



Inherent Risks of Daily Toxic Chemical Exposures to Firefighters



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Introduction:

- **Born and raised in Las Vegas, Nevada**
- **Attended Oklahoma State University 81 - 85**
 - **Fire Protection and Safety Engineering Technology**
 - **Summer Intern National Fire Academy 84/85**
- **Las Vegas Fire Department 86 - 92**
 - **Fire Inspector**
 - **Assistant Fire Protection Engineer**
- **Clark County Fire Department 92 - Present**
 - **Fire Protection Engineer**
 - **Hazardous Materials Coordinator**
- **Other Responsibilities**
 - **Co-Chair Nevada State Emergency Response Commission**
 - **Member of International Association of Fire Chiefs (IAFC) Hazardous Materials Committee**



In God we Trust
Everyone Else Show me
the Data!

So What Does the Data /
Science Tell Use?



In 2010, about six hundred thousand Americans, and more than 7 million humans around the world, will die of cancer. In the United States, one in three women and one in two men will develop cancer during their lifetime.

A quarter of all American deaths, and about 15% of all deaths worldwide, will be attributed to cancer. In some nations, cancer will surpass heart disease to become the most common cause of death. *The Emperor of All Maladies, Dr. Siddhartha Mukherjee*



Matter can be found in three different forms:

- Solid
- Liquid
- Gas



The Periodic Table of Elements - 109 of them but these 6 are the most common:

- ❑ H -- Hydrogen – a gas
- ❑ O – Oxygen – a gas
- ❑ C -- Carbon – a solid (soot)
- ❑ N -- Nitrogen – a gas
- ❑ Fe -- Iron – a solid
- ❑ S -- Sulfur – a solid



Compounds (Examples)

CO Carbon Monoxide – a gas

CO₂ Carbon Dioxide – a gas

H₂O Dihydrogen Monoxide (Water)
– a liquid

Fe₂O₃ Iron Oxide – a solid

H₂S – Hydrogen Sulfide – a gas

HCN – Hydrogen Cyanide – a gas

CH₄ – Methane (Natural Gas)

OH – Alcohol – a liquid

HCHO – Formaldehyde – a liquid



Classes of Fire

CLASS A: The Common Combustibles - Wood, Paper, Plastics

CLASS B: The Flammable – Combustible Liquids and Gases - Crude Oil, Natural Gas, Gasoline, Acetone, Corn Oil

CLASS C: Electrical Origin

CLASS D: The Combustible Metals - Magnesium, Lithium



Air that we Breath --- **78% Nitrogen** and **21% Oxygen**

Fuel ---- Almost everything is made from two common elements – **Carbon (C)** and **Hydrogen (H)-(Organic Chemistry)**. However there are other elements that will act as fuel.



SLOW – NORMAL OXIDATION

Fuel + Oxygen (AIR) ----- Products + Heat
It's slow because of very little **heat input**, usually provided by the atmospheric temperature **60 to 120 F**

RAPID OXIDATION (Combustion)

Fuel + Oxygen (AIR) ----- Products + Heat/Light

The **heat input** is **400 to 1,000 F**. This process is called "**Burning**", "**Fire**", or "**Combustion**"



COMPLETE and CLEAN COMBUSTION

C-H + Oxygen (AIR) ----- CO₂ + H₂O + HEAT

INCOMPLETE, TOXIC and DIRTY COMBUSTION

C-H + Oxygen (AIR) ----- CO + C + H₂O + HEAT
Toxic+Dirty = Smoke

Incomplete combustion produces a toxic atmosphere – Carbon Monoxide (CO) and Carbon (C) and Hydrogen Cyanide (HCN), these items displace the oxygen and create a hazardous environment.



Hazardous materials come in the form of solids, liquid and gases and they can be found in are home, business and in the environment. These materials are classified into nine distinct categories. Here are some examples of hazardous materials in each of the nine categories:

Class 1 are Explosives like (fireworks),

Class 2 are Gases like (oxygen, chlorine, propane),

Class 3 are Flammable and Combustible Substances like (gasoline, acetone, diesel),

Class 4 are Reactive Materials (magnesium in flares),

Class 5 are Oxidizers like (fertilizers),

Class 6 are Toxic/Infectious Substances like (pesticides, insecticides, bacteria, fungi, viruses),

Class 7 are Radioactive Materials like (X-rays, used in the treating of cancer),

Class 8 are Corrosives like (cleaning solvents and pool chemicals) and

Class 9 are Miscellaneous like (dry ice).



Incidents with these substances can occur during the production, storage, transportation, and/or disposal of these materials. When large amounts of a liquid or gaseous hazardous material are released they will form a vapor cloud.

Dose is the amount or concentration of the hurt that is administered. It relates to the strength of the material and/or length of exposure. Example: 30% hydrochloric acid is a smaller dose than 70% hydrochloric acid.

Response is the outcome of that hurt or the results of the hazard that is administered. Example: The response to a burn involving 70% hydrochloric acid will be greater than a burn involving 30% hydrochloric acid provided the acid was on the skin for the same amount of time in both cases.



Emergency Personnel being Exposed to Toxic Chemicals:

- **Emergency Medical Situation**
- **Incident at a Fixed Facility (Homes, Store, etc.)**
- **Chemical Release on Transportation Routes (Freeways, Railroads, Aircraft, Pipeline.)**

Demographics of an Emergency Incident:

- **Extinguish Fire / Provide Emergency Medical Services**
- **Personal Protective Equipment (PPE)**
- **Work Uniform**
- **Mask / Gloves / Protective Clothing**
- **Turnouts / SCBA (Self Contained Breathing Apparatus)**
- **Decontamination**
 - **Washing Hands / Shower**
 - **Disinfectants**



Prevent/Limit Exposure
Prevent/Limit Absorption
Prevent/Limit Toxicity

Triaging the Exposure

1. Exposed / Sick
2. Exposed / Not Sick "YET"
3. Exposed / PPE Protected the Employee



How Chemicals effect the Human Body --- Therapeutic or Toxic

1. Absorption

How the chemical enters the body:

98% - through the skin --- Liquids (Corrosives - acids and Caustics - bases)

(Infectious Materials – bacteria, fungi, viruses)

1% - through the Respiratory Track (Breathing /Lungs) ---
Gases (Chlorine, Ammonia, etc.)

(Infectious Materials – bacteria, fungi, viruses)

1% - through the Gastrointestinal (Stomach) --- (Child
Poisoning / Suicide – Pesticides, Poisons, and Corrosive and
Caustic Liquids, Food Poisoning)



2. Distribution

Where is the chemical going and what systems will be effected:

Target Organs – Lungs, Liver, Heart

Nervous System

Pulmonary System (Breathing)

Gastrointestinal System (Digestive Tract)

Other Systemic Systems (Blood, ability to process oxygen, etc.)



3. Metabolism

“Detoxify the Substance” – Liver, Kidneys, Blood, Cells, Enzymes

One of four things will happen:

- Non-Toxic converted to a Non-Toxic
- Non-Toxic converted to a Toxic
- Toxic converted to a Non-Toxic
- Toxic converted to a Toxic

4. Elimination

“Getting Rid of the Chemical” - Pulmonary System, Gastrointestinal System, Renal System



Comments
Questions ???

