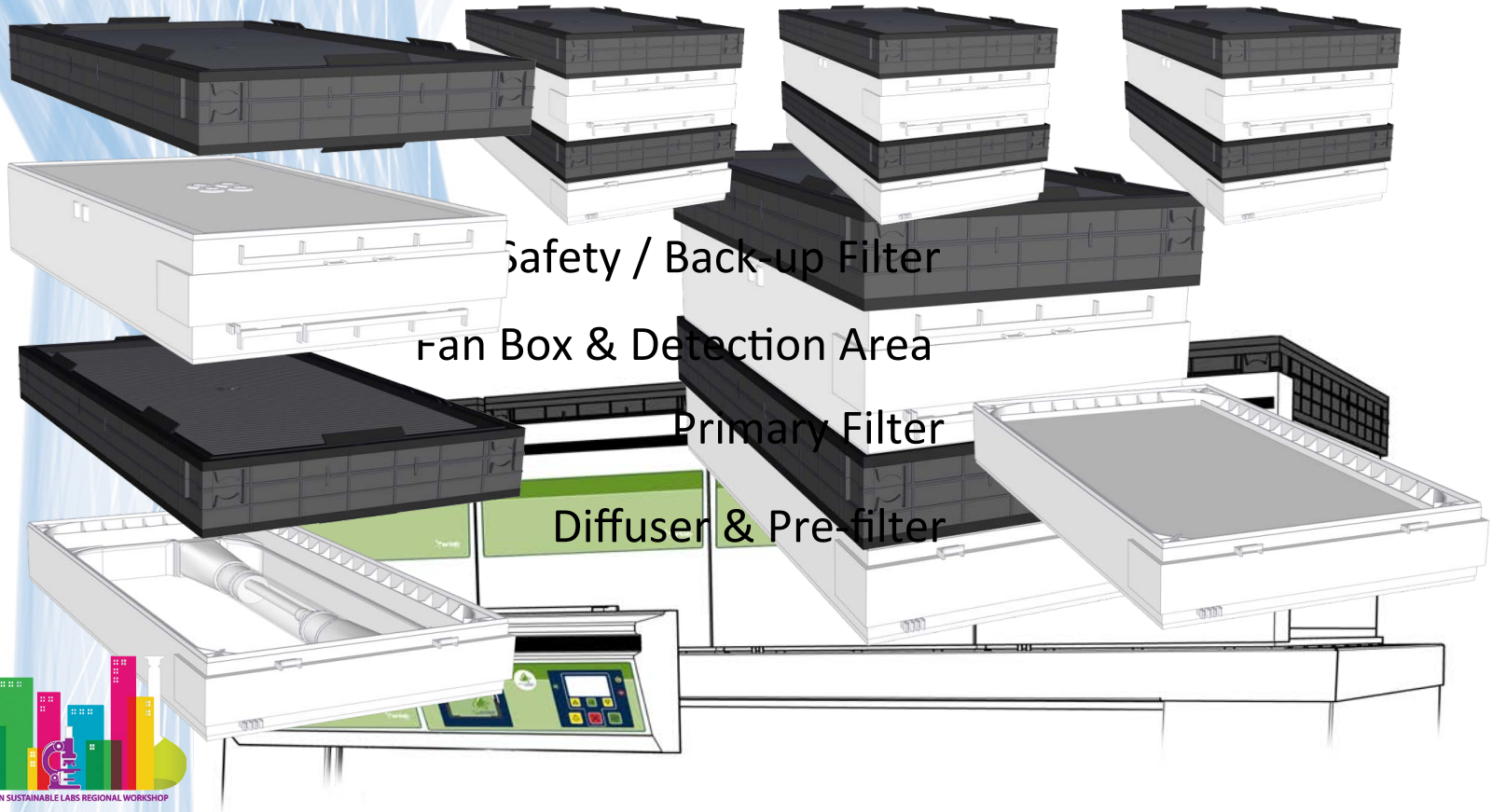
New Filtered Fume Hood Media

- New filtration retains:
  - Polar organic solvents
  - Non-polar organic solvents
  - Inorganic Bases
  - Inorganic acids



Creation of chemical groups on the surface

Filtration Modules



In with Good Air, Out with Better Air

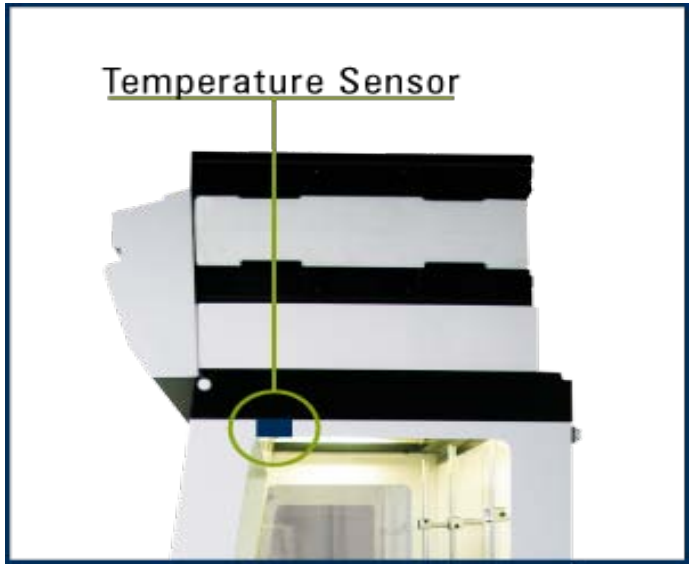


Detection for 1% TLV Exposure

- Suite of sensors:
  - Acid
  - Solvent
  - Lab Air
  - Temperature
  - Sash Sensor

Fire Prevention/Detection

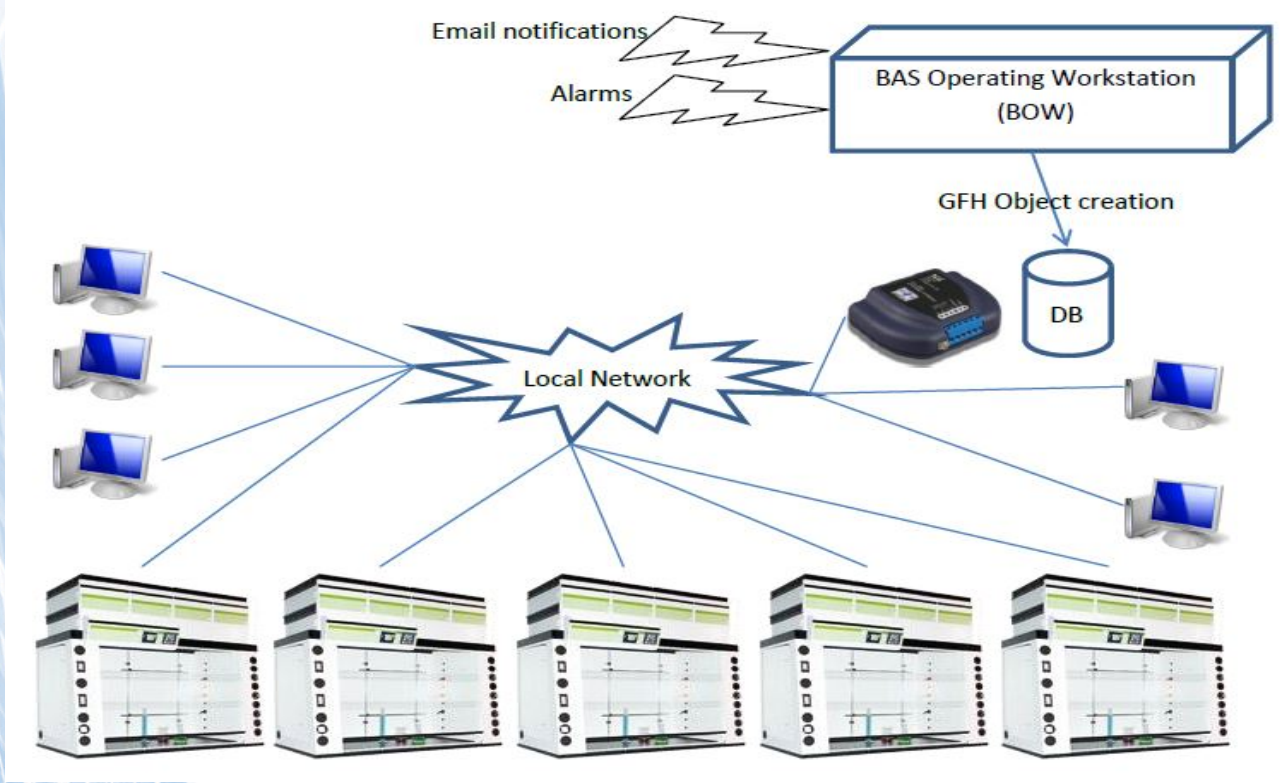
- Temperature Sensor:
  - Detection and Alerting
  - 104°F (40°C) = Alert
  - 140°F (60°C) = Fan Stop



Communication

- Users have access cards
- Local status display and alerts
- Remote monitoring of hood operation and lab conditions

BACnet Integration



Integration

- Steps to Evaluate Acceptability are:
  - Chemical List as per AFNOR NFX 15-211
  - Chemical questionnaire process
  - Programming of sensors

	Product Name	Container	Opened / Closed	Dilution	Temperature	Frequency	Quantity	Duration
1- OXIDATION-REDU	Nitric acid	Beaker	opened	10000 %	22 C	2 time(s) per month	2 mL	20 mn
2- Analysis								
3- Transfer								
4- Transfer								

1 Containment	Approved
2 Detection	Approved
3 Compatibility	Approved
4 Estimated Life Expectancy	Approved

Comments

Expected filter life time : 24 months with all configurations;Semiconductor setting : 3980 mV

Filtered Fume Hoods Must:

Review

- **Filter** a broad range and mixture of chemicals
- **Detect** when filtration ceases, while always maintaining safety
- **Communicate** its status to EH&S / Facilities
- **Integrate** into the culture/applications successfully

Standards / Certification

- Containment: ASHRAE Std 110
- Retention: AFNOR NFX 15-211 as referenced in ANSI/AIHA Z9.5-2012
  - Stages 1 through 4
  - Class 1 (back-up filter)

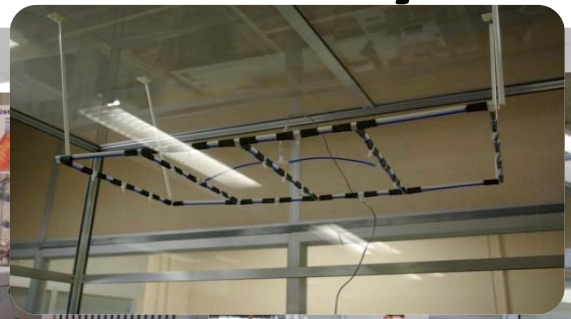
Regarding Compliance…

- Claims of compliance shall be guaranteed by & documented in 3rd-party independent test reports.
- Additionally, per AFNOR NFX 15-211 manufacturer must supply a chemical list.

Erlab Research & Development Lab

Erlab's state of the art Research & Development Laboratory

Erlab Testing Laboratory



Chemical “Long List”

- 500+ chemicals, each tested with 6 or more different concentrations.
- Each test performed twice.
- Represents thousands of chemicals.

THE LONG LIST

Chemical Name	Formula	C.A.S Number	PEL-TWA (OSHA)	PEL-STEL (OSHA)
1, 4-Dioxane	C4H8O2			
1,1,1-Trichloroethane	C2H3Cl3			
1,1,2,2-Tetrabromoethane	C2H2Br4			
1,1,2,2-Tetrachloroethane	C2H2Cl4			
1,1,2,2-Tetrachloroethane	C2H2Cl4			
1,1'-Biphenyl-4,4'-diamine	C8H16N2			
1,1-Dichloroethane	C2H4Cl2			
1,2-Dibromoethane	C2H4Br2			
1,2-Dichlorobenzene	C6H4Cl2			
1,2-Dichloroethane	C2H4Cl2			
1,2-Dichloroethylene	C2H2Cl2			
1,2-Epoxy-3-isopropoxypropane	C6H12O2			
1,2-Ethanediol	C2H6O2			
1,3-Butadiene	C4H6			
1,3-Cyclopentadiene	C5H6			
1,3-Dichloropropene	C3H4Cl2			
1,3-Dichloropropylene	C3H4Cl2			
1,3-Dioxolane	C3H6O2			
1,3-Divinylbenzene	C10H10			
1-Aminobutane	C4H9NH2			
1-Aminopropane	C3H9NO			
1-Butanethiol	C4H10S			
1-Butanethiol	C4H10S			
1-Butanol	C4H10O			
1-Chloro butane	C4H9Cl			
1-Chloro-2,3-epoxypropane	C3H5ClO			
1-Chloro-2,3-epoxypropane	C3H5ClO			
1-Mercaptobutane	C4H10S			
1-Mercaptobutane	C4H10S			
1-Mercaptobutane	C4H10S			
1-Methyl-2-pyrrolidinone	C5H9NO			
1-Propanethiol	C3H8S			
1-Propanol	C3H8O			
2, 2'-Dichlorodiethyl ether	C4H8OCl2			
2, 4-Dimethyl pentane	C7H16			
2,4-Dimethyl-3-pentanone	C7H14O			
2,6-Dimethyl-4-heptanone	C9H18O			
2-Amino 1-propanol	C3H9NO			
2-Amino butane	C4H9NH2			
2-Amino pyridine	C5H6N2			
2-Aminoethanol	C2H7NO			
2-Aminopropane	C3H9N			
2-Butanol	C4H10O			
2-Butanone	C4H8O			
2-Butenal	C4H6O			
2-Butoxyethanol	C6H14O2			
2-Chloroacetaldehyde	C2H3OCl			
2-Chloroethanal	C2H3OCl			
2-Chloroethanol	C2H5OCl			
2-Chloroethyl alcohol	C2H5OCl			
2-Chloropropylene oxide	C3H5OCl			
2-Ethoxy acetate	C6H12O3			
2-Ethoxyethanol	C4H10O2			
2-Furylmethanol	C5H6O2			
2-Furylmethanol	C5H6O2			
2-Heptanone	C7H14O			
2-Hexanone	C6H12O			
2-Hydroxymethylfuran	C5H6O2			
2-Methyl-1,3-butadiene	C5H8			
2-Methylpropyl acetate	C6H12O2			
2-Pentanone	C5H10O			
2-Pentanone	C5H10O			
2-Phenyl propane	C9H12			
2-Propanol	C3H8O			
2-Propanone	C3H6O			
2-Propen-1-ol	C3H6O			
2-Propenal	C3H4O			
2-Propenamide	C3H5NO			
2-Propenenitrile	C3H3N			
2-Propenoic acid	C3H4O2			
2-Propenol	C3H6O			
2-Propyl acetate	C5H10O2			
2-Propylamine	C3H9N			
2-Propyn-1-ol	C3H4O			
2-Propynyl alcohol	C3H4O			
3-Amino-1-propanol	C3H9NO			
3-Chloro-1-propene	C3H5Cl			
3-Cresol	C7H8O			
3-Hydroxytoluene	C7H8O			
3-Methoxy-3-methyl-1-butanol	C6H14O2			
3-Methyl phenol	C7H8O			
3-Methyl-3-penten-2-one	C6H10O			
3-Octanone	C8H16O			
3-Pentanone	C5H10O			
4,4'-Bianiline	C12H12N2			
4,4'-Biphenyldiamine	C12H12N2			
4,4'-Diaminobiphenyl	C12H12N2			
4-Aminotoluene	C7H9N			
4-Cresol	C7H8O	106-44-5		
4-Hydroxytoluene	C7H8O	106-44-5		
4-Methyl 2-pentanone	C6H12O	108-10-1	100 ppm	
4-Methyl-2-pentanone	C6H12O			
4-Methylaniline	C7H9N			
4-tert-Butyl toluene	C11H16			
5-Methyl-3-Heptanone	C8H16O			
Absolute alcohol	C2H6O			
Acetaldehyde	C2H4O			
Acetic acid	C2H4O2			
Acetic anhydre	C4H6O3			
Acetic oxide	C4H6O3			
Acetone	C3H6O			
Acetonitrile	C2H3N			
Acetylene	C2H2			
Acetylene dichloride	C2H2Cl2			
Acetylene tetrabromide	C2H2Br4			
Acetylsalicilic acid	C9H8O4			
a-Chlorotoluene	C7H7Cl			
Acroleic acid	C3H4O2			
Acrolein	C3H4O			
Acrylamide	C3H5NO			
Acrylic acid	C3H4O2			
Acrylic aldehyde	C3H4O			
Acrylonitrile	C3H3N			
Alcohol	C2H6O			
Allyl alcohol	C3H6O			
Allyl alcohol	C3H6O			
Allylene	C3H4			
Allylglycidylether	C6H10O2			
Alumina	Al2O3			
Aluminium	Al			
Aluminum oxide	Al2O3			
Aluminum trioxide	Al2O3			
Amino-benzene	C6H5NH2			
Aminocyclohexane	C6H11NH2			
Aminoethane	C2H7N			
Ammonia	NH3			
Ammonium chloride	NH4Cl			
Ammonium chloride (fumes)	NH4Cl			
Ammonium hydroxyde sol	NH4OH			
Amorphous silica	SiO2			
Amyl alcohol n	C5H12O			
Anhydrous hydrogen bromide	HBr			
Anhydrous hydrogen bromide	HBr			
Aniline	C6H5NH2			
Aqua fortis	HNO3			
Aqua regia	HCL+HNO3			
Aqueous hydrogen bromide (i.e.	HBr			
Aqueous hydrogen chloride (i.e.	HCl aq. sol.			
Arsenic (inorganic compounds, as As)	As			
Asbestos	Hydrated mineral silicates			
Aspirin	C9H8O4			
Atrazine	C8H14ClN5			
Azide	NaN3			
Azine	C5H5N			
Barium chloride	BaCl2.2H2O			
Benzenamine	C6H5NH2			
Benzene	C6H6			
Benzene chloride	C6H5Cl			
Benzene chloride	C6H5Cl			
Benzine 35 80	C8H16N2			
Benzyl alcohol	C6H5CH2OH			
Benzyl chloride	C7H7Cl			
Beryllium compounds (as Be)	Be			
BET	C21H20N3Br			
Bromal	C2HN7NO			
beta-Methyl acrolein	C4H6O			
beta-Methylpropyl ethanoate	C6H12O2			
Bicyclopentadiene	C10H12			
Biotite	K(Mg,Fe)3AlSi3O10[F, OH]2			
Borax	Na2B4O7 • 10H2O			
Boron oxide	B2O3			
Bromine	Br2			
Bromochloromethane	CH2BrCl			
Bromoethane	C2H5Br			
Bromoethene	C2H3Br			
Bromoethylene	C2H3Br			
Bromoform	CHBr3			
Butanoic acid	C4H8O2			
Butyl acrylate	C7H12O2			
Butyl alcohol	C4H10O			
Butyl alcohol sec	C4H10O			
Butyl alcohol sec	C4H10O			
Butyl alcohol ter	C4H10O	75-65-0	100 ppm	
Butyl alcohol ter	C4H10O2	75-12-7		
Butyl carbinol	C5H12O	71-41-0		
Butyl Cellosolve®	C6H14O2	111-76-2	50 ppm	
Butyl ether	C8H18O	142-96-1		
Butyl glycidyl ether	C7H14O2	2426-08-6	50 ppm	
Butyl glycol	C6H14O2	111-76-2	50 ppm	
Butyl lactate	C7H14O3	138-22-7		
Butyl metacrylate	C8H14O2	97-88-1		
Butyl vinyl ether	C6H12O	111-34-2		
Toluol	C7H8	108-88-3	200 ppm	300 ppm
Tribromomethane	CHBr3	75-25-2	0.5 ppm	
Trichloroacetic acid	C2HCl3O2	76-03-9		
Trichloroethane-1,1,2	C2H3Cl3	79-00-5	10 ppm	
Trichloroethanoic acid	C2HCl3O2	76-03-9		
Trichloroethanoic acid	C2HCl3O2	76-03-9		
Trichloroethene	C2HCl3	79-01-6	100 ppm	200 ppm
Trichloroethylene	C2HCl3	79-01-6	100 ppm	200 ppm
Trichloromethane	CHCl3	67-66-3		50 ppm
Triethylamine	C6H15N	121-44-8	25 ppm	
Trifluoroacetic acid	C2HF3O2	76-05-1		
Trimethyl methane	C4H10	75-28-5		
Trimethyl pentane-2,2,4	C8H18	540-84-1		
Trimethylamine	C3H9N	75-50-3		
Trimethylbenzene	C9H12	108-67-8		
Tungsten	W	7440-33-7		
Turpentine oil	C10H16	8006-64-2	100 ppm	
Urea	C2H3Cl	75-01-4	1 ppm	5 ppm
Vinyl acetate	C4H6O2	108-05-4		
Vinyl bromide	C2H3Br	593-60-2		
Vinyl carbinol	C3H6O	107-18-6	2 ppm	
Vinyl chloride	C2H3Cl	75-01-4	1 ppm	5 ppm
Vinylcyanide	C3H3N	107-13-1	2 ppm	10 ppm
Vinylcyclohexene	C8H6	106-99-0	1 ppm	15 ppm
Vinyltoluene	C9H10	25013-15-4	100 ppm	
Vinyl trichloride	C2H3Cl3	79-00-5	10 ppm	
Vinylbenzene	C8H8	100-42-5	100 ppm	200 ppm
White spirit	85% Nonane/15% trimethyl-benzene	8052-41-3	500 ppm	
Xylene (isomers)	C8H10	1330-20-7	100 ppm	
Xylol	C9H10	103-38-3	50 ppm	
Zinc oxide	ZnO	1314-13-2	15 mg/m3	

1,4-Dioxane to 2-Butenal

4-Methyl 2-pentanone to Aqua fortis

Aqua regia to Butyl vinyl ether

... to Zinc oxide.

(13) Pages long!

2-Butoxyethanol to 4-Hydroxytoluene

Chemical "Short List"

Not retained well:

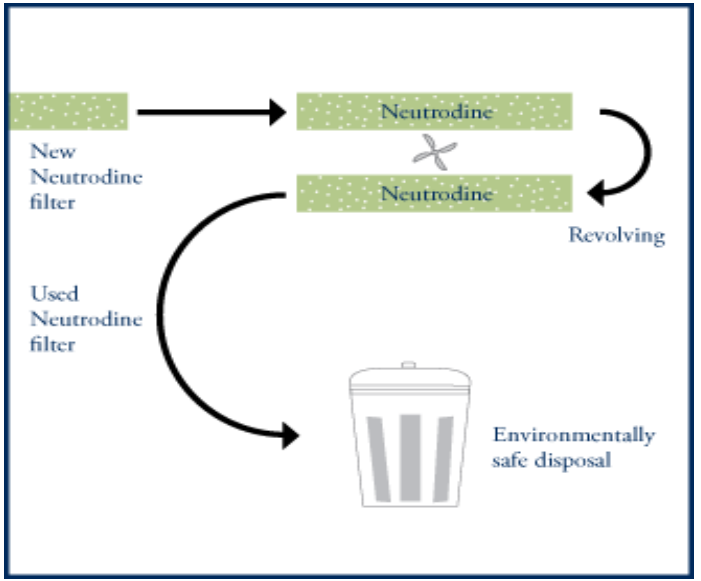
1. Hydrogen
2. Helium and the Noble Gases
3. Methane
4. Ethane
5. Ethylene Oxide
6. Carbon Monoxide
7. Carbon Dioxide
8. Nitrogen Monoxide
9. Propylene
10. Propyne, Propane
11. Acetylene

Not recommended:

- Perchloric Acid, Radioisotope or Acid Digestion Hoods
- Highly exothermic reactions
- Mercury - Well retained but remains extremely toxic (TLV = 0.05 ppm) and difficult to detect
- Organophosphoric Compounds - very high toxicity
- Hydrogen Cyanide -Immediately lethal

Filter Replacement/Disposal

- Standard PPE: Gloves and Glasses
- Secondary filter becomes primary, new secondary installed
- Old filter incinerated through your established process/vendor



Reduce First Costs

- Remove hood exhaust ductwork and airflow control device
- Reduce exhaust fan BHP
- Reduce make-up air (Cooling, Heating)

Reduce Operating Costs

- Reduced fan BHP on Supply and Exhaust
- Reduced cooling tonnage
- Reduced heating BTUs
- Increased $$$ for facility improvements

Evaluation of Filtered Hoods

Comparison 1st Cost NC Ducted vs. Filtered,	CV	VAV	VAV HP/LF	Filtered
Fume Hood, 6Ft, Vertical Sash [1,2]	$10,000	$10,000	$12,000	$25,000
Building Infrastructure: M-E-P, Lab Services & Data [0,3]	$20,000	$25,000	$25,000	$2,000
Total First Costs	**$30,000**	**$35,000**	**$37,000**	**$27,000**
Energy Costs/Year				
Exhaust Fans[4]	$1,367	$911	$711	$293
Make-up Air ($5/cfm) [5]	$6,000	$4,000	$3,120	$0
Maintenance Costs/Year	$1,200	$1,500	$1,500	$1,800
Total Operating & Maintenance/Year	**$8,567**	**$6,411**	**$5,331**	**$2,093**

Cost comparison data prepared by Ellensweig Architects in collaboration with BR+A Consulting Engineers, R.W. Sullivan Engineering and Vanderweil engineers.

Footnotes to cost figures

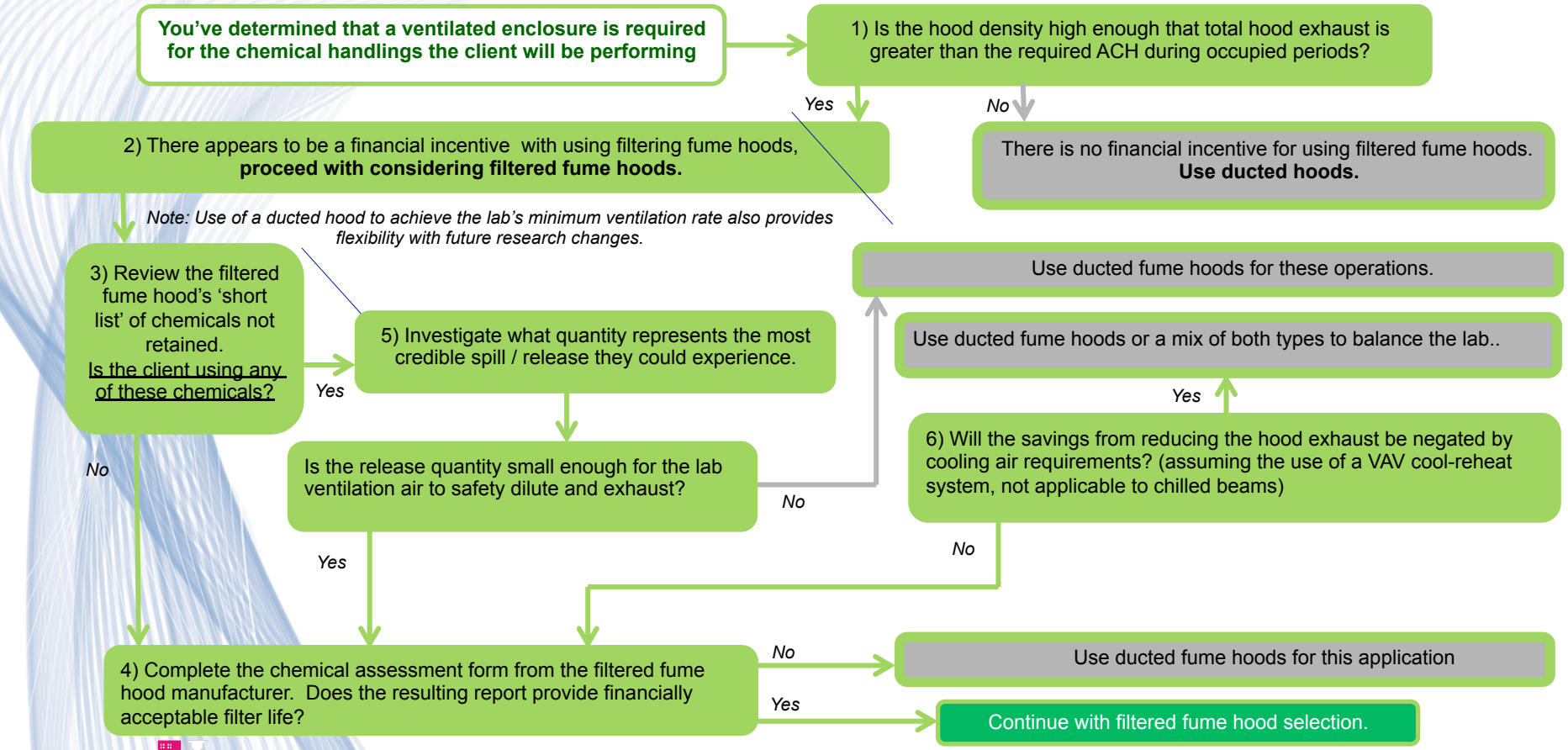
The figures listed do not include potential savings due to reduced chiller capacity resulting in a lower chilled water load.

1. Cost comparison is based on new construction and includes estimated costs per single 6 ft. fume hood with a vertical sash configuration and utility connections including compressed air, lab vacuum, natural gas, electrical power and data. (Exception – combo sash of HP hood)
2. National Grid and other local and national utility companies provide a first time equipment cost rebate of up to 70% of the difference in cost between a conventional constant volume bypass hood and a filtering green fume hood. (Energy rebate savings are not included in the figures listed above)
3. Estimated building infrastructure cost (M-E-P Data) per fume hood based on new building construction with approximately 100 fume hoods)

Footnotes to cost figures

4. Estimated electrical energy costs per year per fume hood.
    - Assumption: Fans will operate 24 hrs/day, 365 days/year, 8,760 hours/year at $0.12kWh
    - Fan HP required 1HP/ 2 in. SP
    - Equivalent electrical load per NEC Article 430/full load current at 460 volts/3 phase/2.1 amps = 1.3 kWh
5. Estimated mechanical energy cost per year per fume hood:
    - 6’ CV bypass (1,200 CFM x $5.00/CFM/year=$6,000)
    - 6’ VAV (800 CFM x $5.00/CFM/year=$4,000)
    - 6” VAV HP hood (624CFM x $5.00/CFM/year=$3,120)
6. The cost savings illustrated above do not take into account possible additional cost savings associated with a reduced floor to floor height related to possible reduced HVAC ductwork.

New Construction Selection Matrix



Renovation Selection Matrix

You've determined that a ventilated enclosure is required for the chemical handlings the client will be performing

1) Is the hood density high enough that total hood exhaust is greater than the required ACH during occupied periods?

Yes

2) There appears to be a financial incentive with using filtering fume hoods, **proceed with considering filtered fume hoods.**

No

There is no financial incentive for using filtered fume hoods. **Use ducted hoods.**

OR *OR*

Note: Use of a ducted hood to achieve the lab's minimum ventilation rate also provides flexibility with future research changes.

3a) Will the existing make-up air and/or exhaust air systems have difficulty with handling the additional loads?

No

Yes

Consider using filtered fume hoods to avoid the cost of upgrading the mechanical systems.

3b) Is there difficulty with installing an exhaust duct to the new hood?

No

Yes

Consider using a filtered fume hood for ease of installation.

3c) Are there any limitations with duct or air valve sizing for the lab that will prevent it from handling an additional hood?

No

Yes

If no, use ducted fume hood(s) for this application for lower first costs.

Continue with filtered fume hood selection. Start at Step 2 of New Construction Matrix.

Customer List

- AirBorn Interconnect
- Amway
- Antioch College
- **Assinbione Zoo**
- Babbitt School
- Bay Path Reg Voc-Tech HS
- Bridgestone Technical Center
- Broward College
- Butler Univ.
- Carmel Christian School
- Central Piedmont CC
- Chemtura
- Clemson Univ.
- Columbia Univ.
- Consumers Energy
- Cornell Equine Drug lab
- Covidien
- Crowder College
- Dorf Ketal Chemicals
- E.P. Scientific
- FBI - Quantico
- **Grand Prairie Reg. College**
- Greenwood Lab School
- Harvard University
- HiRes BioSolutions
- Ivy Tech Comm College
- Khalifa Univ. of Science & Tech.
- L'Oreal - Maybeline
- L'Oreal - R&D
- Manildra Group USA
- Marietta College
- Marywood Univ.
- **McMaster Univ. (twice!)**
- Motiva Enterprises
- Murry State College
- New Mexico Consortium
- OPC Polymers
- Pace Analytical
- Pasco-Hernando State College
- Paul Smith's College
- Purdue Univ. Tech. Center
- Rock Valley College
- Roosevelt H.S.
- SEED School of Maryland
- SKB Environmental
- St. Cloud State Univ.
- St. Joseph's College
- St. Norbert College
- SUNY
- SW Texas Junior College
- Texas A & M
- Total Petrochemical
- Univ. of California
- Univ. of Florida
- Univ. of Rochester
- Univ. of Rochester
- Univ. of Chicago
- Univ. of Michigan
- Univ. of Texas
- Utica College
- W.L. Gore (twice!)
- Washington Univ.
- **Yukon College** ... and more...

Butler University, Gallahue Hall

- Modernize (4) Teaching Labs
- Improve Indoor Air Quality
- Reduce Operating Costs

Construction Costs

$66,000

DUCTED FUME HOODS	COMPONENTS	COST/UNIT	UNITS	TOTAL
	Fume Hoods	$8,000	26	$208,000
	Ductwork, Lab Controls	$5,000	26	$130,000
	Upgrade to Building Supply & Exhaust Systems	$350,000	1 LS	$350,000
			TOTAL	$688,000

FILTERED FUME HOODS	COMPONENTS	COST/UNIT	UNITS	TOTAL
	Fume Hoods	$22,000	26	$572,000
	Ductwork, Lab Controls	$50,000	1 LS	$50,000
	Upgrade to Building Supply & Exhaust Systems	0	1 LS	$0
			TOTAL	$622,000

*Local Indianapolis, IN area costs

10 Yr. Operating Costs

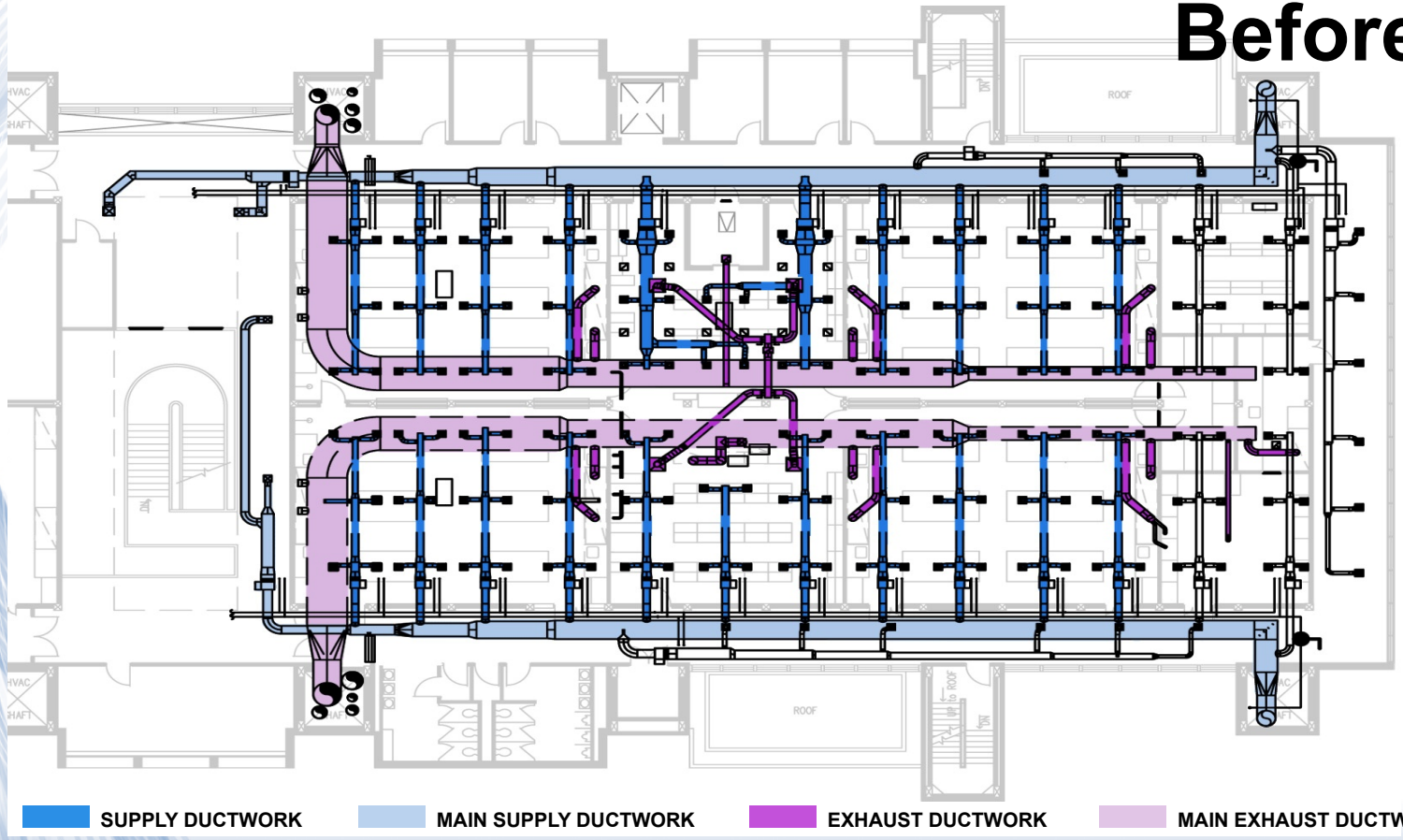
$512,000+

DUCTED FUME HOODS	COMPONENT(S)	CFM / FUME HOOD	QTY OF FUME HOODS	TOTAL CFM	YEARLY COST / CFM	TOTAL YEARLY COST
	Fume Hood	744 CFM*	26	19,344	$5	$96,720
			10 Yr TOTAL OPERATING			$967,720

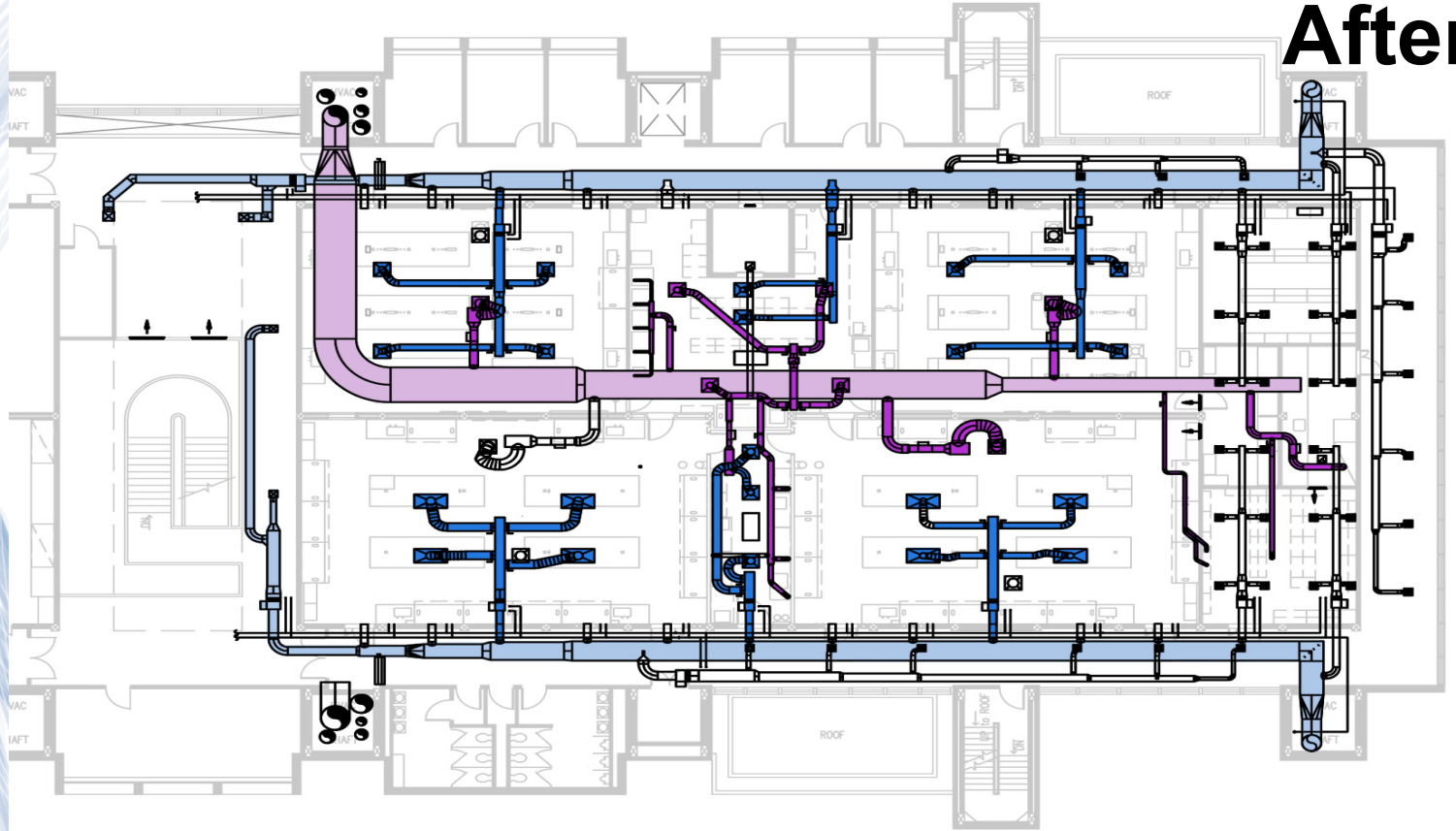
* Based on 60FPM face velocity at 28” sash height

FILTERED FUME HOODS	COMPONENT(S)	CFM / FUME HOOD	QTY OF FUME HOODS	TOTAL CFM	YEARLY COST / CFM	TOTAL YEARLY COST
	Filtered Fume Hood	0 CFM	26	0	$5	$0
		CFM / PERSON	PERSONS	TOTAL CFM		
	Classroom Ventilation	50	104	5,200	$5	$26,000
		COST/ FUME HOOD	QTY OF FUME HOODS	TOTAL COST	FREQ. CHANGE	YEARLY COST
	Filter Replacement	$3,000	26	$78,000	4 Yrs	$19,500
			10 Yr TOTAL OPERATING			$455,000

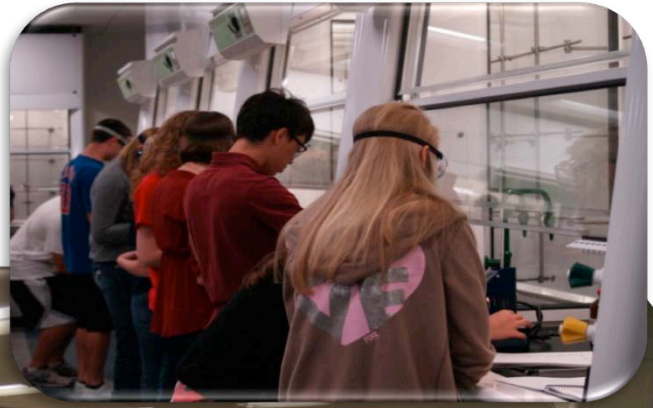
Before


ROOF
ROOF
SUPPLY DUCTWORK
MAIN SUPPLY DUCTWORK
EXHAUST DUCTWORK
MAIN EXHAUST DUCTWORK

After

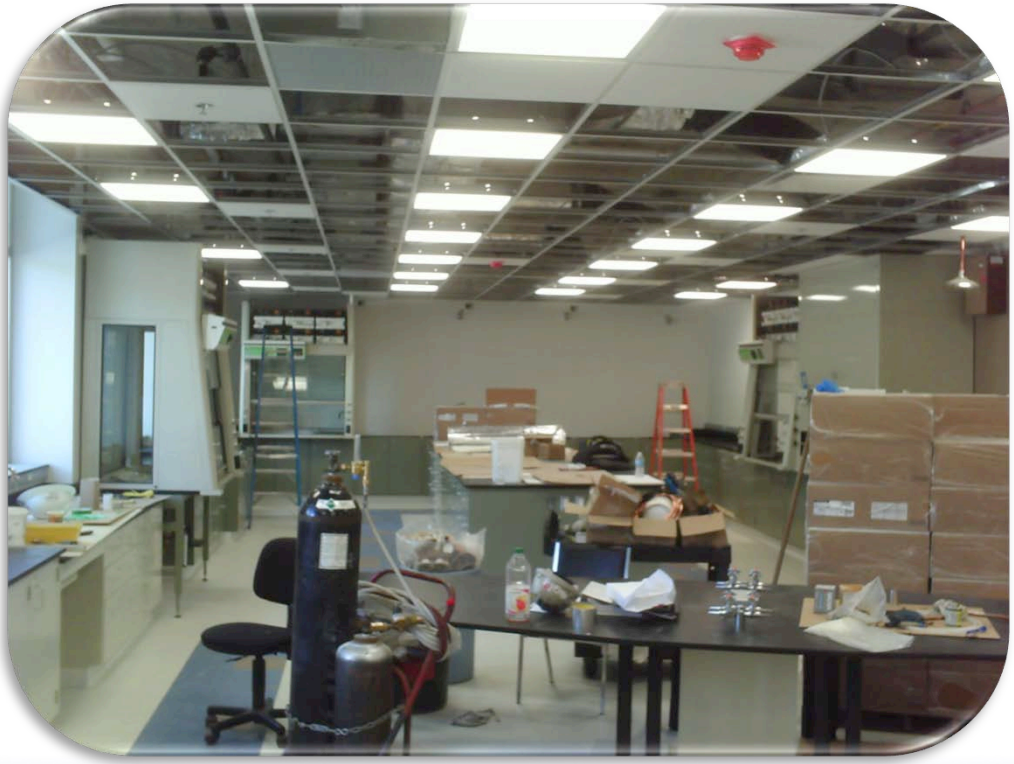

ROOF
ROOF
SUPPLY DUCTWORK
MAIN SUPPLY DUCTWORK
EXHAUST DUCTWORK
MAIN EXHAUST DUCTWORK

End Results 3 Years Later



McMaster University

- No capacity on exhaust system
- Addition of (9) hoods, (8) filtered
- Installed in August, 2013



Acids & Solvents

- ELECTROPHORESIS
- FILTRATION
- PIPETTING
- ANALYSIS
- HISTOLOGY

Reference: GFH-148US45-0113
Source:
Client: MCMASTER UNIVERSITY

,

GFH Approval Level: 1-4

1 Containment	Approved
2 Detection	Approved
3 Neutrodine Compatibility	Approved
4 Neutrodine Estimated Life Expectancy	Approved

Comments

This application is totally compatible with GFH. The chemicals are perfectly trapped and detectable. We can recommend a GFH without any limitation. The filter life time will exceed two years.

Cedric Herry (PhD)
R&D Manager

McMaster University

- Russ Ellis, M. Sc. – Lab Coordinator, Integrated Science Program
  - “The GFH’s serve our needs incredibly well...”
  - “Biggest battle was convincing Safety Dpt that GFH was as safe as traditional ducted hoods. We finally did convince them.”
  - Face velocities are lower, not meeting McMaster’s standard of 100fpm.

McMaster University

“A real big plus is the ability to have one hood fully accessible by installing it on an adjustable-height table.”

McMaster University

"In summary, the hoods look great, save energy and money and allow students to work safely."

Bridgestone Technical Center

- Tested filtered hood for 20 months with over 300 chemicals
- Purchased 11 more
- $5,000 annual energy savings per hood ($60k/yr total)
- 32% less total building energy

U of Rochester – Hutchinson Hall

- NYSERDA rebate: $36.6k
- GFH portion: $12,975 (capital incentive)
- kWh Savings: 32,727
- Peak Reduction: 110.5 kWh
- Fuel Savings: 8,233 Therms

- Operating costs savings: $136,100 annually
- 300% increase in hoods!

Final Thoughts, Imagine:

- Not treating waste water, letting it run into the streets.
- Throwing solid waste along the highway or in the river.
- Pouring your dirty oils or solvents directly on the ground?

Pollution is Pollution is Pollution regardless of dilution!

www.erlab.com

USA
Tel. : +1 (978) 948-2216
Fax: +1 (978) 948-3354
E-mail: captairsales@erlab.com