Toxic Smoke Screen

By Mike Dory

You want to upset a firefighter - especially one with bugles? Tell them, “You’re doing it wrong.” What is the fire service doing wrong? We are NOT treating toxic smoke for what it is. A killer. A toxic, airborne, cancer causing, killer. The smoke firefighters face today is more toxic than at any time in history. Why is that? Because people are obsessed with stuff. We decorate our houses with stuff. And we as a culture can never have enough stuff. And all this stuff is made from plastic. Then consider the fact that the construction industry is not using as much wood as they used to. Instead, synthetics and petroleum- based building products are used. These building materials combined with all our stuff mean that fires are burning much hotter and faster than at any time in our past. And - the smoke that is coming off of the fires are far more toxic.

So, if we’re doing it wrong, how can we do it right? The realization of just how wrong we are came to me when I attended a Fire Smoke Coalition training in the fall of 2013. The information I left with was indisputable and I walked away with a firm determination to spread this information to all who would listen. Of course the problem I encountered is that nobody really wanted to listen. Why? Because the changes we need to implement will cost money.

Because of time and space restraints, I’m not going into detail about all of the toxins that we encounter as we battle structure fires, car fires as well as dumpster fires. I would strongly suggest the readers to go to www.firesmoke.org to get detailed information about fire smoke. And for the record, most of what I’m sharing here comes from the Fire Smoke Coalition’s website. I do not wish to take anything away from the great people at the Fire Smoke Coalition, and I hope to ensure that all acknowledgements be given to them for the great work they do. I strongly suggest that anyone who has the opportunity to attend “Know Your Smoke: The Dangers of Fire Smoke Exposure” do so. Classes are held almost monthly throughout in the United States.

The following shows just how susceptible firefighters can be to a vast number of different cancers than the general public:

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testicular Cancer</td>
<td>102%</td>
</tr>
<tr>
<td>Multiple Myeloma</td>
<td>53%</td>
</tr>
<tr>
<td>Non-Hodgkins Lymphoma</td>
<td>51%</td>
</tr>
<tr>
<td>Skin Cancer</td>
<td>39%</td>
</tr>
<tr>
<td>Malignant Melanoma</td>
<td>32%</td>
</tr>
<tr>
<td>Cancer Type</td>
<td>Percentage</td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Brain Cancer</td>
<td>32%</td>
</tr>
<tr>
<td>Rectal Cancer</td>
<td>29%</td>
</tr>
<tr>
<td>Prostate Cancer</td>
<td>28%</td>
</tr>
<tr>
<td>Stomach Cancer</td>
<td>22%</td>
</tr>
<tr>
<td>Colon Cancer</td>
<td>21%</td>
</tr>
</tbody>
</table>

These percentages are in spite of the fact that firefighters are generally in better physical condition than the general population. They are very aggressive with their nutrition and well being. So why are we so susceptible to cancer? Because we are far more likely to be exposed to known cancer causing toxins such as:

- Arsenic
- Benzene
- Benzo[a]pyrene
- 1,3 Butadiene
- Diesel Engine Exhaust
- Dioxin
- Formaldehyde
- Polychlorinated Biphenyls
- Soot
- Shift Work Affecting Circadian Rhythm

I won’t go into details about all of these cancer causing agents, but I do want to talk about two specific toxins that come from fire smoke: carbon monoxide and hydrogen cyanide.

Carbon Monoxide is a chemical asphyxiate. It doesn’t allow oxygen to attach to the red blood cells. It has an IDLH of 1200ppm. Hydrogen Cyanide is also a chemical asphyxiate. Oxygen molecules can enter the blood, but Hydrogen cyanide does not allow the oxygen to enter the cells of the body. Hydrogen Cyanide has an IDLH of 50ppm. The best way I heard this described is: if a red blood cell is a bus, and oxygen is the preferred passenger, carbon monoxide pushes the preferred passenger out of the way and fills up the bus crowding out the oxygen. Hydrogen cyanide allows the preferred passenger onto the bus, but then doesn’t allow the passenger to get off at its point of destination. If we just monitored these two toxins, it would be a huge improvement for most departments. Single gas detectors are available (depending on manufacturer) for as low as $165. I would suggest getting a monitor that can detect at least 4 different gases. The detectors with Oxygen, Hydrogen Sulfide, Carbon Monoxide, and LEL (Lower Explosive Level) are a simple 4 gas detector beneficially, the same detector can be used for operations like confined space or trench rescue. I would also, if money is available, add at least a 5th sensor. Of course that being Hydrogen Cyanide, or another suggestion offered by the Fire Smoke Coalition, if you don’t do a lot of confined space rescue is to replace Hydrogen Sulfide sensor with an HCN sensor.

To address exposure to toxic smoke particles and gases, I have aggressively researched ways of eliminating as much smoke exposure. The programs and policies I wanted to implement at my department would cost over $150,000 over 5 years. This would put a 4 gas detector on every apparatus we have, a small carbon monoxide detector on every ambulance jump kit, but more importantly, implement an air monitoring team that would be deployed to every structure fire, confined space rescue, trench rescue or whenever else command would deem it necessary. On
structure fire scenes, this air monitoring team would set up strategic air monitoring that would include a wireless 6 gas detector at several positions at the scene of the fire. One detector would be placed on the by the pump panel of the first in engine. Another one could be put at the rehab station, the staging area, the command post, and possibly downwind to protect the ‘rubber necked looky lou’s’ who show up at every structure fire with their phones out recording our every move to be put on YouTube.

So if money is an issue, how can we implement a safety program to protect us from the toxic smoke environments? I would suggest a few small steps that could help with limiting smoke exposure.

To begin with, implement, and enforce, if your department hasn’t already, the Rules of Air Management (ROAM). This costs nothing except a change of attitude and practice. And that is where the battle of change can really occur, the change of attitude.

Another simple change, is implementing a policy of DO NOT BREATHE SMOKE AT ALL, PERIOD. And this would include the practice of “no masking up at the door”. Instead all on scene firefighters must mask up if they ever enter the collapse zone of any structure. Even if they are somewhere on the fire scene where even a ‘light haze’ is present. This could include the pump operators who are outside. They may need to mask up as well.

![Smoke haze at a structure fire in Brush Colorado. The Pump operator may need to mask up while performing pump operations.](image)

Yes, I know, masking up at the door saves air. Besides, it’s how we’ve always done it. Consider the following example. At a Hazmat call, where a 1 ton chlorine tank is leaking, do we run up to the scene and put our Hazmat suits at the door? Why not? Chlorine only has an IDLH (immediately Dangerous to Life and Health) of 10ppm. In Dave Dobson’s presentation on reading smoke, he uses the chemical Acrolein as a ‘ladder fuel’. Acrolein has an ignition temperature of about 600°F. You may not feel 600°F through your bunkers, but all of a sudden, the atmosphere around you ignites, because the Acrolein that is in the smoke has reached its ignition temperature. But consider, Acrolein has an ILDH of only 2ppm, which is much lower than Chlorine. So we mask up for the Hazmat chlorine call way back in the cold zone, but for chemicals just as dangerous at structure fires, we mask up at the door. This is not a 100% guarantee you won’t be exposed to smoke, but it might help limit the amount of smoke one might be exposed to.

Now this policy change might be a little hard to get past the old salty dogs who hate change. “This is how we’ve been doing it for years,” might be the argument. If you think it’s some test of strength to breathe smoke, how tough are we going to be when we have to have a chemotherapy port installed because tough guys can breathe a little smoke?
No masking up at the door here. Obviously! So why do we do it here?

Just because we don’t see a huge plume of smoke, doesn’t mean there aren’t toxic gases present. We can see the smoke plume, but what about the ‘gas’ plume? The gas plume is often times not visible. The gas plume can be at any part of the fire scene. We must be more vigilant in protecting ourselves and those civilians and their cell phones videotaping our every move. We almost need to adopt the policy that we use at radiation Hazmat scenes of time, distance and shielding. Limit the time we breathe smoke; maintain a safe distance so we don’t breathe the ‘gas’ plume, and shield responders and civilians from the toxic smoke clouds.

A dumpster fire where the Hydrogen Cyanide detector reads 9ppm. Note the smoke plume is going off to the right. But the gas plume, also has toxins.

Air monitoring, is still vital. We need to know if guys are exposed to toxins, and if the current monitor is being used to alert us to whether or not toxins are present. One main place to consider as I mentioned earlier, is putting a toxic gas detector on the pump panel of the first in engine would be a huge benefit.
If possible, (and the money is available) we must monitor as much as possible, the atmospheres that are present on fire scenes. NO, we’re not attaching a 5 gas toxic gas monitor to our bunkers as we make entry to extinguish the fire. But we must have monitoring at strategic places of the fire scene. I’ve already mentioned having a monitor at the pump panel of the first into engine, but also possibly the command post, rehab, during overhaul, and also during fire investigations.

Another practice I’ve seen implemented that can be crucial is putting CO detectors on the first in jump kits on EMS calls. I know of at least three incidents when crews on my department were toned out to where someone is just “not feeling right”. The CO detector on the first in kit alarmed with levels as high as 300ppm. This not only alerts EMS crews to the presence of what’s making the patient not feel right, but can be used to protect first responders.

Another policy that must be mandated, is that all turn-out gear and bunkers must be washed immediately, at the end of each shift after every structure fire. Once after a structure fire, I took a 5 gas monitor with a VOC (Volatile Organic Compound) detector and simply walked through the area where our bunker gear was stored, 5 days after the fire. I got reading of 10-15ppm. So the bunkers were sitting there for 5 days, off gassing toxic fumes. This is possibly the most important of all policy changes that we in the fire service must implement. Secondary exposure from exposed bunkers must be eliminated as much as possible.

Conclusion. All of the preceding recommended changes will not eliminate all exposure to 100% of all the nasty toxins that we as firefighters are exposed to. We MUST do all we can, to eliminate as much as we can, to any potential exposures to these toxic chemicals. No breathing any smoke, including the haze. Be aware of not only the smoke plume, but the invisible ‘gas’ plume. Clean our bunkers after every fire. Take a very thorough decon shower as soon as possible after every fire. Properly decon fire scene equipment, including the seats in the fire truck where we sit. Monitor the atmosphere during all phases of the fire scene from extinguishment to the investigation, this would benefit our health immensely.

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