CSL's: A tool whose time has come?

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Laboratory Risk Assessment - or - Who Needs a Hood?

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The Laboratory Safety Challenge

- Ever-evolving chemical selection and process
- Lab walls are getting thinner, both figuratively and literally
- Turnover – 20% per year in academia
- The educational culture

Stakeholders in Laboratory Risk Assessment

- Laboratory workers
- Laboratory upper management and planners
- Laboratory designers
- Laboratory building operators
- Emergency responders

Emerging Risks in Lab Buildings

- **Ventilation design and energy costs**
  - Optimum ACH
  - Hood design goals
- **Building operation**
  - Protection of maintenance staff
  - Education of lab staff about their buildings
  - Re- and retro- commissioning
- **Emergency planning and response**
  - Pre-plans
  - Scene assessment
  - Response rate: 1 emergency response/250 lab-years
- **Does this point the way from risk assessment to control banding?**
  - Addressing these issues requires development of broader understanding and language for lab chemical risks

Chemical Risk Assessment

- **Flammability**
  - Concentrations of concern tend to be a few percent by volume
- **Corrosivity**
  - Particles with kinetic energy are much harder to control than vapors
- **Reactivity**
  - Requires chemical and process specific literature review
- **Toxicity**
  - Concentrations of concern range from 1000 ppm to 0.5 ppm to ALARA
- **Implementing GHS will help this process**

Chemical Protection Strategies

- Change the chemical – limited opportunities in the research setting
- Engineering controls
  - General Ventilation
  - Flammable cabinets
  - Local Ventilation
  - Chemical Hoods
- Administrative Controls and Oversight
  - 20% turnover/year in academic labs
- Personal Protective Equipment
  - Of value only in unexpected situations (Wetterhahn and UCLA)
- Traditionally, hood + PPE = “as safe as can be”

Lab Planning and Design: Moving beyond Tradition

- The traditional engineering approach uses a lot of energy without much thought
- Control Banding: Define Chemical Safety Levels from 1 to 4
  - Developed by analogy with Biosafety Levels
- For design and response purposes, the control band deals with a collection of chemicals rather than a specific biological agent
- The result is a general guideline to appropriate protections (which is likely to need modification, e.g CSL 2+)

Factors to Consider in Selecting a CSL:

- **Flammability** (via MSDS):
  - check flashpoint (is it below ambient temperature?)
  - If yes, are expected airborne concentrations above LEL?
- **Corrosivity** (via pH of solutions):
  - pHs < 2 or > 10.5 require special handling
  - Consider alsos spattering and off-gassing from reactions
- **Reactivity** (via MSDS and literature review)
  - Check potential interactions and contamination concerns
- **Toxicity** (via MSDS and other sources)
  - Review PELs, TLVs, IDLHs and assess against anticipated concentrations
  - Consider potential interactions
  - ALARA for irreversible hazards (cancer, birth defects, sensitization)

Chemical Safety Levels and Lab Facilities

- **CSL-1:** no ventilation (e.g. cold rooms and warm rooms)
  - Chemical uses similar to residential settings (kitchens and cleaning products)
- **CSL-2:** general ventilation (X air changes/hour)
  - Chemical uses similar to cars (gallons of flammables and assorted other chemicals)
- **CSL-3:** local ventilation (i.e. hoods)
  - Chemicals similar to hardware stores – emergency concerns is unexpected reactions
- **CSL-4:** high hazard storage or processes that require specialized procedures

Determining the CSL

Hazard	Fire	Corrosivity	Reactivity	Toxicity
CSL 1	Flashpoint below ambient	2 < pH < 10.5	No chemical changes expected in the process	All chemicals have known toxicities and TLV's > 500 ppm
CSL 2	Flashpoint near ambient, expected concentration < 10% LEL	pH <2 or pH >10.5	No known incompatibilities between chemicals being used	All chemicals have known toxicities and 10 ppm <TLV's < 500 ppm
CSL 3	Expected concentration > 10% LEL	Use of heated corrosives	Chemicals with known reactions or contamination hazards present	Unknown toxicities or OEL < 10 ppm
CSL 4			High hazard reactions in use	Irreversible toxicities require use of designated areas

But don't forget the other pieces of the puzzle

	Facility	Personal Protective Equipment	Oversight	Emergency Response
CSL 1	Any room, no ventilation	None	Generic self inspection guidelines	Standard response
CSL 2	Ventilated lab room (X ACH)	Nitrile gloves, eye protection	General training and oversight	Fire response
CSL 3	Lab room with local ventilation (fume hood)	Appropriate gloves, eye protection, lab coats	Process specific training and protocols	Hazmat defensive response -> commercial clean-up
CSL 4	Specifically designed lab	Process specific PPE	Written SOPs and specific oversight practices	Specialized hazmat response

Next Steps

- Develop a risk assessment tool that addresses the questions of various stakeholders (web-based?)
- Define the boundaries between the various CSL's and where those boundaries blur
- Develop guidance documents for use of CSL's