Controlling Fire Fighter Exposures to Fire Retardants

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Phoenix Fire

- Dispatches approximately 145,000 emergency calls a year
- About 10% or 14,500 are fire related
- These include everything from food on the stove, to car fires, to fully involved structural fires

Phoenix Fire Department

- 57 Fire Stations
- 1677members
  - 82 females
- 518 square miles
- Serving a population of 1.5 million

Preparing Firefighters

- 13 weeks of training
- PPE includes
  - Turnouts
  - SCBA
  - Boots
  - Gloves
  - Nomex Hood
  - Helmet

Turnouts

- Bunker gear/Turnouts only protect firefighters against thermal insult.
- Firefighters consider themselves “bullet proof” when wearing it.
- It is their SUPERMAN cape.

QuickTime™ and a
decompressor
are needed to see this picture.

Perceived Hazards at a Fire Scene

- Running out of air
- Becoming Lost/Trapped
- Structural collapse
- Falling through the roof/floor
- Flashover
- Thermal insult

What we know

- Typical house fires are not identified as potential “toxic hazards” by firefighters.

What we know

- On typical house fires, firefighters' perception of the overall hazard is low.
- "It's just a house fire".
- Built in "bias"
  - Houses are familiar territory
  - Smaller than the "big box" fires
  - Easier to escape
  - Less likely to get lost or run out of air.

What we know

- Chemical Hazards are not even on a firefighter's radar.
- Their turnouts are like a "superman cape". Bullet proof.
- They are taught to have faith in their equipment and they do to a fault.

Fire Overhaul Studies

- 1998 Overhaul Study (Bolstad-Johnson, DM *et al*)
  - Went to 26 house fires
  - Sampled 17 analytes

- 1999 Overhaul Study (Burgess,JL *et al*)
  - 10 Fires in Phoenix
  - 10 Fires in Tucson
  - Biological Monitoring

Exposure Limits

Chemical	OSHA	ACGIH	NIOSH	STEL	IDLH
Acetaldehyde	200 ppm	---	LF	25 ppm (C)	2000 ppm
Acrolien	0.1 ppm	---	0.1 ppm	0.1 ppm (C)	2 ppm
Benzene	1 ppm	0.5 ppm	0.1 ppm	2.5 ppm	3000 ppm
Carbon monoxide	50 ppm	25 ppm	35 ppm	200 ppm (C)	1200 ppm
Formaldehyde	0.75 ppm	--	0.016 ppm	2 ppm	20 ppm
Glutaraldehyde	---	---	---	0.05 ppm (C)	---
Hydrogen chloride	---	---	---	5 ppm	50 ppm
Hydrogen cyanide	10 ppm	---	---	4.7 ppm	50 ppm
Isovaleraldehyde	---	---	---	---	---
Nitrogen dioxide	---	3 ppm	---	1 ppm	---
Sulfur dioxide	5 ppm	2 ppm	2 ppm	5 ppm	100 ppm

1998 Overhaul Study

- The following analytes exceeded published ceiling values:
  - Acrolein 0.1 ppm (at one fire)
  - CO - 200 ppm (at five fires)
  - Formaldehyde - 0.1 ppm (at twenty-two fires)
  - Glutaraldehyde - 0.05 ppm (at five fires)

Results from 1998 Study

- The following analytes exceeded published short term exposure limits (STEL):
  - Benzene - 1 ppm (at one fire)
  - NO_2 - 1 ppm (at two fires)
  - SO_2 - 5 ppm (at five fires)

Results from 1998 Overhaul Study

- 25 independent fires
  - 14 houses, 6 apartments, 5 commercial buildings
- There was tremendous variation observed in the concentrations of the sampled contaminants.
- Variation may be explained by the diverse nature of each fire, including contents, number of rooms, commercial vs. residential.

1998 study

- Average sample time = 30 minutes
- Average response time to the scene = 20 minutes
- Sample results were averages over 30 minutes - peaks were not identified.
- Results are most likely an under estimation of true firefighter exposures.

1999 Study (Burgess,JL *et al*)

25 Firefighters in Tucson

26 Firefighters in Phoenix

- Baseline biological monitoring
- Blood was drawn for serum pneumoprotein analysis.
- Following overhaul blood was analyzed for venous carboxyhemoglobin
- Pulmonary function

1999 Study (Burgess,JL *et al*)

- The study observed acute changes in spirometric measurements and lung permeability following fire overhaul.

- The changes were not prevented by the use of full-face cartridge respirators.

Arson Investigator Study

- Currently Phoenix Fire is conducting a study on our Arson Investigators to identify contaminant exposures and conduct a hazard assessment to determine appropriate PPE.
- Preliminary results indicate a presence of acetaldehyde and formaldehyde.

Couch Burn

- DVD

Evaluation of CBRN Canisters for Use by Firefighters during Overhaul 2009 *(Currie, Caseman and Anthony)*

- 12 tests were conducted
- Measured breakthrough of challenge concentration
- Findings suggest that APR canister reduced overall exposures indicating that they could be used in fire overhaul if CO was controlled.

Controlling Exposures

- Heirarchy of controls
  - Engineering controls
  - Administrative controls
  - Personal Protective Equipment

Got Engineering Controls????

Challenges for Firefighters

- Most of the equipment is designed for one hazard not multiple hazards.

- Example: Fire Bunker Gear
  - Provides thermal protection but not chemical protection

N95 Mask

- Probably one of the most MISUSED forms of PPE by Emergency Responders.
- Protects against particulates and droplets like TB
- DOES NOTHING for CHEMICAL Exposures

Challenges for First Responders

- Identifying the hazard allows the responder to select appropriate hazard controls.
- There are not a lot of direct read instrumentation available to identify hazards on the fire scene.

Conclusions

- SCBA provides the best respiratory protection for all unknown chemical insults on the fire ground.
- Bunker gear provides protection from thermal insult only.
- A comprehensive study should be conducted to see how much of a chemical insult firefighters are exposed to on a typical fire.