Personal Protective Equipment: Considerations for Hazard Communication Documents

Presented to:

Society for Chemical Hazard Communication

Presented by:

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Today's Presentation

- We will focus on PPE selection as it pertains to GHS-compliant Safety Data Sheets (SDSs)
- Some background information, theoretical and practical considerations
- PPE by route of exposure
- We will NOT be discussing labeling requirements

PPE – Routes of Exposure

We can really condense PPE selection down to 3 basic routes:

- inhalation;
- dermal, and;
- ocular.

Dermal can further be broken down into hand protection v. body protection. (*Note: we are not covering physical hazards today*).

Reminder: Hazard v. Risk

- SDS Authors are generally ***<u>not allowed</u>*** to make judgments about PPE information to be included based on *assumptions about downstream exposure situations* (REACH Annexes on Extended SDSs are an exception).
- We are not at the user's site, so we can't accurately estimate exposure (by ANY route) – in addition to precautionary handling statements, we can only give reasonably specific *<u>options</u>* for PPE.

Exposure Assessment Caveats

- As stated in the previous slide…we cannot perform an accurate exposure assessment – the reader has to do this – so…it behooves manufacturers and preparers to explicitly state this in Section 8 of their SDSs!!

PPE for Chemical Eye Protection

- Safety Glasses with fixed sideshields:
  - Mechanical irritants and/or low-hazard (e.g. minimal irritancy) solids/pastes/liquids
- Indirect vented goggles:
  - Moderate or high level of irritancy solids/pastes/liquids
- Indirect Vented Goggles + Faceshield
  - Corrosive solids/pastes/liquids (generally pH <2 or >11.5, depending on buffering capacity)
- Unvented Goggles
  - Specific high-hazard materials, e.g. formaldehyde

PPE for Inhalation

- Two key pieces of information needed for respirator selection are:
  - Identity of airborne contaminants (we know these from the formulation) and;
  - The airborne concentration, in the user's environment (again, we generally won't know this information), so….
- The best we can do is provide general options based on the ingredients present in the formulation.

Personal Protection - Respirators

- Two basic types of respirators
  - Air purifying respirator (APR)
  - Air-supplying

- Three basic facepiece configurations
  - Half facepiece
  - Full facepiece
  - Half OR full facepiece

Air Purifying Respirators

- Can be assigned for individual components by cartridge type from manufacturers – e.g. organic vapor
- Remember to consider lack of information on how product may be used – e.g. has dissolved solids in a liquid media, but may become aerosolized, so addition of a particulate combination or prefilter may be advised
- PAPRs (Powered Air Purifying Respirators) – offer much higher protection factors, but need for assigning them is determined on exposure levels, which we won’t know

Air Supplying Respirators

- Necessary for components that present a concern of oxygen deficiency (e.g. propellants, other asphyxiants)
- VOCs – if the molecular weight is < 50 and B.P. <? 70 C., then migration in/through the sorbent bed is likely, and exposure may occur
- Unknowns – thermal/chemical degradation products

Respirators – Global Issues

- Different countries have different terminology and classification schemes for respirator types
- Example: in the U.S., NIOSH certifies different efficiency levels and oil-resistant classes for particles (e.g. N95, P100, etc.) – EU does not
- As a manufacturer or author, you will need to choose how to align (or genericize) your SDS language

PPE for Skin Protection

- PPE Material Selection for skin protection is NOT an exact science
- Most chemicals do not have published breakthrough data for glove materials (approximately 400-500 out of 60,000+ chemicals in commerce)
- Mixtures present special challenges for determining a single glove material
- Broad-spectrum gloves (e.g. polymer laminates) can help solve some of these issues, but generally have poor dexterity and acceptance

Glove Selection – General Considerations

- Pure materials are the most straightforward
- Important to determine which gloves types are NOT good choices (due to degradation)
- Approach extrapolation based on similar molecular structures with care:
  - e.g. Methyl acrylate - butyl rubber is best choice
  - Methyl methacrylate - PVA is best choice

Information Resources

- Most definitive general resources are:
  - Forsberg and Mansdorf Guide

  - Trade associations (e.g. acrylates)
  - Glove manufacturer’s guides (but specific to their glove models)
- Secondary resources:
  - Gestis website (German) – use caution – not as definitive as Primary resources (above), but very useful for identifying which gloves <u>not</u> to recommend due to degradation

Glove Testing

- Methods include ASTM 739, EN 374-3 and ISO 6529
- All have strengths and weaknesses
- EN used “Normalized BTT” (breakthrough time) - when permeation >0.1 or 1 mg/(cm^2 x min)

Glove Testing

- Detection is easiest for:
  - volatile solvents
  - inorganic acids or alkaline solutions
- Detection is difficult for:
  - Non-volatiles
  - Poor solubility in water
  - Reactive chemicals (e.g. isocyanates)

Glove Testing

- Results are always somewhat equivocal, because:

Plan A – Use the Forsberg Guide
(industry standard)

Maker Bay - Primary Chemicals Used	Glove Material: Butyl Rubber	Neoprene	Nitrile	PVAL	PVC	Viton	Silver Shield/Barrier	
Frequently Used:								
Ethoxyethanol (2-)	G	Y	Y	R	R	R	G	Main ingredients of phenolic and urethane system mixes.
Ethylbenzene (trace?)	R	R	R	R	R	G	?	
Formaldehyde	G	G	G	R	Y	G	G	
Methylenedianiline (4,4) (MDA)	G	G	R	?	?	G	G	
Aniline (surrogate for MDA)		Y	Y	G	Y	Y	G	
Phenol	G	Y	?	Y	?	G	G	
PMA (108-65-6)	G	R	Y	G	R	G	G	
PME (320-67-8)	G	Y	Y	?	Y	G	?	
TDI (trace)	G	R	R	G	R	G	G	
Toluene (trace)	R	R	R	G	R	G	G	
Xylene	R	R	R	G	R	G	G	
Misc:								
Acetone	G	R	R	R	R	R	G	These chemicals used less frequently and/or separately
Ammonia	?	?	?	?	?	?	?	
Ammonium hydroxide	G	G	G	R	Y	G	?	
Di(2-ethylhexyl) Phthalate (DEHP)	G	?	Y	?	R	G	G	
Glutaraldehyde (MDA Decon Sol)	G	G	G	R	?	G	G	
IPA (Isopropanol) - used in mixes	G	G	G	R	Y	G	G	
Methoxy-2-Propanol (1-) (PME)	G	Y	Y	?	Y	G	?	
Methyl Ethyl Ketone (MEK)	G	R	R	R	R	R	G	
Potassium Hydroxide	G	G	G	R	G	G	G	
Sodium Hydroxide (30-70%)	G	G	G	G	G	G	G	

G	Greater than 4 hours
Y	1 to 4 hours
R	Not recommended <1 hour
?	Not tested

Based on Forsberg Guide

Chemical-Resistant Glove Selection Guide for Regulated Areas

Resin Family / Activity	Glove
Wet mixes containing: • MDA • Lapox K450 • BL • PMA • PME • CB-75	Barrier™ Glove Liner (68-38-121 thru 124) Use with appropriate outer glove to prevent puncture and improve dexterity (e.g., nitrile slurry-glove) 
Contents in question	
Raw MDA or Lapox K-450	Butyl Rubber (3M# 68-38-117 thru 120)  or Barrier™ Glove Liner (68-38-121 thru 124) Use with appropriate outer glove to prevent puncture and improve dexterity (e.g., nitrile slurry-glove) 
Phenolic Mixes	
Epoxy mixes not containing water	
Cleanup with CLI Aromatic Amine Decon. System	
Teardown / Maintenance	
Latex mixes	Nitrile – 11 mil thick (3M# 68-38-125 thru 128) 
Epoxy mixes containing water	

Limitations of the Forsberg Guide:

- **Does not specify which type of nitrile glove was tested**
- **Does not specify what solvent was used**
- **Does not address mixtures**
- **Resulting glove options <u>do not meet operator needs</u>:**
  - **Difficult on/off**
  - **Low physical strength**
  - **Low abrasion resistance**
  - **Poor dexterity**

Plan B – Permeation Testing by Glove Manufacturers

Benefits:

- Leverage subject-matter experts at no cost to 3M
- Follow established consensus standard (ASTM F 739)

F 739 – 07

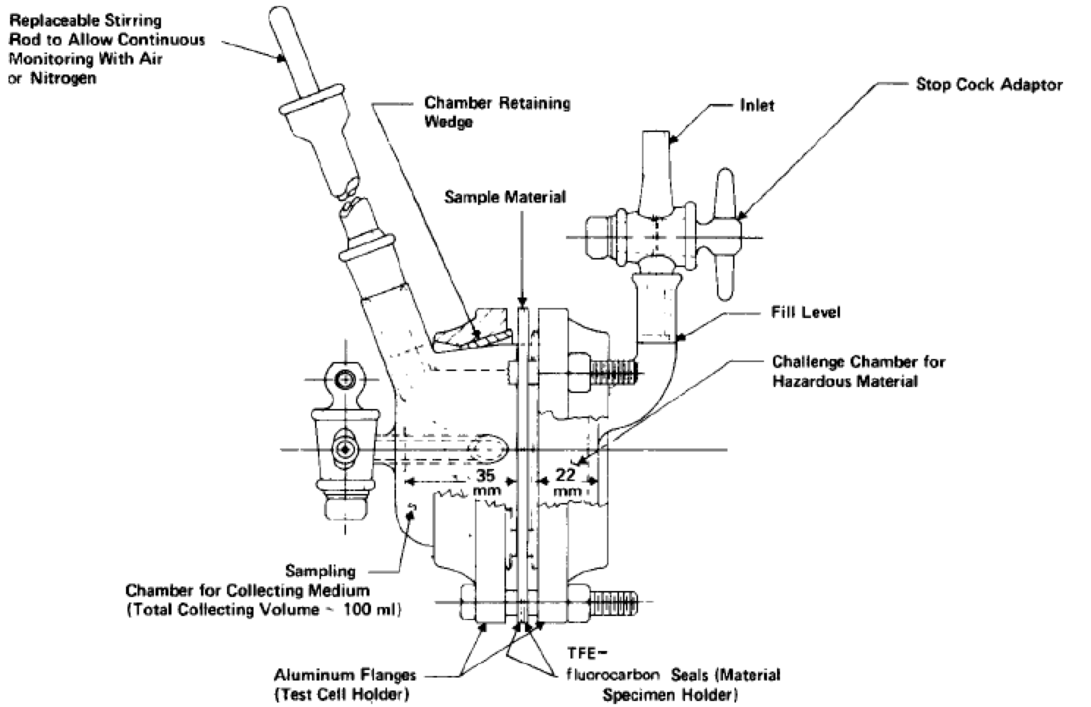

FIG. 2 Alternative Permeation Test Cell Design

Manufacturer's Permeation Test Results

Limitations:

- Allows testing for elements of a mixture but Ansell and Best only report total mg permeation
- Allows for a liquid or gas collection medium but Ansell and Best only use gas – only volatiles represented
- Results represent solvent breakthrough, not MDA

Glove Permeation Tests for 3M Polymer Mixes

	Sample # 1		Sample # 2		Sample # 3		Sample # 4		Sample # 5		Sample # 6		Sample # 7		Sample # 8		Sample # 9	
	Ansell TNT 92-600 Nitrile Dispos.		Ansell Neotouch 25-201 5-mil neoprene		Ansell Butyl 38-414 14-mil		Ansell Solvex 37-145 11-mil nitrile		Ansell Neox neoprene (tested 11/09)		Scorpio neoprene (tested 11/09)		Best Nitri-Dex 707 (tested 12/09)		Best Nitri-Pro 7199NC-10 (tested 12/09)		Best Neo Grab 6780R-10 (tested 12/09)	
CHEMICAL	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate	Break-thru (min)	Max Perm. Rate
Urethane/PMA 41150000010	10	Good	153	Ex	>480	Ex	10	V-Gd	298	Ex	163	V-Gd	not tested		not tested		not tested	
Urethane/Xylol 411500411311	<10	Good	36	Good	<10	Good	50	Good	75	Fair	48	Fair	25	Fair	64	Good	199	Good
Phenolic/PME 41150040818	90	V-Gd	35	V-Gd	>480	Ex	>480	Ex	>480	Ex	>480	Ex	not tested		not tested		not tested	

Threshold rate for breakthru time is 0.1 ug / cm2 / min as per ASTM standard F739

Permeation ratings: (per N. Schlatter)

Poor < 9000 ug/cm2/min
Fair < 900 ug/cm2/min
Good < 90 ug/cm2/min
V-Gd < 9 ug/cm2/min
Exc. < 0.9 ug/cm2/min

Chemical-Resistant Glove Guide for MDA Regulated Areas

Updated 12/15/09

Activity	Glove Options
Routine contact with wet or tacky mixes **Cleanup with:** • Solvents (PME, PMA, xylene) • CLI Aromatic Amine Decon. System	**Best Nitri-Pro: Cotton reinforced nitrile** • 3M Stock #68-38-063 • Maximum use time: 24 hours from chemical contact 
High dexterity, <u>light duty</u> tasks – contact with wet or tacky mixes	**Best Nitri-Dex 707: 9-mill nitrile** • 3M Stock #68-38-121 to 124 (Size 6, 7, 8, 10) • Maximum use time: 1-hour from chemical contact • Do not use with pure solvents (PMA, PME, Xylol) 
Wipe sampling only – no contact with wet or tacky mixes	**Ansell Touch N Tuff Disposable Nitrile** • 3M Stock #68-38-050 to 053 (S – XL) • Discard after each use or 15 minutes max 

- Inspect gloves each time they are put on. Discard if visibly damaged or worn.
- Cut-resistant gloves should cover chemical-resistant gloves when used together

Note time use limits

Learnings:

- Forsberg guide not useful regarding MDA
- Manufacturer's permeation tests measured only volatile components
- Manufacturer's permeation tests do not address components of mixtures – report total mg permeation only
- MDA breakthrough took longer than solvent breakthrough for all the gloves and mixes tested
- MDA penetrated unsupported gloves significantly faster than supported gloves of the same material (nitrile and neoprene)

Glove Selection

- One approach is establishing a hierarchy of health endpoints, based on severity and reversibility
- Fatal in contact with skin
- Corrosive
- Dermal sensitizer
- Skin-absorbable toxin
- Irritant
- Dermal defatting

Glove Selection: Final thoughts

- If you mix or compound raw materials from another manufacturer, request that they conduct testing (nominal cost)
- Work directly with a glove manufacturer to conduct testing for you – but, remember – their 'answer' will be one of their own glove models, and you must use care in genericizing results
- Gestis guide in EU (also gives BT data) http://www.dguv.de/ifa/en/gestis/stoffdb/ index.jsp,
- http://www.ansellpro.com/specware/ index.asp
- http://www.ansellpro.com/download/Ansell_8th EditionChemicalResistanceGuide.pdf

Closing Comments

- This was a VERY brief overview!
- Don’t consider someone ‘trained’ to perform PPE selection after a presentation such as this – you can attend a week-long course on respirator or glove selection alone.
- Push for improvements at the Trade Association and Regulatory level, especially for dermal PPE selection.